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Assessment of Periodontal Health Status and Treatment Needs Among Dental Students of Al-Kufa University by Using the Community Periodontal Index for Treatment Needs: A Cross-Sectional Study

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Abstract

Objective: This cross-sectional study aimed to assess the periodontal status and treatment needs of undergraduate dental students at Al-Kufa University in Iraq and investigated the influence of demographic factors (age and gender) and oral hygiene practices (tooth brushing technique, frequency of brushing, use of interdental aids, dental visit patterns) on periodontal health.

Materials and Methods: A sample of 200 undergraduate dental students (aged 18-24 years) was selected using a multistage systematic random sampling procedure during the 2023-2024 academic year. Periodontal health was assessed using the World Health Organization Community Periodontal Index for Treatment Needs (CPITN). The CPITN probe was used to evaluate bleeding on probing, presence of calculus, plaque retentive factors, and pocket depths (4, 5, and 6 mm). Data were analyzed using SPSS version 23, and the Pearson's chi-square test was used to assess associations, with a p-value ≤ 0.05 considered statistically significant.

Results: The study revealed a high prevalence of periodontal disease (86.5%) among the students. Calculus was the most frequent finding (65.5%), while only 13.5% of students exhibited a healthy periodontium. The majority (69%) required scaling and root planning (TN2). Female students exhibited significantly healthier periodontia compared to males ($p<0.05$). Older students (21-24 years) had a significantly higher prevalence of deeper periodontal pockets than younger students ($p<0.05$). Smoking was significantly associated with poorer periodontal health ($p<0.05$). A statistically significant association was found between the frequency of tooth brushing and periodontal health ($p<0.05$), with those brushing twice daily showing better periodontal status. While not statistically significant, the use of interdental aids was associated with healthier periodontia. Students with irregular dental visit patterns had a higher prevalence of calculus ($p<0.05$).

Conclusion: This study found a high prevalence of periodontal disease and significant treatment needs among undergraduate dental students at Al-Kufa University. Gender, age, smoking status, and oral hygiene practices were associated with periodontal health. These findings emphasize the urgent need for comprehensive oral health education programs, incorporating behavioral change strategies and promoting the importance of preventive dental care.

Keywords: AL- Kufa University, Periodontal Disease, Cross-Sectional Study, Dental Student, Community Periodontal Index for Treatment Needs

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Introduction

Periodontal diseases (PDs) are one of most ubiquitous and major dental diseases among the human populations worldwide [1]. PDs, comprising gingivitis and periodontitis, are probably the most common disease of mankind. These diseases are considered as the main cause of tooth loss among adult populations. No nation or region of the world is free from this pathological disease [1,2].

Gram-negative anaerobic bacteria found in dental biofilm are linked to the chronic

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inflammatory diseases known as PDs, which cause irreversible damage to the periodontium. Dental plaque that has accumulated and not been removed is a major factor in the development and course of disease [2,3]. Dental plaque is defined clinically as a structured, resilient, yellow-grayish substance that adheres tenaciously to the intraoral hard surfaces, including removable and fixed restorations in the absence of proper oral hygiene practices. Plaque is classified as a type of biofilm, which is characterized as microbial populations embedded in a matrix and adhering to surfaces, interfaces, or other objects [4]. The biofilm nature of dental plaque means that it tenaciously adheres to surfaces which increase in complexity and pathogenicity with time [5].

PDs can be regarded as a host-microbial interaction in which the transition from health to disease can be brought about by the balance between host and bacterial factors. The result of this interaction is influenced by both bacterial and host factors. The balance could be upset, for example, by a rise in bacterial virulence, a decrease in host resistance, or an increase in plaque biofilm. Local, systemic, and/or other factors further alter periodontal disease's clinical presentation [6]. Due to a shortage of oral health professionals in many developing nations, services are typically provided by neighborhood or focal emergency clinics in urban areas, with preventive dental care receiving little weight [1]. To assess the condition of periodontal health, the World Health Organization's (WHO) Oral Health Unit and Federation Dentaire International (FDI) collaborated to develop the community periodontal index for treatment needs (CPITN). It is a quick and easy way to determine a population group's treatment needs (TNs) and has served as the primary indicator in some epidemiological studies on the prevalence of periodontal disease, it [7,8].

In the adult population, the most severe PD code (CPITN code 4) ranges from 10% to 15% globally. While oral health has generally gotten worse in developing nations, it has significantly improved in industrialized nations. The WHO Oral Data Bank has noted and documented these patterns and trends. Populations in these countries are becoming more and more afflicted with PDs, periodontal infections, and compromised masticatory functions [9-12].

There is currently no available epidemiological data on the state of periodontal health in the governorate of AL-Najaf, Iraq, from either the general population or the dental students at AL-Kufa University. This investigation was conducted among a sample of AL-Kufa University dental students for the reasons previously mentioned.

Materials and Methods

Study Design and Setting

This research employed an observational, analytical, cross-sectional study design to investigate the periodontal health status and treatment needs of undergraduate dental students [13]. The study was conducted at the Department of Periodontics, College of Dentistry, Al-Kufa University, located in Najaf, Iraq. Data collection was carried out during the academic year 2023–2024. The cross-sectional design allowed for a snapshot of the periodontal health of this specific population at a particular point in time.

Ethical Considerations

Before commencing the study, ethical approval was obtained from the Ethical Committee of the College of Medicine, University of Kufa (reference # MEC-36, Date: 14/5/2024). The study adhered to the ethical principles outlined in the Declaration of Helsinki [14]. All participants received a detailed explanation of the study's purpose, procedures, risks, and benefits. Written informed consent was obtained from each student prior to their participation, ensuring

their voluntary involvement and understanding of the study's implications.

Study Subjects and Sampling Methodology

The target population for this study comprised all undergraduate dental students (N = 741) enrolled at Al-Kufa University during the study period. To ensure a representative and manageable sample, a multistage systematic random sampling procedure was implemented [15]. The student population was initially divided into five strata based on their academic year (first year through fifth year). Stratification aimed to ensure proportional representation of students from each year of the dental program, minimizing potential bias due to differences in clinical experience or exposure to periodontal education. Within each stratum, 40 students were randomly selected using a systematic random sampling technique [16]. This technique involved:

Determination of the Sampling Interval. The sampling interval (k) was calculated by dividing the total number of students in each stratum by the desired sample size for that stratum (40 students).

Random Starting Point. A random number between 1 and k was selected as the starting point.

Systematic Selection. Every kth student on the list, starting from the randomly selected starting point, was chosen until 40 students were selected from that stratum. This multistage sampling procedure ensured a representative sample of undergraduate dental students from all academic years, minimizing sampling bias and enhancing the generalizability of the findings to the broader student population.

Inclusion Criteria

Active Enrollment. Participants had to be actively enrolled as undergraduate dental students at Al-Kufa University's College of Dentistry.

Age Range. Students were required to be between 18 and 24 years of age. This age range targeted the typical student population in dental schools.

Exclusion Criteria

Age Outside Range. Students younger than 18 or older than 24 were excluded to ensure a consistent age group.

Non-Participation. Students who declined to participate were excluded to respect their autonomy and ensure voluntary participation.

Orthodontic Treatment. Students undergoing orthodontic treatment were excluded because orthodontic appliances could influence periodontal health and confound the study results.

Dental Implants. Individuals with dental implants were excluded, as implants require different periodontal assessment techniques and could impact the study findings.

Medical Conditions. Students with medical conditions that could restrict periodontal examination or affect periodontal health were excluded. These conditions included, but were not limited to, HIV/AIDS, diabetes mellitus, and individuals undergoing long-term medication use.

Data Collection Procedures

Data were collected through two primary methods: a self-administered questionnaire and a standardized clinical periodontal examination.

Questionnaire. A structured questionnaire was used to gather information on the following:

Demographic Data. Age and gender were collected to describe the study sample and explore potential associations with periodontal health.

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Dental Health-Related Practices. The following variables were included:

- Tooth Brushing Frequency. Students were asked about how often they brushed their teeth, with options including once daily, twice daily, more than twice daily, and other (specifying their frequency).

- Tooth Brushing Technique. Students indicated their usual tooth brushing technique from the following options: horizontal, vertical, scrubbing, circular, or other (specifying their technique).

- Use of Interdental Aids. Participants indicated whether they used dental floss, toothpicks, interdental brushes, or other interdental cleaning aids (specifying the type).

- Frequency of Dental Visits. Options included regular checkups, irregular visits, visits only for emergencies, or never visiting a dentist.

- Reason for Dental Visits. Students selected their primary reason for visiting the dentist as preventive (for checkups and cleanings), curative (for treatment of dental problems), or other (specifying the reason).

The questionnaire was designed to be self-administered, allowing students to complete it at their own pace and ensuring privacy in their responses. Clear instructions were provided, and any questions from students were addressed before they began completing the questionnaire.

Clinical Periodontal Examination. A standardized clinical periodontal examination was conducted on each participant to assess their periodontal health status. The examination was performed by a single calibrated examiner to ensure consistency and minimize inter-examiner variability [17]. The following procedures were followed:

- Preparation. The examiner used gloves and a mask for infection control. A disposable mouth mirror and a sterile CPITN-E probe were used for each participant as shown in Figures 1 and 2. The CPITN-E probe is specifically designed for use with the CPITN index and has a 0.5 mm ball tip and color-coded markings at 3.5 mm and 5.5 mm to facilitate pocket depth measurements.

- Examination Protocol. The examination adhered to the World Health Organization (WHO) guidelines for using the Community Periodontal Index for Treatment Needs (CPITN) [12]. The following steps were followed:

- Mouth Division. The mouth was systematically divided into six sextants: upper right, upper left, lower right, lower left, upper anterior, and lower anterior.

- Sextant Assessment. Each sextant was examined to ensure the presence of at least two teeth, excluding third molars unless they served as a replacement for a missing second molar. If a sextant had less than two teeth, it was recorded as Code X (missing sextant).

- Index Teeth Selection. For each sextant with two or more teeth, specific index teeth were examined. The index teeth selected were based on the participant's age:

- For students 20 years and older. 17, 16, 11, 26, 27, 36, 37, 31, 46, and 47.

- For students 19 years and younger. 16, 11, 26, 36, 31, and 46.

- Probing Technique. The index teeth were probed at the mesial, midline, and distal locations on both the facial (labial/buccal) and lingual (palatal) surfaces. Gentle probing pressure was applied, inserting the probe into the gingival sulcus or periodontal pocket until resistance was felt [18].

- Parameter Assessment. The following parameters were evaluated for each index tooth:

- Bleeding on Probing (BOP). The presence of bleeding within 30-60 seconds after probing. BOP

is an early indicator of gingival inflammation.

- Calculus. The presence of detectable calculus using the probe. Calculus, a hardened form of plaque, is a significant contributor to periodontal disease.

- Plaque Retentive Factors. The presence of any factors that could contribute to the accumulation of plaque, such as overhanging restorations, poorly fitting crowns, or anatomical grooves. These factors make plaque removal more difficult and can exacerbate periodontal disease.

- Pocket Depths. The depth of the gingival sulcus or periodontal pocket, measured in millimeters, was recorded for each probing site using the CPITN-E probe. The probe's markings at 3.5 mm and 5.5 mm helped to identify pockets exceeding 4 mm and 6 mm, respectively.

- CPITN Code Recording. The highest CPITN code observed for each sextant was recorded. This method of recording ensures that the most severe periodontal finding within each sextant is captured.

CPITN Codes and Treatment Needs. The Community Periodontal Index for Treatment Needs (CPITN) utilizes a simplified coding system to classify periodontal health status and guide treatment decisions [19]. The CPITN codes and their corresponding treatment needs are as follows:

Code 0: Healthy Periodontium. This code indicates a healthy periodontium with no signs of inflammation, calculus, or pocketing. No treatment is needed (TN0).

Code 1: Bleeding on Probing. This code signifies gingival inflammation, even in the absence of calculus or pocketing. The recommended treatment (TN1) is oral hygiene instruction, emphasizing proper brushing and interdental cleaning techniques to control plaque accumulation.

Code 2: Calculus Present. This code indicates the presence of calculus, which can irritate the gums and contribute to periodontal disease progression. The recommended treatment (TN2) is scaling and root planing to remove the calculus and smooth the root surfaces, promoting healing and reducing inflammation.

Code 3: Pockets 4-5 mm Deep. This code signifies a moderate level of periodontal disease, characterized by deeper pockets where plaque and calculus can accumulate more easily. The recommended treatment (TN2) is scaling and root planing, like Code 2.

Code 4: Pockets 6 mm or Deeper. This code indicates a more advanced stage of periodontal disease, with deep pockets that are difficult to clean and pose a significant risk of tooth loss. The recommended treatment (TN3) is complex periodontal treatment, which may involve surgical procedures, advanced cleaning techniques, and long-term maintenance.

Statistical Analysis

Data collected from the questionnaires and clinical examinations were entered and analyzed using IBM SPSS Statistics for Windows, Version 23.0 (IBM Corp., Armonk, NY). Descriptive statistics were used to summarize data, including frequencies and percentages for categorical variables such as gender, smoking status, tooth brushing technique, frequency of tooth brushing, use of interdental aids, frequency of dental visits, and reasons for dental visits. For the continuous variable age, the mean, standard deviation, minimum, and maximum were calculated. Pearson chi-square ($\chi 2$) test was employed to examine associations between the highest CPITN code recorded for each student and the categorical

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variables. This test was used to determine if there was a statistically significant frequency differences between periodontal health status and these potential risk factors. A p-value (P) of ≤ 0.05 was considered statistically significant, indicating a less than 5% probability that the observed association between the variables was due to random chance.

Figure 1. Instruments, equipment and materials used in the study.

Figure 2. The CPITN-E probe.

Results

Periodontal Health Status and Treatment Needs

Table 1 and Figure 3 display the findings of the clinical periodontal examination, which involved evaluating the periodontal health status using CPITN. The results showed that 13.5% of students had a healthy periodontium, 17.5% had bleeding on probing, and 65.5% of them had calculus. Additionally, 3.5% and none of students, respectively, had pocket depths of 4-5 mm and 6 mm or more.

Table 1. Distribution of students according to result of periodontal health status using CPITN.

No.	CPTIN	Number	Percentage %
1	Healthy periodontium	27	13.5%
2	Bleeding	35	17.5%
3	Calculus	131	65.5%
4	Pocket depth 4-5mm	7	3.5%
5	Pocket depth 6mm or more	0	0%
	Total	200	100%

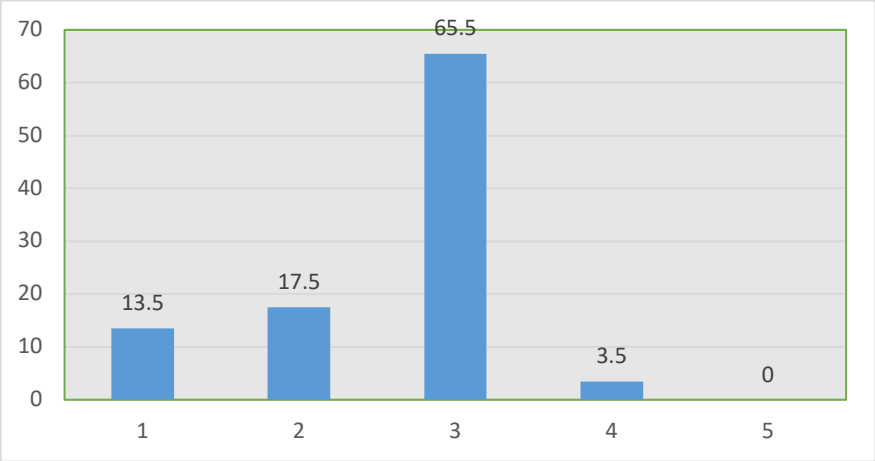

Figure 3. Percentages of Periodontal Health Status in the sample.

About type of treatment that each student included in the study needs is described in Table 2 and Figure 4. Most students (69%) required professional intervention, as indicated by TN2.

Table 2. Distribution of students according to their treatment needs using CPITN.

Treatment needs	Number	Percentage %
TN0	27	13.5%
TN1	35	17.5%
TN2	138	69%
TN3	0	0%
Total	200	100%

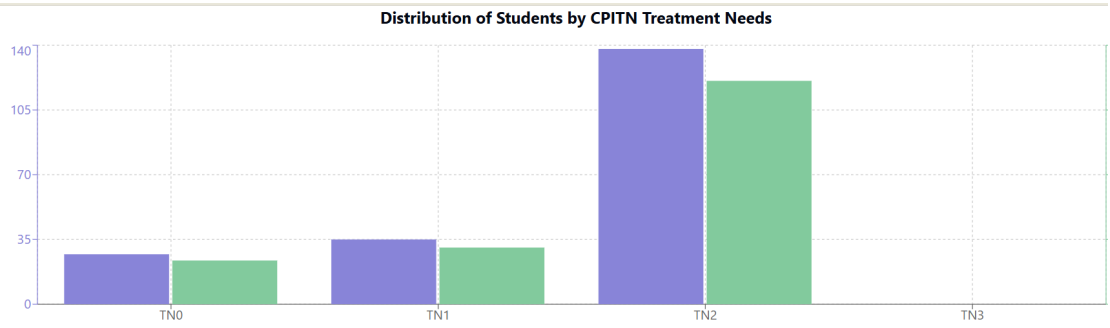

Figure 4. Distribution of students by CPITN Treatment Needs.

Association between categorical variables with highest CPITN codes The association between age, gender, smoking, with highest codes of CPITN were tested statically using chi square (X^2).

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Age: The percentage of students in the 18–20 age group had a higher percentage of healthy periodontium (9%) and a lower percentage of other codes. In the 21–24 age group, the deep pocket had the highest percentage, which was 2%. The association between age and highest CPITN codes was statistically significant (P<0.05), as shown in Table 3.

Table 3. Distribution of students according to result of periodontal health status using CPITN by age.

CPTIN	Age (18-20) No. (%)	Age (21-24) No. (%)
Healthy periodontium	18 (9)	9 (4.5)
Bleeding	13 (6.5)	22 (11)
Calculus	32 (16)	99 (49.5)
Pocket depth 4-5mm	3 (1.5)	4 (2)
Pocket depth 6mm or more	0 (0)	0
Total	66 (33)	134 (67)
X^2= 36.98 Degree of freedom (DF) =4 (P<0.05) (S)		

Gender: Compared to male students, female students had a higher percentage of healthy periodontium (9%). Table 4 indicates that these associations were statistically significant (P<0.05).

Table 4. Statistical analysis and distribution of students according to their highest CPITN codes by gender.

CPTIN	Students Gender	
	Female No. (%)	Male No. (%)
Healthy periodontium	18 (9)	9 (4.5)
Bleeding	14 (7)	21 (10.5)
Calculus	41 (20.5)	90 (45)
Pocket depth 4-5mm	6 (3)	1 (0.5)
Pocket depth 6mm or more	0 (0)	0
Total	79 (39.5)	121 (60.5)
X^2= 18 Degree of freedom (DF) =4 (P<0.05) (S)		

Smoking: Students who did not smoke had healthier periodontium (12.5%) than students who smoked, who are more likely to have calculus (57%), and to have a pocket depth of 4-5 mm (3.5%). Smoking and the highest CPITN codes were statistically significantly associated (P<0.05), as shown in Table 5.

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Table 5. Statistical analysis and distribution of students according to their highest CPITN codes by smoking status.

CPTIN	Smoking	
	Non-Smoker No. (%)	Smoker No. (%)
Healthy periodontium	25 (12.5)	2 (1)
Bleeding	7 (3.5)	28 (14)
Calculus	17 (8.5)	114 (57)
Pocket depth 4-5mm	0 (0)	7 (3.5)
Pocket depth 6mm or more	0 (0)	0
Total	49 (24.5)	151 (75.5)
X^2= 109.52 Degree of freedom (DF) =4 (P<0.05) (S)		

Association between age and gender with Periodontal TNs of CPITN

The associations between age and gender with TNs were tested statistically using X^2. Age: The highest percentage of students with TN0 was reported among 18-20 years age group (9%). TN2 was recorded more often among 21- 24 years old. These associations were statistically significant (P<0.05), as shown in Table 6.

Table 6. Statistical analysis and distribution of students according to their periodontal TNs by age.

TNs	Age (18-20) No. (%)	Age (21-24) No. (%)
TN0	18 (9)	9 (4.5)
TN1	13 (6.5)	22 (11)
TN2	35 (17.5)	103 (51.5)
TN3	0 (0)	0 (0)
Total	66 (33)	134 (67)
X^2= 32.305 DF=3 P<0.05(S)		

Gender: No need for treatment (TN0) was higher among female students (9%). While for TN2, the higher percentage (45.5%) was recorded among male students. These associations were statistically significant (P<0.05), as shown in Table 7.

Table 7. Statistical analysis and distribution of students according to their periodontal TNs by gender.

TNs	Students Gender	
	Female No. (%)	Male No. (%)
TN0	18 (9)	9 (4.5)
TN1	14 (7)	21 (10.5)
TN2	47 (23.5)	91 (45.5)
TN3	0 (0)	0 (0)
Total	79 (39.5)	121 (60.5)
X^2 =9.828 DF=3 P<0.05(S)		

Dental health-related practices and pattern of visits to dental clinic

Tables 8 and 9 show the numbers and percentages of dental health-related practices, in which 97.5% of the study students reported to have practiced teeth cleaning regardless of the method of teeth cleaning. Regarding method of teeth brushing, most students (36.41%) practiced scrubbing method for teeth cleaning. About frequency of teeth cleaning, the greater part of students cleaned their teeth twice and once daily (50.25% and 30.25%), respectively. Using of interdental aids was reported in 45.5 % of the students. Out of them, 84.61% were using dental floss, 43.95% were using toothpick, and 3.29% were using interdental brush.

Table 8. Statistical analysis and distribution of students according to their highest CPITN codes by method and frequency of teeth brushing.

	Teeth cleaning	
CPITN	Yes (%)	No (%)
Healthy periodontium	31 (15.5)	0
Bleeding	30 (15)	2 (1)
Calculus	129 (64.5)	1 (0.5)
Pocket depth 4-5 mm	5 (2.5)	2 (1)
Pocket depth 6 mm or more	0	0
Total	195 (97.5)	5 (2.5)
X^2= 180.5 Degree of freedom (DF) =4 (P<0.05) (S)		

	Method of teeth brushing			
CPITN	Horizontal N (%)	Vertical N (%)	Scrubbing N (%)	Circular N (%)
Healthy periodontium	4 (2.05)	5 (2.56)	8 (4.1)	9 (4.61)
Bleeding	4 (2.05)	15 (7.69)	14 (7.17)	7 (3.58)
Calculus	12 (6.15)	39 (20)	46 (23.59)	27 (13.84)
Pocket depth 4-5 mm	1(0.51)	1 (0.51)	3 (1.53)	0
Pocket depth 6 mm or more	0	0	0	0
Total	21 (10.76)	60 (30.76)	71 (36.41)	43 (22.05)
X^2= 31.9 Degree of freedom (DF) =12 (P<0.05) (S)				

	Frequency of teeth brushing			
CPITN	Once (%)	Twice (%)	More (%)	Occasional (%)
Healthy periodontium	7 (3.59)	13 (6.67)	4 (2.05)	4 (2.05)
Bleeding	7 (3.59)	11 (5.64)	7 (3.59)	2 (1.02)
Calculus	40 (20.51)	74 (37.94)	15 (7.69)	6 (3.07)
Pocket depth 4-5 mm	5 (2.56)	0	0	0
Pocket depth 6 mm or more	0	0	0	0
Total	59 (30.25)	98 (50.25)	26 (13.33)	12 (6.15)
X^2= 96.91 Degree of freedom (DF) =12 (P<0.05) (S)				

Table 9. Statistical analysis and distribution of students according to their highest CPITN codes by use type of interdental aid.

CPITN	Use of interdental aids	
	Yes (%)	No (%)
Healthy periodontium	16 (8)	8 (4)
Bleeding	23 (11.5)	17 (8.5)
Calculus	50 (25)	79 (39.5)
Pocket depth 4-5 mm	2 (1)	5 (2.5)
Pocket depth 6 mm or more	0	0
	91(45.5)	109(54.5)
X^2= 8 Degree of freedom (DF) =4 (P>0.05) (NS)		

CPITN	Type of interdental aid		
	Dental floss (%)	Toothpick (%)	Interdental brush (%)
Healthy periodontium	10 (10.98)	14 (15.38)	1 (1.09)
Bleeding	6 (6.59)	10 (10.98)	2 (2.19)
Calculus	50 (54.9)	16 (17.58)	0
Pocket depth 4-5 mm	11 (12.08)	0	0
Pocket depth 6 mm or more	0	0	0
Total	77 (84.61)	40 (43.95)	3 (3.29)
X^2= 68.44 Degree of freedom (DF) =8 (P<0.05) (S)			

Frequency of visits to the dentist. Most of the dental students visited the dentist irregularly (49.5%). The highest percentage of calculus was reported among dental students who visited the dental clinic irregularly (27.5%). The associations between highest CPITN codes and frequency of visits to the dentist was statistically significant different (P<0.05), as shown in Table 10.

Reason for dental visit. The highest percentage attended the dental clinic for curative reason (77.5%), while calculus was higher in the curative group (51%) and the association was statistically significant (P<0.05), as shown in Table 10.

Table 10. Statistical analysis and distribution of dental students according to their highest CPITN codes by patterns of visits to dental clinic.

Frequency of visits to dentist				
CPITN	Regular (%)	Irregular (%)	Never (%)	on emergency (%)
Healthy periodontium	7 (3.5)	19 (9.5)	5 (2.5)	2 (1)
Bleeding	9 (4.5)	21 (10.5)	0	0
Calculus	16 (8)	55 (27.5)	21 (10.5)	39 (19.5)
Pocket depth 4-5 mm	0	4 (2)	2 (1)	0
Pocket depth 6 mm or more	0	0	0	0
Total	32 (16)	99 (49.5)	28 (14)	41 (20.5)
X^2= 65.8 Degree of freedom (DF) =12 (P<0.05) (S)				
Reasons for visit				
CPITN	Curative (%)		Preventive (%)	
Healthy periodontium	20 (10)		6 (3)	
Bleeding	27 (13.5)		4 (20)	
Calculus	102 (51)		30 (15)	
Pocket depth 4-5 mm	6 (3)		5(2.5)	
Pocket depth 6 mm or more	0		0	
Total	155 (77.5)		45(22.5)	
X^2= 60.5 Degree of freedom (DF) =4 (P<0.05) (S)				

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Discussion

This study unveiled a concerning periodontal health landscape among undergraduate dental students at Al-Kufa University. The high prevalence of periodontal disease, the significant need for treatment, and the associations with various factors underscore the urgency of addressing oral health challenges within this future generation of dental professionals.

A High Prevalence of Periodontal Diseases: A Global Concern Mirrored Locally

Our study revealed that a staggering 86.5% of dental students exhibited signs of periodontal disease. This finding aligns with global trends, as periodontal diseases are among the most prevalent chronic conditions worldwide, affecting a substantial proportion of adults [1,2]. However, the prevalence found in our study is even higher than some reports from other regions. For instance, a study conducted on dental and medical students at the Medical University of Bialystok in Poland reported a prevalence rate of 75.38% [12], while a study in Iraq on both dental and non-dental students found a prevalence of 59.23% [13]. These variations in prevalence rates could be attributed to differences in study populations, methodology, or cultural factors influencing oral hygiene practices and access to care.

Calculus: A Red Flag for Inadequate Plaque Control

The high prevalence of calculus (65.5%) among the students is a significant finding. Calculus, a hardened form of plaque, is a major contributor to periodontal disease development and progression [22]. Its presence indicates a lack of effective plaque control, suggesting a need for improved oral hygiene practices and potentially a lack of awareness regarding the importance of regular professional dental cleanings.

Treatment Needs: Scaling and Root Planing Emerge as a Priority

Most students (69%) required scaling and root planing (TN2), indicating a substantial burden of untreated periodontal disease. Scaling and root planing are essential procedures for removing plaque and calculus from below the gum line, smoothing the root surfaces, and promoting healing [23]. The high percentage of students requiring TN2 underscores the importance of accessible and affordable dental care services within the university setting.

Unveiling the Influences: Age, Gender, and Smoking

Our study investigated several factors that could influence periodontal health, revealing important associations.

Age, a Cumulative Impact Factor. As anticipated, older students (21-24 years) exhibited a higher prevalence of deeper periodontal pockets compared to younger students, suggesting that the duration of exposure to periodontal risk factors plays a role [20]. Even in this relatively young population, prolonged exposure to plaque, inadequate oral hygiene, and other factors led to a worsening of periodontal health. This highlights the importance of establishing healthy oral hygiene habits early in life and maintaining them throughout adulthood.

Gender, a Disparity Requiring Further Exploration. The significant difference in periodontal health between genders, with female students exhibiting healthier periodontia, aligns with previous research [14,21,22]. This difference could be attributed to a complex interplay of factors, including potentially better oral hygiene practices among females [23], variations in hormonal influences on periodontal tissues [24], or even differences in attitudes towards oral health and aesthetics

[25]. Further research is needed to disentangle these factors and develop gender-specific interventions to address the observed disparity.

Smoking, A Well-Established Risk Factor. The detrimental effects of smoking on periodontal health are well-documented [26]. Our study reinforced this association, with smokers exhibiting significantly poorer periodontal status compared to non-smokers. Smoking compromises the immune system, impairs blood flow to the gums, and alters the oral microbiome, creating a favorable environment for periodontal pathogens [27]. This finding underscores the critical need to integrate smoking cessation programs into the dental school curriculum and educate students about the specific risks smoking poses to periodontal health.

Empowering Through Oral Hygiene Practices

Our findings strongly support the critical role of effective oral hygiene practices in maintaining periodontal health [28]. Students who brushed their teeth twice daily exhibited significantly better periodontal status, highlighting the importance of consistent and thorough plaque removal through proper brushing techniques [29]. While the use of interdental aids did not reach statistical significance in our study, the trend towards healthier periodontia among those who used these aids suggests a potential benefit. Interdental cleaning, using dental floss, toothpicks, or interdental brushes, can effectively remove plaque from areas that toothbrushes cannot reach, contributing to better overall periodontal health [30,31].

Emphasizing Preventative Dental Care

Our study underscored the vital role of regular dental care in preventing and managing periodontal disease. Students who visited the dentist irregularly had a significantly higher prevalence of calculus, emphasizing the importance of professional cleanings to remove plaque and calculus that cannot be adequately addressed through home care alone [32]. Moreover, the higher prevalence of calculus among students who primarily sought curative dental care highlights the need to shift the focus toward preventive care. Encouraging regular dental checkups, even in the absence of symptoms, allows for early detection and treatment of periodontal issues, preventing disease progression and potentially more invasive interventions.

Implications for Al-Kufa University

The findings of this study provide a clear roadmap for addressing the periodontal health challenges faced by dental students at Al-Kufa University.

- **Comprehensive Oral Health Education:** The dental school curriculum should integrate comprehensive oral health education programs that go beyond traditional lectures and textbooks. These programs should incorporate interactive learning methods, behavioral change strategies, and hands-on demonstrations to effectively engage students and empower them to adopt healthy oral hygiene practices [33,34].
- **Promote Preventative Care:** The university should prioritize preventative dental care through educational campaigns, peer-to-peer support groups, and incentives for regular checkups. Collaborating with local dental providers to offer discounted or subsidized dental services to students can further encourage early intervention and prevention [35,36].

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- **Accessible and Affordable Dental Care:** Establishing an on-campus dental clinic could significantly improve access to care for students, providing convenient and affordable services. Alternatively, the university could explore partnerships with local dental clinics to offer discounted services or develop financial assistance programs to help students cover the cost of dental care [37,38].

Study Limitations

This study was limited by its single-center design, potentially limiting the generalizability of findings to other dental schools in Iraq. The cross-sectional design, while providing a snapshot of periodontal health, cannot establish cause-and-effect relationships, and longitudinal studies are needed to assess changes over time. Reliance on self-reported data regarding oral hygiene practices and dental visit patterns may be subject to recall or social desirability bias, highlighting the need for more objective measures in future research. Finally, the study's focus on a selected set of factors means that other potentially influential factors, such as diet, stress, and genetic predispositions, warrant further investigation.

Conclusion

The high prevalence of periodontal disease among dental students at Al-Kufa University is a call to action. This study emphasizes the urgent need for a multi-faceted approach to improve oral health within this population. By integrating comprehensive oral hygiene education, promoting preventative care, and enhancing access to affordable dental services, Al-Kufa University can equip its future dental professionals with the knowledge, skills, and resources they need to achieve and maintain optimal oral health, setting a positive example for their patients and contributing to a healthier community.

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