ORIGINAL PAPER

ASSOCIATION OF MODIFIABLE AND NON-MODIFIABLE RISK FACTORS WITH PERIODONTAL DISEASE IN IRAQI INDIVIDUALS: A RETROSPECTIVE STUDY

Firas B. Al-Taweel, Ali A. Abdulkareem, Hayder R. Abdulbaqi

Department of Periodontics, College of Dentistry, University of Baghdad, Iraq

ABSTRACT

INTRODUCTION: Periodontal diseases are ranked among the most common health problems affecting mankind. These conditions are initiated by bacterial biofilm, which is further modulated by several risk factors.

OBJECTIVES: To investigate the association of different risk factors with periodontal disease and related clinical parameters in a sample of Iraqi patients.

MATERIAL AND METHODS: Records of 1161 of patients attending the College of Dentistry, University of Baghdad were accessed. The extracted data for each patient included age, gender, smoking status, systemic conditions, and whether using oral hygiene measures or not. Diagnosis and clinical parameters were also recorded including plaque and gingival indices and probing pocket depth.

RESULTS: The analysis showed that patients have more risk of developing periodontitis in association with smoking (OR = 2.40, CI 95%), systemic disease (OR = 2.95, CI 95%), and age (OR = 2.23, CI 95%). In addition, risk of progression to severe periodontitis was highly associated with smoking (OR = 2.40, CI 95%) and neglecting oral hygiene measures (OR = 2.08, CI 95%). Clinical parameters significantly increased in association with smoking, oral hygiene level, and aging.

CONCLUSIONS: Smoking and neglecting the oral hygiene regimen were the most profound risk factors for developing periodontitis and progression of periodontitis to a more severe form. This was associated with deterioration of all clinical parameters examined.

KEY WORDS: dental biofilm, risk factors, oral hygiene, periodontitis.

INTRODUCTION

Periodontal tissues are subjected to different degrees of inflammation, known as periodontal disease, with subsequent reversible or irreversible damage at any stage of the adult life. The most common forms of periodontal diseases are gingivitis and periodontitis, which adversely affect the life quality, economy, health warfare, and psychology of individuals [1]. Periodontal disease is a global health dilemma affecting a vast population in developed and developing countries in a range of 20-50% and severe periodontitis accounts for about 10% of overall periodontal conditions affecting the population internationally [2, 3]. In addition, severe periodontitis has been reported as the major factor contributing to tooth loss in many countries worldwide [4].

Although dental biofilm is known as the primary etiologic agent for periodontal diseases, the course of these con-

ditions could be modified by a range of risk factors including age, oral hygiene measures, smoking, gender, and systemic diseases [2]. Smoking is a well-documented risk factor for periodontal disease [5]; prevalence and severity are significantly associated with smoking, with smokers potentially having 3.5 times higher risk of developing severe periodontitis than non-smokers [6]. Among systemic conditions, diabetes mellitus emerged as another modifiable risk factor strongly associated with progression of periodontal disease [7]; in fact, studies showed that treatment of periodontal disease led to improvement in glycemic state, suggesting a two-way relationship between the two conditions [8, 9]. Another crucial risk factor for onset of periodontal disease is the level of oral hygiene measures performed by the individuals [10]. The effect of oral hygiene practice was investigated in 50 eligible studies by systematic review and meta-analysis; the results showed that the risk of having periodontitis was increased by 2-5-fold in association with fair to poor oral hygiene level [11]. Previously, periodontal diseases were considered as age-related changes; still today studies are showing an increasing tendency of severity of periodontal disease with age [12]. A National Health and Nutrition Examination Survey conducted in the United states, during 1999-2004, showed the prevalence of periodontal disease from 4% in young adults to about 12% in late elderly subjects [13]. The same survey also showed that males were more affected by periodontal disease than females. Although some studies support gender as a risk factor for periodontal disease [14], other results contradict this notion [15].

OBJECTIVES

Limited data are available about the actual picture of periodontal diseases in the Iraqi community; therefore, this pilot study was designed to investigate the association of various risk factors with periodontal diseases in a selected sample of Iraqi patients.

MATERIAL AND METHODS

STUDY DESIGN

This was a retrospective study. The targeted population comprised patients who attended clinics in the department of periodontics in the teaching dental hospital of the College of Dentistry, University of Baghdad. Permission to access the patients' data was granted from the scientific committee of the Department of Periodontics, College of Dentistry, University of Baghdad (Ref. 85 in 09/10/2018).

SAMPLING METHOD

Data of 1865 patients were collected from pre-recorded periodontal case sheets concerning treatment

of periodontal disease in the period 2015-2018. After excluding incomplete records, the remaining records numbered 1161, which were analyzed. Required information for each patient was sorted and recorded in a spreadsheet using Microsoft Excel software (version 2016, Microsoft Corporation, Redmond, WA, USA) then saved to be used later for further analysis.

Inclusion criteria: 1) patients who visited the clinic of the dental hospital for the first time, 2) or resumed periodontal treatment whereas the treatment was started elsewhere, 3) were diagnosed with periodontal disease. Exclusion criteria: only patients who had incomplete records were excluded from the current study. Diagnosis was determined after consideration of both clinical periodontal examination and radiographic examination. In clinical periodontal examination, the target was measuring periodontal health status using plaque index (PI), gingival index (GI), and probing pocket depth (PPD). Systemic history, diagnosis as well as clinical parameter data were extracted including gender, age, smoking status, and whether using oral hygiene measures or not. After collecting extracted data, patients were divided according to age, gender, smoking status, systemic disease, use of oral hygiene regimen, and diagnosis.

STATISTICAL ANALYSIS

Due to the parametric nature of the data, differences in percentages were estimated using the chi-square test and Baptista-Pike test for the determination of the odds ratio. Differences in PI, GI, and PPD between the two groups of each variable were calculated by the unpaired t-test. Analysis was performed using GraphPad Prism (version 8, San Diego, CA, USA). A statistical difference was considered significant when $p < 0.05$.

RESULTS

A total of 1161 periodontal records were examined; average age was 42.4 years with a range of 20-76 years. Total number of teeth, surfaces, number of missing teeth, percent of bleeding and periodontal pockets are summarized in Table 1. According to gender, males comprised 656 (56.5%) while females accounted for 505 (43.5%) of the sample. The percentage of smokers was 42% ($n = 487$) and of non-smokers 58% ($n = 674$). Other demographic variables including history of systemic diseases, oral hygiene measures, and age groups are illustrated in Table 1.

Distribution of these variables according to diagnosis (gingivitis and periodontitis) showed that males were affected by both forms of periodontal diseases more than females. The same pattern was observed in individuals not committing to oral hygiene measures as compared to those performing teeth cleaning (Table 2).

Patients with no history of any systemic disease showed higher prevalence of gingivitis (49%, $n = 567$)

than patients affected by systemic conditions (15%, $n = 179$); however, both groups were almost equally affected by periodontitis (about 18%). According to age groups, prevalence of gingivitis was the highest in association with individuals aged below 50 years (37.81%, $n = 439$), while those older than 50 years showed the highest prevalence (22%) of periodontitis in comparison to the younger age groups (Table 2).

Further analysis of associations indicated that smoking, history of systemic disease and age represented risk factors for development of periodontitis; i.e. risk of hav-

ing periodontitis is increased by two to three-fold in association with these factors (Table 2).

Periodontitis was further subclassified into mild-moderate (PPD = 4-6 mm) and severe (PPD ≥ 6 mm). The association of different variables with severity of periodontitis showed that smokers and patients neglecting their oral hygiene measures have about two-fold higher risk of developing severe periodontitis (Table 3). Other factors including gender, systemic condition, and age showed a weaker association with the severity of periodontitis (Table 3).

Comparison of clinical parameters (PI, GI, and PPD) showed that PI was significantly higher ($p < 0.05$) in males in comparison to females, smokers vs non-smoker individuals, patients neglecting the oral hygiene regimen and in older subjects than younger individuals. The only exception was in the systemic condition cohort, in which no significant difference in PI was observed between the two groups (Table 4). For GI, a significant difference ($p < 0.05$) was observed in smokers, patients with no oral hygiene measures, and younger subjects than their counterparts in the same group (Table 4). PPD showed a significant difference ($p < 0.05$) between all groups of all variables including smoking status, history of systemic diseases, oral hygiene measures, and age. However, no significant difference was found in PPD between males and females.

DISCUSSION

Periodontal disease is a global problem associated with health, economic, social, and psychological consequences at the personal and community level [1]. Previous studies were limited in reporting the potential association of different risk factors and prevalence of periodontal conditions in the Iraqi community. Therefore, this study was conducted to investigate these aspects of periodontal diseases by utilizing data available in the Department of Periodontics, College of Dentistry,

TABLE 1. Baseline demographic data

Variables	
Average age (years ± SD)	42.48 ± 13.79
Age range (years)	20-76
Number of teeth examined, n	28,018
Number of missing teeth, n	4490
Number of surfaces examined, n	111,976
Number of bleeding surfaces, n (%)	16,657 (14.9)
Number of periodontal pockets, n (%)	3240 (2.9)
Biofilm-induced gingivitis, n (%)	746 (64.3)
Periodontitis, n (%)	415 (35.7)
Male, n (%)	656 (56.50)
Female, n (%)	505 (43.50)
Smoker, n (%)	487 (41.95)
Non-smoker, n (%)	674 (58.05)
Systemic disease, n (%)	379 (32.64)
No systemic disease, n (%)	782 (67.36)
Oral hygiene, n (%)	270 (23.26)
No oral hygiene, n (%)	891 (76.74)
< 50 years, n (%)	601 (51.77)
≥ 50 years, n (%)	560 (48.23)

TABLE 2. Association of gingivitis and periodontitis with different demographic variables

Variables	Gingivitis, n (%)	Periodontitis, n (%)	95% CI	p value§	Odds ratioÍ
Male	412 (35.49)	244 (21.02)	0.914-1.485	0.217	1.17
Female	335 (28.85)	170 (14.64)			
Smoker	256 (22.05)	231 (19.89)	1.873-3.073	< 0.001	2.40
Non-smoker	490 (42.21)	184 (15.85)			
Systemic disease	179 (15.42)	200 (17.23)	2.287-3.811	< 0.001	2.95
No systemic disease	567 (48.84)	215 (18.52)			
Oral hygiene	146 (12.58)	124 (10.68)	1.320-2.311	< 0.001	1.75
No oral hygiene	600 (51.68)	291 (25.06)			
< 50 years	439 (37.81)	162 (13.95)	1.743-2.856	< 0.001	2.23
≥ 50 years	307 (26.44)	253 (21.79)			

§χ^2 test, significance level $p < 0.05$

Í Odds ratio by Baptista-Pike

TABLE 3. Association of mild-moderate and severe periodontitis with different demographic variables

Variables	Mild-moderate*, n (%)	Severe**, n (%)	95% CI	p value§	Odd ratioᵻ
Male	206 (17.74)	38 (3.27)	0.447-1.412	0.45	0.97
Female	148 (12.75)	22 (1.89)			
Non-smoker	167 (14.38)	17 (1.46)	1.042-1.221	0.003	2.40
Smoker	188 (16.19)	43 (3.70)			
Systemic disease	187 (16.11)	28 (2.41)	0.956-1.125	0.389	1.27
No systemic disease	168 (14.47)	32 (2.76)			
Oral hygiene	113 (9.73)	11 (0.95)	1.045-4.130	0.035	2.08
No oral hygiene	242 (20.84)	49 (4.22)			
< 50 years	142 (12.23)	17 (1.46)	0.927-3.023	0.083	1.69
≥ 50 years	212 (18.26)	43 (3.70)			

*PPD = 4-6 mm

**PPD ≥ 6 mm

§χ^2 test, significance level $p < 0.05$

ᵻOdds ratio by Baptista-Pike

TABLE 4. Comparison of clinical parameters according to different demographic variables

Variables	PI, mean ± SD	p value*	GI, mean ± SD	p value*	PPD, mean ± SD	p value*
Male	1.34 ± 0.48	0.006	1.18 ± 0.33	0.497	4.51 ± 0.51	0.609
Female	1.26 ± 0.45		1.16 ± 0.38		4.45 ± 0.66	
Smoker	1.36 ± 0.49	< 0.001	1.20 ± 0.39	0.019	5.39 ± 1.49	< 0.001
Non-smoker	1.25 ± 0.43		1.16 ± 0.31		4.54 ± 0.67	
Systemic disease	1.35 ± 0.53	0.089	1.15 ± 0.28	0.297	5.29 ± 1.18	0.024
No systemic disease	1.29 ± 0.45		1.18 ± 0.36		4.81 ± 1.07	
Oral hygiene	1.26 ± 0.49	0.022	1.16 ± 0.36	0.045	4.63 ± 0.79	0.034
No oral hygiene	1.34 ± 0.57		1.21 ± 0.37		5.16 ± 1.56	
< 50 years	1.28 ± 0.44	0.017	1.19 ± 0.37	0.021	4.37 ± 0.67	0.002
≥ 50 years	1.35 ± 0.51		1.14 ± 0.31		4.91 ± 1.23	

*Unpaired t-test, significance level $p < 0.05$

University of Baghdad. The selection of the teaching dental clinics in this institute provides the advantage of screening a large number of periodontal records that could provide a representative sample for different socioeconomic, ages, and educational levels.

The course of periodontal diseases is known to be modulated by a range of modifiable and non-modifiable risk factors [16]. One of these factors is oral hygiene, which was reported as a profound risk factor for periodontal diseases [10, 11]. Commitment to oral hygiene instruction (OHI) is not only necessary to control dental biofilm formation but also may affect the composition of oral microflora in the long term. Salivary and supragingival microbiota were compared over ten days of discontinuing OHI. The results showed that supragingival microbiota was not restored to the baseline level even after 14 days of resuming OHI [17]. Consistently, results from the current study showed that patients who clean their teeth, even with presence of periodontal diseases, have a better level of oral hygiene reflected by lower dental biofilm accumulation, less gingival inflammation, and shallower periodontal pockets. This signifies the impact of the oral hygiene regimen in controlling the inflammation of periodontal tissue despite the presence of other etiologic and plaque-retentive factors. The results showed that smokers had two-fold higher risk of developing periodontitis and a similar risk for periodontitis to progress to a more severe form than non-smokers. In addition, periodontal parameters showed higher deterioration in smokers than non-smokers. These results are in agreement with many cross-sectional [18], case-control [19], and prospective cohort studies [20]. Further, these studies reported that smokers have 1.6-6.8-fold higher risk of developing severe periodontitis than non-smoker controls [21-24]. The adverse effect of smoking is continuously reported in the literature worldwide, which is mainly due to toxic products that impair healing and affect the blood circulation, increasing oxidative stress, and compromising immunity of periodontal tissue [25].

The results from the current study showed that males were more affected by periodontal diseases, with higher dental biofilm accumulation. However, no specific association of gender was detected with periodontal disease or severity of periodontitis. Previous results suggested a stronger association of periodontal destruction with male than female sex, which is mostly attributed to a higher level of ignorance of oral hygiene among males [26, 27]. Yet, there is conflict about results related to the role of the gender difference in the rate of progression of periodontal diseases as females are more prone to hormonal fluctuations such as during puberty, pregnancy, and post-menopause, which may significantly alter the course of periodontal diseases [28]. Generally, gender is still not considered as a strong risk factor due to inconsistency and lack of strong evidence but still it can be considered as a demographic variable that may alter other risk factors [16]. Aging was associated with increased risk of developing periodontitis associated with increased dental biofilm scores, gingival inflammation, and deeper periodontal pockets than younger adults. Increased prevalence of periodontal disease with older age groups was previously reported [13], which is accompanied with increased tooth mortality [29]. An experimental study on mice showed that aging was associated with an increased *Porphyromonas gingivalis* population, and hence higher chance of developing severe periodontal disease [30]. Individuals affected by systemic conditions also showed higher risk of developing periodontitis than healthy controls, but no significant difference was observed in terms of severity of periodontitis between the two groups. The relation of systemic conditions with periodontal disease is still cloudy except the association with diabetes mellitus, which showed a strong bidirectional relationship with periodontal disease [7-9]. Nevertheless, the differential relation of different systemic diseases was beyond the scope of the current study, which did not investigate the relation of each systemic disease with periodontal disease independently.

The data collected for this study were dependent on previous records that were recorded by many operators, which may cause a discrepancy in reproducibility. However, this is one of the problems associated with retrospective studies that can be minimized by increasing the size of the sample. Also, the nature of this study limits the ability to suggest a causal relationship with risk factors investigated. Further nationwide prospective cross-sectional studies are required to further evaluate the prevalence and risk factors in the Iraqi community.

CONCLUSIONS

The prevalence of biofilm-induced gingivitis was 64% and of periodontitis 36% of the population. In addition, it can be concluded that smoking, systemic conditions, oral hygiene level, and age were associated with higher risk of developing periodontitis. Progression of periodontitis to a more severe form was highly associated with smoking and oral hygiene measure than other factors investigated.

CONFLICT OF INTEREST

The authors declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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