Periodontal Disease Prevalence and its Relation to Risk Factors Among Patients Attending Umm Al-Qura University Dental Teaching Hospital

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A R T I C L E   I N F O

A B S T R A C T

Background: Periodontal disease is a crucial oral health problem due to its high pervasiveness and correlation to general health. Several risk factors have been reported to induce periodontal disease progression.
Aim: To determine the prevalence of periodontal disease and its correlation with the associated risk factors among different age groups of patients attending Umm Al-Qura University Dental Teaching Hospital.
Methods: This is a retrospective study that utilizes the screening records of patients who attended the dental teaching hospital in 2018. The age, gender, periodontal condition, oral hygiene status, compliance with oral hygiene measures status, smoking status, and systemic health conditions were obtained from the patients' screening records. Data were collected, tabulated, and analyzed using SPSS. Chi-squared and Pearson correlation tests were used to analyze the data. A p-value less than 0.05 was considered significant.
Results: Of the total 4,967 attending patients, 3,158 (64%) patients presented with periodontal disease. A significant high negative correlation was found between periodontal disease and compliance with oral hygiene measures ($p = 0.001$; $r = -0.894$) and between periodontal disease and oral hygiene status ($p = 0.001$; $r = -0.889$). Furthermore, a significant positive correlation was found between periodontal disease and smoking ($p < 0.000$; $r = 0.689$) and between periodontal disease and the systemic disease ($p = 0.000$; $r = 0.482$). Compliance with oral hygiene measures was significantly higher for females ($p = 0.04$), while the smoking was significantly higher for males ($p = 0.001$).
Conclusion: The prevalence of periodontal disease among patients attending Umm Al-Qura university dental teaching hospital was 64%, and several risk factors were associated with the disease. It is necessary to educate the community about periodontal disease and its initiating and predisposing factors to decrease the risk of having the disease and to promote oral and general health.

1. Introduction

Periodontal disease is recognized as the inflammation of the periodontium. In the early stage, the inflammation is limited to the gingiva and noticed clinically by gingival redness, swelling, and bleeding on probing, as with gingivitis. The condition at this stage is reversible without permanent damage when appropriately treated. If the disease is left untreated, it progresses to an advanced and irreversible stage whereby the inflammation extends to the tooth-supporting structures, causing profound periodontal pocketing, connective tissue attachment loss, and surrounding bone resorption, as with periodontitis [1]. Several common etiological factors are predisposed to periodontal disease initiation and progression. Bacterial plaque is the main initiating factor, and the interaction between the bacterial plaque and the host immune-inflammatory response is responsible for most periodontal tissue damage [2]. Oral hygiene neglect, poor compliance with periodontal maintenance therapy, hereditary factors, systemic diseases such as diabetes, and smoking as well as stress have been involved in periodontal disease initiation and progression. Periodontal disease can occur in any individual irrespective of age, gender, race, and socioeconomic status, but previous studies have found it to be more prevalent in patients who are older, male, African American, and from lower socioeconomic populations [3,4].

The global prevalence rate of periodontal disease is estimated to be 20–50% [5]. The most prevalent types of periodontal diseases are gingivitis and periodontitis. The prevalence of gingivitis and periodontitis varies in studies from different countries and regions.

These variations result from differences in participants' ages, ethnicities, environmental factors, case definitions, and diagnostic methods. The United States National Health and Nutrition Examination Survey (NHANES) estimated gingivitis prevalence to be 82% and the overall prevalence of periodontitis in adults was 46%, and of these cases, 8.7% were mild, 30% were moderate, and 8.5% were severe [4]. Another study was performed with people 65 years of age and older which found the prevalence of periodontitis to be 64%, with higher rates for males (16%) than females (6%) [6].

Periodontal disease is a significant cause of multiple tooth loss, masticatory dysfunction, and edentulous conditions that impact an individual's nutritional intake, self-confidence, social life, and general health [7]. It has been found that periodontitis significantly contributes to the universal burden of oral diseases and the severe form of periodontal disease was ranked the sixth most prevalent disease in the world with a prevalence rate of 11.2% affecting the individual's quality of life [8]. Furthermore, previous publications have linked periodontitis with other systemic diseases, including cardiovascular disease, diabetes, pregnancy complications, respiratory disease, chronic kidney disease, rheumatoid arthritis, Alzheimer's disease [9-13]. Therefore, it is necessary to decrease the burden of periodontal disease by raising community awareness of disease prevention as well as early diagnosis and treatment to maintain oral and general health.

Although several studies have determined the status of periodontal disease for various cities and regions in Saudi Arabia [14-20], no study has reported the status of periodontal disease and its correlation with associated risk factors for the population of Makkah city.

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Umm Al-Qura University Dental Teaching Hospital in Makkah city offers dental services to patients of different ages and socioeconomic conditions; this diversity allows the opportunity to explore the extent of periodontal disease in the population of Makkah city. Hence, this research aimed at determining the prevalence of periodontal disease and its correlation with the associated risk factors among different age groups of patients attending Umm Al-Qura University Dental Teaching Hospital.

2. Material and Methods

2-1. Ethical approval

The Biomedical Ethics Committee at Umm Al-Qura University approved the study (approval number: HAPO-02-K-012-2021-01-524).

2-2. Study setting

The study was performed in the Dental Teaching Hospital, Faculty of Dentistry, Umm Al-Qura University, Makkah, Saudi Arabia.

2-3. Study design and sampling

This was a retrospective study that included the screening records of patients who attended Umm Al-Qura University Dental Teaching Hospital from January to December 2018. There were 4,967 attending patients in 2018 whose records were included in this study. The demographic data, compliance with oral hygiene measures, the presence of systemic diseases, smoking and oral hygiene status were obtained from patients' records. The required data were retrieved from patients' electronic records without revealing any identifying information. Periodontal disease patients were categorized according to their age into four groups: less than 20 years, 20 to 35 years, >35 to 50 years, and over 50 years of age. The extent of periodontal disease and the correlation between periodontal disease and oral hygiene status, compliance with oral hygiene measures, smoking status, and systemic diseases were studied using statistical analysis for the above-mentioned age groups.

2-4. Study procedure

Dental interns (after the demonstration, assessment, and direct supervision by the college faculty members) examined the patients clinically and radiographically and completed screening forms. The periodontal condition was examined following the update on the 1999 American Academy of Periodontology (AAP) classification [21]. Patients suffering from gingivitis manifested by plaque accumulation [22], gingival redness, swelling, bleeding on probing [23] and no clinical attachment loss or periodontitis manifested by deep periodontal pockets, clinical attachment loss, and radiographic bone loss were documented as having periodontal disease. The oral hygiene condition was determined using the simplified oral hygiene index [24]. The compliance with oral hygiene measures was determined by the patients' self-report about their dental care (at least twice daily tooth-brushing, once daily flossing and tongue brushing regularly) [25]. The smoking status (non-smoker or smoker, including any smoking type, duration, and frequency), and the systemic health condition (presence or absence of systemic diseases) were recorded. Only the American Society of Anesthesiology (ASA) 1 and ASA 2 classified patients [26] were eligible for treatment in the dental teaching hospital and were included in this study. After that, the screening data for each patient was transferred to the dental hospital's electronic database.

2-5. Statistical analysis

Data were collected, tabulated, and then analyzed using SPSS version 20. Data were displayed as frequencies, and the comparisons were made using a chi-squared test (X^2). Pearson tests were used to evaluate the correlation between variables and periodontal disease. P-values less than 0.05 were considered significant.

3. Results

Of the total 4,967 visiting patients, 3,158 (64%) patients presented with periodontal disease, while 1,809 (36%) did not present with periodontal disease. Of the 3,158 patients with periodontal disease, 1,847 (58%) were male, and 1,311 (42%) were female. The sample was further divided by age into four groups: less than 20 years, 20 to 35 years, >35 to 50 years, and over 50 years of age, as seen in figure (1).
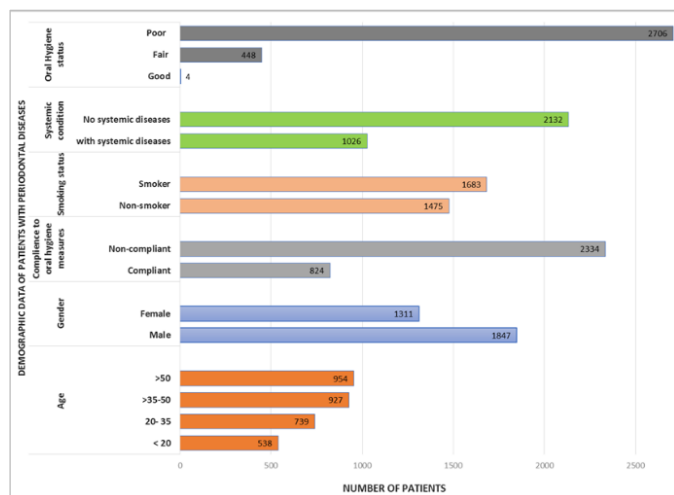

Figure 1: Demographic data of patients with periodontal disease who attended Umm Al-Qura University dental teaching hospital in year 2018.

3-1. Relation between periodontal disease and the compliance with oral hygiene measures.

Table (1) shows the relationship between compliance with oral hygiene measures and the development of periodontal diseases. Of the 3,158 patients examined with different forms of periodontal disease, 26.1% were compliant with oral hygiene measures while 73.9% were not compliant with oral hygiene measures. However, a significant difference was observed between compliant and non-compliant patients with periodontal disease for all age groups (p = 0.000). The correlation coefficient between compliance with oral hygiene measures and the presence of periodontal disease had a value near one (r = −0.894), indicating a high inverse correlation. The negative value confirms that compliance with oral hygiene measures decreased the presence of periodontal disease. In addition, female patients showed significantly higher (p = 0.01) compliance with oral hygiene measures across all age groups compared to males.

Table (1): Relationship between periodontal disease and compliance with oral hygiene measures among different age groups

	Age groups					X^2 p value
	< 20 N (%)	20 – 35 N (%)	>35 – 50 N (%)	> 50 N (%)	Total	
Compliant patients						
Male	67 (26%)	101 (30%)	34 (27.6%)	28 (26.2%)	230 (27.9%)	29.48 (0.01)*
Female	191 (74%)	235 (70%)	89 (72.4%)	79 (73.8%)	594 (72.1%)	
Total	258 (31.3%)	336 (40.8%)	123 (14.9%)	107 (13%)	824 (100%)	
Non- compliant patients						
Male	206 (73.6%)	269 (66.7%)	520 (64.7%)	506 (59.7%)	1,501 (64.3%)	33.52 (0.01)*
Female	74 (26.4%)	134 (33.3%)	284 (35.3%)	341 (40.3%)	833 (35.7%)	
Total	280 (11.9%)	403 (17.3%)	804 (34.4%)	847 (36.4%)	2,334 (100%)	
Total						
	538 (17%)	739 (23.4%)	927 (29.4%)	954 (30.2%)	3,158 (100%)	
X^2 (P value)	278.8 (0.000)*					
Pearson's R (P value)	-0.894 (0.000)*					

*Significant at p value < 0.05

X^2 chi square test

3-2. Relationship between periodontal disease and smoking.

Table (2) shows the smoking status among periodontal disease patients and the relation of smoking to periodontal disease. Of the total patients with periodontal disease, 1,683 patients (53.3%) smoked while 1,475 patients (46.7%) did not smoke. A significant difference was found between smoker and non-smoker patients and with periodontal disease (p =0.000) among all age groups. The Pearson correlation value (r = 0.689) indicated a significant positive correlation between smoking and the development of periodontal disease. Of the patients who smoke, the percentage of males in each age category was significantly higher than that of females in each age category (p = 0.001).

Table (2): Relationship between periodontal disease and smoking among different age groups.

Smoking status	Age groups					X^2 p value
	< 20 N (%)	20 – 35 N (%)	>35 – 50 N (%)	> 50 N (%)	Total	
Smokers						
Male	25 (96.2%)	227 (63.4%)	437 (68.9%)	462 (69.5%)	1151 (68.4%)	63.56 (0.001) *
Female	1 (3.8%)	131 (36.6%)	197 (31.1%)	203 (30.5%)	532 (31.6%)	
Total	26 (1.5%)	358 (21.3%)	634 (37.7%)	665 (39.5%)	1683 (100%)	
Non-smokers						
Male	119 (23.2%)	102 (26.8%)	135 (46.1%)	142 (49.1%)	498 (33.8%)	17.89 (0.01) *
Females	393 (76.8%)	279 (73.2%)	158 (53.9%)	147 (50.9%)	977 (66.2%)	
Total	512 (34.7%)	381 (25.8%)	293 (19.9%)	289 (19.6%)	1,475 (100%)	
Total						
	538 (17%)	739 (23.4%)	927 (29.4%)	954 (30.2%)	3,158 (100%)	
X^2 (P value)	156.66 (0.000)*					
Pearson's R (P value)	0.689 (0.000)*					

*Significant at p value < 0.05

X^2 chi square test

3-3. Relation between periodontal disease and systemic diseases.

Table (3) shows the relationship between the presence of systemic diseases and periodontal diseases. Of the total patients with periodontal disease, 1,026 (32.5%) presented with either diabetes mellitus or hypertension or both (357 patients had diabetes mellitus, 346 patients had hypertension and 323 patients had both diabetes mellitus and hypertension). No significant difference was found between patients with diabetes mellitus only, hypertension only or both (p = 0.09). On the other hand, 2,132 (67.5%) of periodontal disease patients were systemically healthy. A significant difference was observed between the presence of periodontal disease and systemic disease among all age groups (p = 0.000). The Pearson correlation value (r = 0.482) showed a significant weak positive correlation between the presence of systemic diseases and periodontal diseases. Although, fewer female patients presented with systemic disease compared to male patients for all examined age groups, no significant difference was observed between male and female patients (p = 0.07).

Table (3): Relation between periodontal disease and the presence of systemic diseases among different age groups.

Systemic diseases	Age groups					X^2 p value
	< 20 N (%)	20 – 35 N (%)	>35 – 50 N (%)	> 50 N (%)	Total	
Patients with systemic diseases						
Male	32 (57.1%)	147 (58.3%)	168 (52.9%)	218 (54.4%)	565 (55.1%)	3.64 (0.07)
Female	24 (42.9%)	105 (41.7%)	149 (47.1%)	183 (45.6%)	461 (44.9%)	
Total	56 (5.5%)	252 (24.6%)	317 (30.9%)	401 (39%)	1026 (100%)	
Patients without systemic diseases						
Male	196 (40.3%)	238 (48.9%)	207 (33.9%)	256 (46.3%)	897 (42.1%)	3.55 (0.06)
Female	286 (59.7%)	249 (51.1%)	403 (66.1%)	297 (53.7%)	1235 (57.9%)	
Total	482 (22.6%)	487 (22.8%)	610 (28.6%)	553 (26%)	2132 (100%)	
Grand total						
	538 (17%)	739 (23.4%)	927 (29.4%)	954 (30.2%)	3158 (100%)	
X^2 (P value)	77.39 (0.000) *					
Pearson's R (P value)	0.482 (0.000) *					

*Significant at p value < 0.05

X^2 chi square test

3-4. Relation between periodontal disease and oral hygiene status.

Table (4) shows oral hygiene status and its relation to the presence of periodontal disease for all age groups. A significant difference (p = 0.000) was found between the four age groups regarding their oral hygiene status. The coefficient correlation between oral hygiene status and periodontal disease has a value near one (r = −0.889), which indicates a high correlation. The negative value confirms that maintaining good oral hygiene decreases the presence of periodontal disease. Regarding the difference between male and female patients according to oral hygiene status, in the age groups younger than 20 years and 20 to 35 years of age, female patients showed significantly higher percentages for good and fair oral hygiene than males (p = 0.04 and p=0.05 respectively), while males showed higher percentage for poor oral hygiene than females in the same age group. No significant differences were found between male and female patients regarding their oral hygiene status for >35 to 50 years (p = 0.09) and older than 50 years age groups (p = 0.07).

Table (4) Relationship between periodontal disease and oral hygiene status among different age groups.

Age groups	Oral hygiene status				X^2 p value
	Good N (%)	Fair N (%)	Poor N (%)	Total N (%)	
0 - 20 years					
Male	84 (34.6%)	95 (44%)	52 (65.8%)	231 (42.9%)	10.77 (0.04) *
Female	159 (65.4%)	121 (56%)	27 (34.2%)	332 (61.7%)	
Total	243 (45.2%)	216 (40.1%)	79 (14.7%)	538 (100%)	
21 – 35 years					
Male	187 (57.1%)	135 (45.3%)	71 (62.8%)	364 (49.3%)	10.32 (0.05) *
Female	141 (42.9%)	163 (54.7%)	42 (37.2%)	375 (50.7%)	
Total	328 (44.4%)	298 (40.3%)	113 (15.3%)	739 (100%)	
>35 – 50 years					
Male	64 (54.7%)	193 (46.8%)	184 (46.2%)	441 (47.6%)	4.23 (0.09)
Female	53 (45.3%)	219 (53.2%)	214 (53.8%)	486 (52.4%)	
Total	117 (12.7%)	412 (44.4%)	398 (42.9%)	927 (100%)	
Over 50 years					
Male	54 (52.9%)	205 (49.3%)	181 (41.5%)	440 (46.1%)	3.95 (0.07)
Female	48 (47.1%)	211 (50.7%)	255 (58.5%)	514 (53.9%)	
Total	102 (10.7%)	416 (43.6%)	436 (45.7%)	954 (100%)	
X^2 (P value)	176.33 (0.000) *				
Pearson's R (P value)	-0.889 (0.000) *				

*Significant at p value < 0.05

X^2 chi square test

4. Discussion

Periodontal disease is a crucial oral health problem due to its high pervasiveness and correlation with general health. It is a multifactorial disorder with numerous systemic and local risk factors playing a role in its clinical consequence. Risk factors have been shown to exaggerate the disease condition [5], potentially resulting in severe attachment and bone loss with accompanying tooth mobility, which causes remarkable psychological, social, and oral health issues.

Several investigations have confirmed an association between periodontal disease and systemic diseases such as diabetes, cardiovascular disease, pregnancy complications, and osteoporosis [27-30].

One mechanism postulated, is the direct dissemination of the periodontal pathogens from periodontal pockets to connective tissues and via the bloodstream to other organs, leading to several diseases, including cardiovascular diseases, adverse pregnancy reactions,

respiratory diseases, diabetes, Alzheimer's disease, and others [31]. Another mechanism being proposed and studied is the role of periodontal disease and the increase in systemic inflammation. Systemic inflammation affects the homeostasis in a person leading to various undesirable effects that increase morbidity and mortality. Bacteria in the biofilm formed on the surfaces of teeth causes chronic periodontal disease, which continuously leads to a systemic influx of virulent components and metabolites, including lipopolysaccharides (LPS). In response to this invasion of foreign agents, the host's defense mechanisms produce various prostaglandins and cytokines which are in turn, responsible for most periodontal tissue damage and contribute to the development of systemic illness [32].

Also, the shared risk factors between periodontal disease and systemic diseases including genetic or environmental factors such as smoking, lifestyle and socioeconomic condition may contribute to this correlation. It has been found that improving the periodontal condition improves the condition of these systemic diseases [31]. Therefore, knowing the status of periodontal disease and the associated risk factors for the target population has significant relevance for maintaining healthy oral and systemic conditions in this population.

Umm Al-Qura University Dental Teaching Hospital in Makkah city provides various dental services to many patients of different ages from varying cultural and socioeconomical backgrounds. From January to December 2018, 4,967 newly opened files were registered at the dental teaching hospital, the highest patient flow rate since the hospital began operating. This large increase in the number of attending patients, combined with the diversity of the Makkah population, provided an opportunity to examine the prevalence of periodontal disease and its correlation with associated risk factors among the different age groups of the dental teaching hospital patients.

The prevalence of periodontal disease varies between studies, which could be due to dissimilarities in the studied populations' age groups and case definitions. In the present study, the overall prevalence of periodontal diseases among attending patients was 64%. This result is in accordance with the result of another study [14], which reported a prevalence rate of 68%, but is lower than prevalence rates reported in prior studies, which were 81%, and in another study was 63.2% for gingivitis and 36.8% for periodontitis [17, 20]. This variation might be due to the present study being performed using a larger sample size than previous studies and with a wider range of age groups. A report by the Centers for Disease Control and Prevention stated that 47.2% of people 30 years and older in the United States have some sort of periodontal disease [3]. The sample for the present study included people younger than 30 years, which may be the cause of increased prevalence rate.

There are many risk factors well documented in the literature as being associated with periodontal disease initiation and progression. These include age, smoking, hereditary factors, stress, poor compliance with oral hygiene measures and regularity of dental visits, diabetes, and other systemic diseases [5, 33]. The current study found that most of the study population did not comply with oral hygiene measures, with high non-compliance among males as well as people aged >35 to 50 years and older than 50 years of age. Moreover, a significant high negative correlation was found between compliance with oral hygiene measures and the development of periodontal disease, which suggests that a commitment to oral hygiene measures minimizes the chance of having periodontal disease. Previous studies have reported similar findings [16, 34-37] that older males and those who do not comply with oral hygiene measures have a higher risk of developing periodontal disease than females and individuals who comply with oral hygiene measures. These findings are likely due to the cumulative effects of the untreated disease increasing with age, along with males having worse attitudes toward practicing oral hygiene and committing to preventive measures in comparison to females.

Several epidemiological and clinical studies have confirmed that smoking negatively impacts periodontal health [38, 39]. Smoking negatively influences the host's defense mechanisms and responses through vasoconstrictive effects, decreases fibroblast proliferation, decreases collagen and ground substance production, increases collagenase and osteoclastic activity, and impairs neutrophils and the

functioning of other immune cells [40]. Furthermore, smokers have rates of clinical attachment and bone loss two to five times greater than those of non-smokers [41]. In this study population, smokers outnumbered non-smokers, and smoking was more common among males aged 35 years and older. In agreement with previous studies [38, 40], this study found a significant positive correlation between smoking and periodontal disease, which indicates that smoking enhances the risk of severe periodontal disease.

The severity of periodontal disease in relation to smoking type, duration, or frequency was not performed in this study as the present study aimed to assess only the prevalence of periodontal disease and the relationship between risk factors such as smoking and periodontal disease. Likewise, there are inherent difficulties when evaluating smoking as a risk factor. For instance, when measuring the subject's tobacco exposure over time, researchers most often rely on interviews or questionnaires or quantify lifetime exposure in pack years where current cigarette use may not reflect past usage. Hence, cotinine level measurement, which is not regularly done in our hospital, provides a reliable quantitative measure of smoking status and can be correlated with the severity of the periodontal disease.

The association between periodontal condition and systemic disorders has been widely studied in periodontal research [42]. Many systemic diseases have been implicated as risk indicators or risk factors in periodontal disease. Systemic diseases may cause variation in the host response among individuals resulting in an impaired or exaggerated host immune response to bacterial pathogens that may lead to more severe forms of the disease. Furthermore, systemic diseases alter host tissues and physiology, which may impair the host's barrier function and immune defense against periodontal pathogens, thereby creating the opportunity for destructive periodontal disease to progress [43]. Conversely, evidence suggests that periodontal infection may significantly enhance the risk for certain systemic diseases or alter the natural course of systemic conditions.

Since Umm AL-Qura university dental hospital is a dental teaching hospital and patients are treated mainly by dental students under the direct supervision of the college faculty members, so only ASA 1 and ASA 2 patients were eligible for treatment at the dental teaching hospital and were included in the study. Likewise, since there was no significant difference between the number of patients with diabetes mellitus only, hypertension only, or both in the present study, we could not discuss their effect separately on periodontal disease.

The present study results of the correlation between systemic disease and periodontal disease conforms with findings of previous studies [42,43] and reported a significant positive correlation between periodontal disease and systemic diseases irrespective of age and gender. On the other hand, this finding disagreed with previous studies [44,45] that have not found any association between systemic diseases and periodontal disease. The lack of a precise epidemiologic definition for periodontal disease in these studies possibly contributed to these conflicting results.

It has been reported that inadequate oral hygiene practice causes the accumulation of plaque and calculus which, in turn, increases the risk of periodontal disease by two to five times [46]. Likewise, the present study demonstrated a significant high negative correlation between oral hygiene status and periodontal disease, suggesting that poor oral hygiene increases the risk of periodontal disease. This study also showed that poor oral hygiene was most prominent in people >35 to 50 years of age and those older than 50 years of age for both genders. However, a significantly higher percentage of males, younger than 20 years of age and 20 to 35 years of age had poor oral hygiene compared to females in the same age groups. These findings are supported by previous studies [16, 47], and this trend might be due to worse attitudes toward practicing oral hygiene and committing to preventive measures and regular dental visits in males compared to females.

The following points are being noted limitations of this study and areas for further investigation. First, the study included only patients attending one dental center in Makkah, which might not adequately represent the entire community in the city. Second, this study did not provide details about the extent and the severity of periodontal diseases; instead, it has only reported, in general, the overall prevalence of periodontal disease, which might not accurately reflect the actual periodontal condition of the study population. Third, this study did not discuss the effect of specific systemic disease on periodontal disease.

Despite these limitations, this is the first study to report on the prevalence of periodontal disease and the associated risk factors in the population of Makkah city. Further research should explore in detail the prevalence of each form of periodontal disease in the population of Makkah city. It is recommended that a community-based program is established to increase community awareness regarding periodontal disease and its risk factors to promote improvements in oral health conditions.

5. Conclusions

The present study reported that 64% of the study population had periodontal disease. Several risk factors were associated with periodontal disease. Good oral hygiene and compliance with oral hygiene measures were higher in females, while smoking and poor oral hygiene were more prevalent in males. It is necessary to educate the community about periodontal disease and its predisposing factors to decrease their risk of developing the disease and promote oral and general health.

6. Acknowledgment

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