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Study of Gingivitis and Associated Factors among Adult Patients Visiting the School of Dentistry, Islamabad

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ABSTRACT

Background: Gingivitis is one of the most common non-communicable diseases affecting all age groups. It is an inflammatory response of the oral cavity that, if untreated, can progress to periodontitis. Clinically, it presents with microbial plaque, redness, oedema, bleeding on probing, and halitosis. This study aimed to assess the frequency of gingivitis using the Gingival Index of Loe and Sinless and its association with clinical characteristics and oral hygiene among patients visiting SOD, Islamabad. **Methods:** This cross-sectional study used a non-probability convenience sampling technique. Data were collected from 100 patients with gingival index scores ranging from 0–3. Clinical examinations were performed to measure gingival indices, oral hygiene habits, and related clinical features. Associations between variables were analyzed using the Chi-square test. **Results:** The mean age of participants was 33.88 ± 10.71 years, with an equal gender distribution. Gingival assessment showed that only 10% had no inflammation, while most exhibited mild (34%), moderate (35%), or severe (21%) gingivitis. Daily toothbrushing, mouth rinsing after meals, and smoking habits demonstrated significant associations with gingival health, with poor brushing practices, lack of rinsing, and smoking linked to higher levels of moderate and severe gingivitis. Dental floss use and annual dental checkups showed no significant associations. Clinical characteristics including gingival bleeding, dental plaque, toothache, and halitosis were strongly associated with increasing gingivitis severity, whereas crowding of teeth showed no significant relationship. **Conclusion:** Gingivitis and its associated factors significantly impact oral health. Adherence to proper oral hygiene can improve gingival status and reduce disease risk, preventing progression to severe clinical conditions.

Keywords: Dental Plaque, Gingival Health Index, Gingivitis, Oedema, Oral Health, Periodontitis

INTRODUCTION

Gingivitis is an inflammatory response that is caused by dental plaque and does not result in clinical attachment loss or detectable bone loss is called gingivitis. The bleeding gums cause an inflammatory dental process that affects the gingiva. It is a common occurrence in dentistry, affects patients of all age groups, and characterizes the state of the soft tissue in the teeth [1]. The main cause of gingival disease is plaque deposition, which includes different microorganisms. As gingivitis progresses, plaque matures the proportion of gram-positive and gram-negative bacteria increases, such as rods, cocci, fusiform, filaments and spirochetes [2]. Plaque build-up on the tooth surface is the primary contributor to gingivitis. The bacteria on the tooth surface are an irritant to the gingival tissue and trigger the host's immune system to fire. The first is an in-built immune response that recognizes bacteria in the presence of pattern recognition receptors (PRRs) like Toll-like receptors (TLRs) on epithelial cells and immune cells (neutrophils and macrophages). The bacterial lipoproteins and LPS binding to TLRs causes the release of inflammatory mediators, such as cytokines and prostaglandins. These cytokines and other mediators of

inflammation draw more immune cells to the infection site, making local blood vessels more permeable, and causing the typical clinical signs of redness, swelling and bleeding on probe. Neutrophils and T lymphocytes are attracted to the diseased gingiva in response to these signals. First line of defense: neutrophils try to phagocytose and kill bacteria, but their long-term presence contributes to tissue death, including breakdown of collagen. T lymphocytes (T-helper cells) also help to control the immune system and modulate inflammation in the periodontal tissues [3]. This plaque accumulation shows the clinical symptoms such as redness, oedema, gingival bleeding, change in texture, halitosis, and occasionally pain. These symptoms appear after 12-21 days of dental plaque accumulation, clinically determined within one week after doing oral hygiene care and other precautions. If this condition continues, initially edematous gingival tissue becomes more fibrotic.

Similarly, it is widely accepted that gingivitis, which is the first stage of periodontal disease for a child, an adolescent or an adult, goes on to become periodontitis in a small proportion of cases. Plaque gingivitis is the most frequent type of gingival inflammation, which is caused when dental plaque forms between teeth and gingival grooves and leads to soft tissue destruction [4]. Gingival diseases can also be chronic and result from the presence of food and leftovers along with the wearing of orthodontic appliances and contact with smoking, diabetes, genetic changes, hormonal changes in pregnant women, teeth concretion, poor oral hygiene and inefficient dental or hygienic practice [5]. Both oral and systemic factors affect the oral microbiome during pregnancy. Complex biological processes inside the gingival tissues are triggered by hormonal changes, specifically elevated levels of progesterone and estrogen. Together with the presence of local irritants, dietary changes, and poor oral hygiene, these hormonal changes play an important role in the development of gingivitis and periodontitis. It is crucial to continue good oral health throughout pregnancy to prevent gingivitis, which commonly occurs between the third and eighth months of gestation [6]. The determinable effect of smoking on gingival health is due to systemic influences or local interaction with gingiva. The link between smoking and gingival health is complex. Gingivitis occurs more severely in smokers as compared to non-smokers. Smoking and poor oral hygiene cause faster plaque and calculus accumulation, leading to poor gingival health and receding gums [6].

Numerous factors, including the presence of dental plaque, genetic, socioeconomic, demographic, iatrogenic, and behavioral factors, are significantly linked to gingivitis. It appears that these elements have an impact on the process, which makes determining the risk factors challenging [7]. The most common type of gingivitis includes marginal gingiva, which is caused by the accumulation of microbial plaque in persons who lack oral hygiene care. Gingivitis progresses through an initial stage to produce early lesions and then proceeds to advance disorders. The pathophysiology of gingivitis is a dynamic process influenced by microbial factors, host immune responses, and environmental factors, including oral hygiene practices, smoking, and systemic health. According to epidemiological research, gingivitis brought on by plague is common in dentate people of all ages. The hallmark of gingivitis caused by plaque is the appearance of inflammation restricted to the gingiva and not extending to other tooth-supporting tissues [8].

The presence of dental plaque is associated with this kind of inflammation. The irritation will not go away if dental plaque is there next to the gingival tissues [8]. The longevity of the permanent teeth would be negatively impacted by this undesirable oral state. Therefore, to enhance oral health conditions during this time, it is crucial to acquire good dental hygiene behaviors and lifestyle habits. Put another way, adolescents would be better able to maintain their oral health if they understood and managed the factors that relate to oral disorders throughout this time [9]. Numerous factors, including community members' routines and lifestyles, the environment, and socioeconomic conditions, can be linked to the incidence of oral health disorders. Throughout the world, gingivitis primarily affects young people [10]. Gingival Index, developed by Loe and Silness, classifies the extent of inflammation into three levels: mild, moderate and severe, and is also referred to as the GI. Early stages of gingivitis are associated with little inflammation, which means bleeding on probing. Mild inflammation is characterized by a minuscule redness, score =1, along with a minimal swelling of the gingiva. Scoring of two or moderate inflammation hints towards a more developed later of gingivitis as there is noticeable swelling, bleeding when probed, and heat. Scoring of three, which is severe inflammation, alongside being troublesome, marks the stage of the tertiary periodontitis, which could also potentially ravage gingivitis. Due to the burst blood vessels, the skin loses exercise elasticity. To sum it up, the average is taken out of the four sites' marks for each term of gingival health [11]. The treatment of mild, moderate and severe gingivitis is done to prevent progression to periodontal disease. For mild gingivitis (score 1), treatment mainly focused on brushing technique and improving oral hygiene. Brushing and Flossing technique removes plaque, which settles the mild inflammation. Moderate gingivitis (score 2) treatment involves intensive intervention, which includes scaling and root planning to remove dental plaque and calculus, also anti-microbial mouthwashes are prescribed. Severe gingivitis (score 3) treatment includes more care, which includes deep cleaning and root planning, also frequent dental checkups are required; in some cases, antibiotics may be prescribed [12]. The present study is focused on determining the frequency of gingivitis in infected patients (16 to 50 years) at the dental Out-Patient Department School of Dentistry, Islamabad, Pakistan.

MATERIALS AND METHODS

The study was a cross-sectional study that was carried out at the School of Dentistry (SOD), Islamabad, between August 2024 and December 2024 to determine the level of gingivitis and its risk factors among adult patients. Patients aged 16 to 50 years who received dental care were the study population, and the sample size was 100 patients, calculated by the prevalence formula. The non-randomized convenience sampling method was used. Inclusion criteria were cooperative male and female patients within the given age range, and exclusion criteria were patients younger than 16, older than 50, mentally handicapped or non-cooperative. SOD provided ethical approval, and informed consent in writing was obtained from the participants.

2.1. DATA COLLECTION PROCEDURE

A structured proforma was used to collect data; the proforma was developed in English and validated by supervisors. Demographic information, oral hygiene habits and clinical results were documented after consent was obtained. A conventional dental unit was used to examine patients with a mouth mirror and probe to classify the health status of the gingivae as no inflammation, mild, moderate, or severe. Inclusion and exclusion criteria were used carefully to promote validity.

2.2. STATISTICAL ANALYSIS

The data obtained were analyzed in SPSS version 25. Chi-square test was used to determine relationships among the study variables, and a p-value of less than or equal to 0.05 was regarded as statistically significant.

RESULTS

The demographic analysis showed that the mean age of participants was 33.88 ± 10.71 years, ranging from 17 to 50 years. The study population was evenly distributed by gender, with males and females each constituting 50% of the total sample as shown in Table 1.

Table 1. Frequency Distribution Analysis for Demographic Variables

Characteristics	Mean ± SD	Min value	Max value
Age in years	33.88 ± 10.71	17	50
Gender	**Frequency**	**Percentage**	
Male	50	50%	
Female	50	50%	

Table 2 illustrates the frequency distribution of the gingival index. Out of 100 patients, 10 patients had no inflammation, 34 had mild gingivitis, 35 had moderate gingivitis, and 21 had severe gingivitis. When examining gingivitis in males and females separately, the percentage of mild gingivitis was the same for both genders, i.e. 17%, the percentage of moderate gingivitis was slightly higher in females (18%) than in males (17%); the percentage of severe gingivitis was higher in males (12%) compared to females (9%).

Table 2: Frequency of Gingival Index among Patients Visiting the School of Dentistry, Islamabad

Gingival index	Frequency	Male (n=50)	Female (n=50)
No Inflammation	10	4	6
Mild	34	17	17
Moderate	35	17	18
Severe	21	12	9
Total	100	50	50

Table 3 indicates the association of oral hygiene habits with gingival health issues in terms of their severity. Daily brushing has having strong significant association with gingival health issues (p=0.000). A high majority of patients who do not practice brushing tooth daily suffer from moderate n=23 and severe n=20 gingival health issues. However, daily toothbrushes do not have inflammation n=9 and mild gingival health issues n=22. Dental floss use does not have a significant association with gingival health issues (p>0.005), illustrating the least a proportion of dental floss users suffer from mild n=4 and moderate n=4 gingival health problems, whereas no severe problems at all. It supports the alternative thought that omission of dental floss usage is significantly associated with gingival health problems, contributing 30/34, 31/35, 21/21 mild, moderate and severe gingival health problems, respectively, among people who do not practice dental floss for interdental hygiene. Regular annual dental checkups do not have a significant association with gingival health issues (p>0.005), illustrating the least proportion of patients going for dental checkups suffering from mild n=3, moderate n = 1, and severe n=1. It supports the alternative thought that omission of dental checkups regularly is significantly associated with gingival health issues, contributing 31/31, 34/35, 21/21 mild, moderate and severe gingival health problems, respectively, among people who do not visit a dentist. Mouth rinsing after eating is significantly associated with gingival health issues (p=0.007). A high majority of patients who do not rinse their mouth after every meal suffer from moderate n=14 and severe n=14 gingival health issues. However, people who follow this habit had no inflammation n=3 and mild gingival health problems n=9. Smoking has having strong, significant association with gingival health issues (p=0.001) as it has a great impact on oral hygiene. Out of 100 patients the 20 patients were those who had the habit of smoking, and they suffered from mild n=5, moderate n=8 and severe n=6 gingival health issues, and all of them were males. However, people who do not smoke had no inflammation n=9.

Table 3: Chi-square Analysis for Association among Oral Hygiene Habits and Gingival Health Status

Oral Hygiene Habits		Gingival Health Status				P-value
		No Inflammation (n=10)	Mild (n=34)	Moderate (n=35)	Severe (n=21)	
Daily Brushing (Twice a day)	No	1	12	23	20	0.000
	Yes	9	22	12	1	
Use Dental Floss	No	8	30	31	21	0.303
	Yes	2	4	4	0	
Regular Annual Dental Checkups	No	8	31	34	20	0.278
	Yes	2	3	1	1	
Rinse Mouth After Eating	No	3	9	14	14	0.007
	Yes	7	25	21	7	
Smoker	No	9	29	27	15	0.001
	Yes	1	5	8	6	

Table 4 indicates the association of clinical characteristics with gingival health issues in terms of their severity. Gingival bleeding while brushing teeth has a strong, significant association with gingival health issues (p=0.000). A high majority of patients who had bleeding while brushing was suffering from moderate (n=26/34) and severe (n=21/21). The least number of patients suffering from bleeding while brushing was found in mild (n=11/34) and no inflammation (n=9/10), so it is strongly related to gingival severity. Dental plaque also shows a strong, significant association with gingival health issues (p=0.001). Most patients were suffering from dental plaque, and their ratio was higher in moderate (n=35/35) and severe (n=21/21) cases of gingival health issues and lower in mild (n=26/34) and no inflammation (n=7/10) cases of gingival health issues. Toothache shows a significant association with gingival health issues, as patients who suffer from gingivitis complain of toothache. A high ratio of patients who suffer from toothache were in moderate (n=22/35) and mild (n=21/34) patients complaining toothache in severe cases of gingivitis was (n=17/21) and was least in no inflammation (n=3/10). Crowding of teeth does not have a significant association with gingival health issues (p>0.005), illustrating the least proportion of crowding patients suffering from mild (n=10/35), moderate (n=9/34) and severe (n=5/21) gingival health problems. It supports that crowding is not always related to gingivitis, contributing 24/35, 26/34, 16/21 mild, moderate and severe gingival health problems, respectively, among those people who do not suffer from crowding. Bad breath (Halitosis) has having strong significant association with gingival health issues (p=0.000). Most patients who had bad breath were moderate (n=31/34) and severe (n=21/21) gingival health issues, while a minority of patients suffering from bad breath were mild gingival health issues (n=16/35) and no inflammation (n=2/10).

Table 4: Chi-Square Analysis for the Association of Gingival Health Status with Clinical Characteristics of Gingival

Clinical Characteristics		Gingival Health Status				P Value
		No inflammation (n=10)	Mild (n=35)	Moderate (n=34)	Severe (n=21)	
Gingival bleeding while brushing your teeth?	No	9	23	9	0	0.000
	Yes	1	11	26	21	
Dental Plaque	No	3	8	0	0	0.001
	Yes	7	26	35	21	
Toothache	No	7	13	13	4	0.005
	Yes	3	21	22	17	
Crowding of teeth	No	7	24	26	16	0.963
	Yes	3	10	9	5	
Bad breath (Halitosis)	No	8	18	4	0	0.000
	Yes	2	16	31	21	

DISCUSSION

Our study findings revealed the frequency of mild, moderate and severe gingivitis with age and gender, respectively. So that the study focused on the gingivitis and associated factors among adult patients visiting the School of Dentistry, Islamabad. Additionally, it also shows the associations between clinical characteristics and gingival health status as well as oral hygiene practices. Gingivitis was also more common in patients in our study who were between the ages of 16 and 50. Gingivitis is very common everywhere, although the elderly are more affected, so we chose to study gingivitis for adults. An analysis of the overall incidence in the adult population revealed that between 50.0% and 100.0% of people had gingivitis. According to several other studies, gingivitis starts in early childhood and gets worse in puberty [13]. The survey revealed that the country's periodontal health is extremely poor, with only 28% of those aged 12 to 65 having healthy gums and 93% of those aged 65 and older having some form of gingival or periodontal disease [14]. Due to the narrow age range of participants (i.e. 16- 50) of our study, there may be a reason that age is not associated with gingival inflammation in comparison with another research. People in this age range exhibit symptoms of oral disorders, including different types of periodontal diseases. The World Health Organization views the 35-44 age range as a critical demographic for calculating oral health. Furthermore, people over 50 are most at risk for periodontal disorders, which tend to become more common as people age [13]. However, the findings from our study are consistent with a previous study that showed no significant relationship between age and the presence or severity of gingivitis. This discrepancy may be due to variations in study populations, methodologies, or other factors such as oral hygiene practices, systemic health conditions, or access to dental care, which can all influence the development of gingivitis regardless of age.

Our study analysis highlights slight differences in the severity of gingivitis between genders, with females showing a slightly higher prevalence of moderate gingivitis, while males have a higher percentage of severe gingivitis. The present study shows that most patients were brushing only once every day, and their technique of brushing was also questionable, which is why there was a high rate of mild gingivitis among the patients. The recent studies show the percentage of mild and moderate gingivitis is less in females than in males, but the percentage of severe gingivitis is higher in females than in males because female patients had low Hb level (8-10gm/dl), so they are more prone to gingivitis. They were most functional reproductively at the age of 13 -30 years, and their personal health was compromised enough; this must be one of the obvious reasons that they suffer more from severe gingivitis [14]. So, our results are not consistent with this study, but the results of our study are in line with earlier studies that clarified a significant correlation of sex with gingival illness. This might be because men are less likely to visit the dentist with a poor state of mind towards oral hygiene in comparison to females; that's why they suffer more with severity [14].

Our study results demonstrate the significant association between gingival health status and oral hygiene habits, i.e. regular tooth brushing, mouth rinsing after eating and smoking ($p<0.005$) and do not show the significant association with flossing and regular dental follow-ups ($p>0.005$). Regular tooth brushing with its proper technique has a great impact on oral health as it is very effective in preventing plaque accumulation and thus, preventing gingivitis significance of flossing is due to a lack of motivation and difficulties using flossing. Assuredly, dental floss helps remove interdental plaque, but some people do not know the proper technique of flossing they damage their gums, which may lead to inflammation, so poor technique can reduce its benefit [15]. That's why it is not always associated with good gingival health. The concept of dental floss was introduced by Parmly in 1819.

Dental checkups regularly may not be sufficient on their own to prevent gingivitis, as they only detect the signs of gum disease and professional cleaning, but cannot detect daily habits that can lead to gingival health issues. Also, people have less awareness about dental examinations, and they avoid checkups, which leads to a poor impact on their gingival health. Rinsing your mouth after every meal helps to remove the food debris and prevent plaque buildup, which otherwise can irritate the gums. Habit of smoking poorly affects periodontal health by decreasing the gingival blood flow, which may damage the gums, leading to inflammation and bleeding. Numerous other studies have confirmed the connection between the development of gingivitis and poor oral hygiene [16].

All risk factors for periodontal disorders, including gingivitis. Additionally, according to Heitz-Maxfield (2024), oral hygiene practices such as brushing and flossing affect gingivitis. Neglecting them harms the health of the oral cavity, as gingivitis occurs. Other literature also documents a strong relationship between gingivitis and brushing frequency. Those who brushed their teeth two or more times had less gingivitis than those who only brushed their teeth once or never. Together, these studies support our conclusion that oral hygiene habits are significantly related to gum health, underscoring the importance of good oral hygiene practices in the prevention of gingivitis and periodontal disease [17].

Our analysis of results illustrates a significant association between clinical characteristics, i.e. gingival bleeding, dental plaque, toothache, halitosis and gingival health status ($p<0.005$) and does not show an association with crowding ($p>0.005$). Gingival bleeding is a very common sign of gingival health issues. It can be easily detected clinically and shows the early diagnosis of more advanced gingivitis, as it shows the extent and severity of the disease. Plaque is also one of the most common signs of gingivitis. The presence of this sticky layer irritates the gums, and if it remains around the tooth, it may lead to gingival inflammation and gum pain. Toothache is mostly the sign of a severe form of gingivitis and can appear very quickly when the inflammation reaches the apex, leading to ulceration, bleeding gums, sensitivity and toothache. Crowding does not result in worsening the gingival health on its own; it's about how a person can maintain oral hygiene through proper brushing, flossing and dental care in crowding. If the crowding is severe and makes it harder to maintain oral hygiene, then it leads to gingival health problems [17]. Most halitosis cases are related to gingivitis because there are majority of bacteria present in dental plaque, and when this layer remains around the gum line for a longer time, it leads to bad breath. Many studies have found a significant association between gingival health and clinical characteristics. According to the literature, the most important factor associated with gingivitis is the accumulation of plaque on the surface of the teeth, resulting in an inflammatory reaction with clinical symptoms of redness, edema, bleeding gums, bad breath, sometimes pain, while persistent, which were originally edematous, can become more fibrotic [18]. For example, a study by Pentapati, Kalyan-Chakravartha et al. demonstrated that gingival bleeding, plaque index, halitosis, and probing depth were closely related to the severity of gingivitis [19]. The findings in this study are consistent with our results, where a significant relationship was observed between GHS and clinical complications (p-value = 0.000), suggesting that poor gingival health often correlates with higher levels of clinical complications such as inflammation or infection. This observation was consistent with previous similar reports. There is evidence of a direct relationship between the number of contact areas overlapping tooth displacement and the number of red bleeding areas in the gums. There was also a significant correlation between dental occlusion and the amount of plaque, with the abnormal alignment of teeth, their surrounding surface is covered with more plaque, which can further lead to severe tooth pain [20]. Our study results are consistent with findings obtained in previous studies.

Since gingivitis is a multifactorial disorder, other elements may be involved that were not investigated in this study, including the protective role of saliva. In addition, it is possible that other elements, such as cultural, societal, occupational, and intra- and inter-individual host variables, could play a role in the development of gingivitis. Therefore, it is important to collect comprehensive data on this condition to evaluate its epidemiology, determine the variables that may contribute to the onset of early stages of gingivitis at a younger age, explain its pathogenesis, and identify patients who need specialized dentistry.

LIMITATIONS AND FUTURE DIRECTION

The main limitations of this study include the cross-sectional nature of the study, which does not allow for the determination of causality. The convenience sample used in the study is restricted to one dental clinic; hence, the findings cannot be generalized to the population. Moreover, other possible confounding variables, including socioeconomic status, dietary habits, systemic health conditions, and specific biochemical indicators such as saliva composition, were not evaluated in the study. Longitudinal designs using larger randomly selected cohorts in different settings should be used in the future to gain a better insight into the temporal relationship and causality of the related factors. A broader set of potential risk factors, such as genetic predispositions and microbiological analyses, would offer a more detailed view of the determinants of gingivitis and help to create more effective and targeted public health interventions.

CONCLUSION

Adherence to good oral hygiene habits is strongly correlated with better gingival tissue health and prevention from progression into worse periodontal disorders. Similarly, the appearance of worse clinical characteristics is strongly associated with the development of severe gingivitis and ultimately leads to periodontal disorders. In our study, several other risk factors, including smoking and pregnancy, have been identified as crucial factors that contribute to the development of gingivitis and progression of gingivitis into periodontal disorders.

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CONFLICT OF INTEREST

Authors declare no conflict of interest in publication and data privacy.

AUTHOR CONTRIBUTION

All authors contributed to this research study and approved final manuscript.

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