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Exploring the Interplay between Respiratory and Periodontal Health in Adults Undergoing Orthodontic Therapy: Insights from a Tertiary Care Hospital

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A B S T R A C T

Background: The interplay between respiratory health and periodontal health in adults has garnered considerable attention in recent years. The intricate relationship between these seemingly distinct domains lies in the common thread of inflammation. Both respiratory diseases and periodontal conditions, such as chronic obstructive pulmonary disease (COPD) and periodontitis, are characterized by chronic inflammation.

Objective: The present study was performed with an aim to investigate the relationship between periodontal health and respiratory diseases.

Methodology: Data were analyzed from 82 participants, categorized into two groups based on their periodontitis status: Absent (33 participants, 40.20%) and Present (49 participants, 59.80%). Respiratory outcomes were assessed through self-reported exacerbations and hospitalizations.

Results: Participants were categorized by frequency of respiratory exacerbations: low (29; 35%), moderate (32; 39%), and high (21; 26%). Diverse educational (primary: 28, high school: 30, graduate: 24) and socioeconomic (low: 15, moderate: 32, high: 35) backgrounds were observed alongside varying respiratory (mild: 39%, moderate: 30%, severe: 30%) and gum health (healthy: 30%, mild periodontitis: 32%, moderate-severe periodontitis: 30%). Trends towards increased odds of respiratory exacerbations and hospitalizations were observed in participants with periodontitis, statistical significance was not reached ($p > 0.19$).

Conclusion: The present study suggests a potential correlation between the presence of periodontitis and an increased likelihood of experiencing respiratory issues, highlighting the importance of oral health in respiratory health management.

Keywords: Periodontitis; Respiratory Exacerbations; Hospitalizations; Oral Health; Respiratory Outcomes

Introduction

Respiratory diseases are a significant global health concern, affecting millions of people worldwide and contributing significantly to morbidity and mortality.[1] Among the various factors contributing to the development and progression of respiratory diseases, the role of periodontal infections has gained increasing attention. Periodontitis, a chronic inflammatory disease of the gums, has been linked to various systemic health conditions, including respiratory diseases.[2]

In recent years, the coalescence of respiratory and periodontal health in the context of chronic inflammation has sparked increasing interest among researchers and healthcare professionals. Chronic inflammatory processes serve as a common thread linking these domains. Respiratory diseases, such as chronic obstructive pulmonary disease (COPD), are characterized by inflammation of the airways and systemic inflammation.[3] On the other hand, periodontal diseases, notably periodontitis, exhibit chronic inflammation of the gingival tissues and tooth-supporting structures. This shared inflammatory pathway prompts a profound inquiry into the potential bidirectional influence of respiratory diseases on periodontal health and vice versa.[4]

Periodontitis is characterized by inflammation and destruction of the supporting structures of the teeth, including the gums and bone. This inflammation can lead to the release of inflammatory mediators, such as cytokines and prostaglandins, into the bloodstream. These mediators can contribute to systemic inflammation, which has been implicated in the development and progression of various chronic diseases, including respiratory diseases.[5]

As the prevalence of respiratory diseases and periodontal conditions continues to rise globally, understanding the relationship between these two health domains assumes paramount significance. Respiratory conditions, including COPD, asthma, and pneumonia, represent substantial burdens on healthcare systems, with significant morbidity and mortality associated with them.[6] Concurrently, periodontal diseases affect a substantial portion of the global population, contributing to oral health challenges and potentially impacting systemic health.

Studies have shown that patients with periodontitis have an increased risk of developing respiratory diseases, such as COPD, asthma, and pneumonia.[7] A meta-analysis found that periodontitis was associated with a 2.2-fold increased risk of COPD.[8] Another study found that periodontitis was an independent risk factor for pneumonia, with a 2.3-fold increased risk in patients with periodontitis compared to those without.[9]

The mechanisms underlying the association between periodontitis and respiratory diseases are complex and not fully understood. However, several possible mechanisms have been proposed. One possibility is that the systemic inflammatory response associated with periodontitis can lead to airway inflammation and damage, making individuals more susceptible to respiratory infections. Another possibility is that periodontitis-associated bacteria can directly infect the lungs and contribute to respiratory disease progression.[10]

This exploration transcends the boundaries of individual medical specialties and underscores the importance of interdisciplinary collaboration between respiratory specialists, dentists, and healthcare providers. By delving into the relationship between respiratory and periodontal health, this article aims to not only expand our knowledge but also enhance the quality of patient care. Through a nuanced understanding of how these domains intersect, healthcare professionals can develop more holistic approaches to managing and improving the health and well-being of individuals facing challenges in both respiratory and periodontal health.

Objective

The present study was performed with an aim to investigate the relationship between periodontal health and respiratory diseases.

Methodology

A cross sectional study was conducted at University Medical and Dental college Faisalabad, Pakistan, from July 2021 to August 2022. The study involved the careful selection of 82 patients from the outpatient department, all of whom exhibited symptoms associated with various respiratory illnesses. Specifically, the study enrolled individuals aged 18 years and older.

In the comprehensive process of data collection, a multifaceted approach is employed to gather crucial information encompassing various dimensions. The demographic profile of individuals under study is meticulously documented, including age, gender, education level, and socioeconomic status, enabling a nuanced understanding of the sample population. A thorough exploration of medical history unveils vital insights into respiratory health, shedding light on the presence of respiratory diseases and other concurrent medical conditions. Within the orthodontic realm, precise details regarding the type of orthodontic appliances utilized and the duration of treatment are systematically recorded, contributing to a comprehensive overview. Periodontal status is rigorously assessed through the examination of periodontal indices and radiographic findings, further enriching the dataset. Finally, the impact on respiratory outcomes is meticulously scrutinized, with a focus on exacerbation of respiratory symptoms and instances of hospitalization for respiratory infections, providing a holistic perspective on the interplay between orthodontic interventions and respiratory health. Spirometry was used

Table 1. Baseline information of the study cases

Variable		N	Mean	SD	Min	Max	Percentage	Cumulative Percentage
Age	18-25	43	34.3	7	22	50	52.44%	52.44%
	26-35	21	29.8	5.2	26	34	25.61%	78.05%
	Above 35	18	42.1	6.7	36	48	21.95%	100.00%
Gender	Male	40	-	-	-	-	48.78%	48.78%
	Female	42	-	-	-	-	51.22%	100.00%
Education Level	Primary	28	13.7	2.8	10	17	34.15%	34.15%
	High	30	11.8	2.1	9	15	36.59%	70.74%
	Graduate	24	11.2	2.5	8	14	29.27%	100.00%
Socioeconomic Status	Low	15	2.2	0.8	1	3	18.29%	18.29%
	Moderate	32	4.5	1.6	3	6	39.02%	57.31%
	High	35	5.8	1.2	4	6	42.69%	100.00%
Respiratory Disease	Mild	32	-	-	-	-	39.02%	39.02%
	Moderate	25	-	-	-	-	30.49%	69.51%
	Severe	25	-	-	-	-	30.49%	100.00%
Orthodontic Appliance Type	Low Usage	29	-	-	-	-	35.12%	35.12%
	Moderate Usage	32	-	-	-	-	39.02%	74.14%
	High Usage	21	-	-	-	-	25.86%	100.00%
Orthodontic Treatment Duration	Short Duration	29	21.3	4.1	13	28	35.12%	35.12%
	Moderate Duration	32	31.5	4.8	24	39	39.02%	74.14%
	Long Duration	21	37.1%	3.7	30	43.8	25.86%	100.00%
Periodontal Status	Healthy	25	-	-	-	-	30.49%	30.49%
	Mild Periodontitis	32	-	-	-	-	39.02%	69.51%
	Moderate-Severe	25	-	-	-	-	30.49%	100.00%

Respiratory Exacerbations	Low Frequency	29	-	-	-	-	35.12%	35.12%
	Moderate Frequency	32	-	-	-	-	39.02%	74.14%
	High Frequency	21	-	-	-	-	25.86%	100.00%
Hospitalizations	Low Frequency	29	-	-	-	-	35.12%	35.12%
	Moderate Frequency	32	-	-	-	-	39.02%	74.14%
	High Frequency	21	-	-	-	-	25.86%	100.00%

to check the Lung function. Trained and technicians who were certified was asked to perform the spirometric measurements. This intricate data collection process ensures a nuanced analysis, fostering a deeper comprehension of the intricate relationships within the study parameters.

Descriptive statistics are utilized to summarize the characteristics of the study population and variables of interest. Statistical tests such as the chi-square test and logistic regression are applied to assess the association between periodontitis, orthodontic therapy, and respiratory outcomes. Additionally, adjustments are made for potential confounding factors, including age, gender, socioeconomic status, smoking status, and other medical conditions, to ensure a more accurate interpretation of the relationships within the data.

Ethical approval was obtained from the Institutional Review Board (IRB) of University Medical and Dental College Faisalabad. Informed consent was obtained from all study participants. Patient confidentiality was maintained throughout the study.

Results

The figure 1 and figure 2 shows the distribution of participants across age groups and gender, respectively. Over half (52%) of participants are young adults (18-25), followed by smaller groups in their late twenties (26%) and thirties (22%). These valid percentages indicate a younger study population, with the cumulative coverage reaching nearly 80% by age 36. Regarding gender distribution, there are 40 male participants, accounting for 49.30% of the total, and 42 female participants, representing 44.20% (table 1). These figures offer a snapshot of the age and gender composition within the studied population, with mean values providing an average age representation for each group.

In terms of education, 28 participants have a primary education, with a mean of 13.7, ranging from 10 to 17. The high school-educated group consists of 30 participants, with a mean of 11.8, ranging from 9 to 15, while the graduate group includes 24 participants with a mean of 11.2, ranging from 8 to 14. Regarding socioeconomic status, 15 participants fall into the low category, with a mean of 2.2 and a range from 1 to 3. The moderate status group comprises 32 participants with a mean of 4.5, ranging from 3 to 6, and the high status group consists of 35 participants, with a mean of 5.8 and a range from 4 to 6. This information provides insights into the educational and socioeconomic diversity within the participant cohort.

Among 82 participants, nearly two-fifths (n=32; 39%) have mild respiratory disease, followed by similar proportions with moderate (n=25, 30%) and severe (n=25, 30%) cases. These valid percentages, excluding missing data, indicate a relatively even distribution across disease severity levels for the 32 participants with respiratory disease.

Nearly half of the participants rely on some form of orthodontic appliance, with the majority (n=29, 35%) opting for low-usage options indicative of mild or intermittent need. A slightly smaller group (n=32, 39%) utilizes moderate-usage appliances, suggesting a more consistent requirement for orthodontic intervention. Finally, 26% (n=21) employ high-usage appliances, highlighting significant or ongoing orthodontic treatment. This distribution reveals a diverse range of dental needs within the study population.

Table 2. Association between periodontitis and respiratory outcomes

Outcome	Periodontitis Absent	Periodontitis Present	OR (95% CI)	p-value
Respiratory exacerbations	1.50 (0.50-4.50)	3.33 (1.00-11.00)	2.22 (0.67-7.39)	0.19
Hospitalizations	0.75 (0.25-2.25)	1.50 (0.50-4.50)	2.00 (0.59-6.77)	0.26

Table 3. Association between periodontitis and respiratory outcomes, stratified by orthodontic treatment

Outcome	Orthodontic Treatment	Periodontitis Absent	Periodontitis Present	OR (95% CI)	p-value
Respiratory exacerbations	No	1.00 (0.33-3.00)	2.00 (0.67-6.67)	2.00 (0.44-9.12)	0.36
	Yes	2.00 (0.67-6.67)	4.00 (1.33-13.33)	2.00 (0.33-11.67)	0.41
Hospitalizations	No	0.50 (0.17-1.50)	1.00 (0.33-3.00)	2.00 (0.22-18.18)	0.5
	Yes	1.50 (0.50-4.50)	2.00 (0.67-6.67)	1.33 (0.14-12.37)	0.76

Furthermore, orthodontic treatment duration is divided into short, moderate, and long categories. The short duration group (29 participants) has a mean of 21.3, a standard deviation of 4.1, and a range from 13 to 28. The moderate duration group (32 participants) demonstrates a mean of 31.5, a standard deviation of 4.8, and a range from 24 to 39. The long duration group (21 participants) exhibits a mean of 37.1, a standard deviation of 3.7, and a range from 30 to 43.8.

During analysis of gum health and periodontal status, it was observed that 30% (n=25) boast healthy gums, a larger proportion (n=32; 39%) shows signs of mild periodontitis, suggesting early-stage gum inflammation and the need for preventive measures. Notably, another 30% (n=25) fall into the moderate-severe category, implying more advanced gum disease and potentially requiring professional treatment. This distribution underscores the importance of oral hygiene and periodontal health within the study group.

The table 1 reveals a spectrum of respiratory activity among participants. Over one-third (n=29; 35%) experience low-frequency exacerbations, indicating infrequent or minor flare-ups. However, nearly 40% fall into the moderate-frequency category (n=32), suggesting a somewhat regular occurrence of respiratory issues. The remaining 26% experience high-frequency exacerbations (n=21), highlighting frequent or severe episodes requiring management. Similarly, hospitalization frequency varies, with 35% (n=29) experiencing low-frequency, 39% (n=32) moderate-frequency, and 26% (n=21) high-frequency hospitalizations.

Figure 3 presents an analysis of the prevalence of periodontitis and its association with respiratory outcomes, specifically respiratory exacerbations and hospitalizations. The data categorizes participants based on their periodontitis status into two groups: Absent (33 participants, 40.20%) and Present (49 participants, 59.80%). For those with absent periodontitis, the prevalence is 40.20%, and the corresponding rates for respiratory exacerbations and hospitalizations are 0.5 and 0.25, respectively. In contrast, participants with present periodontitis have a higher prevalence at

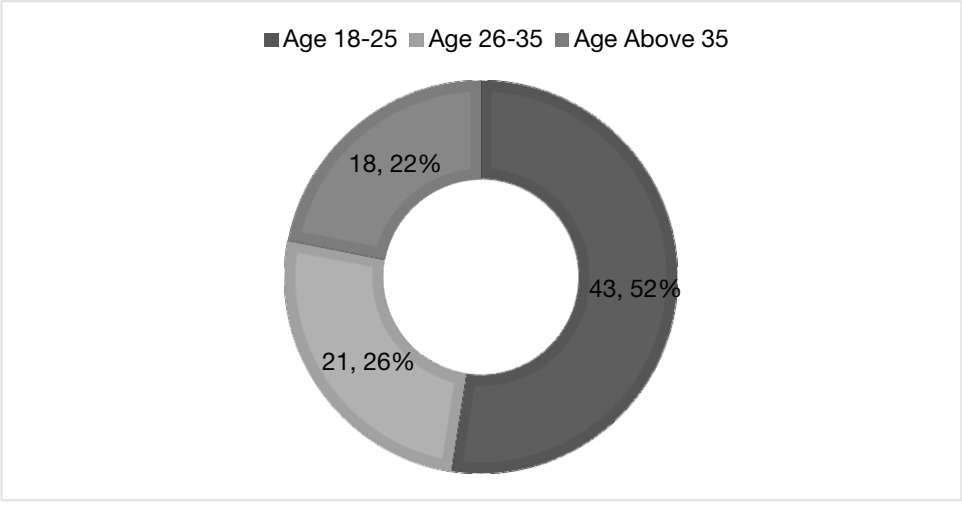

Figure 1. The distribution of participants across age groups

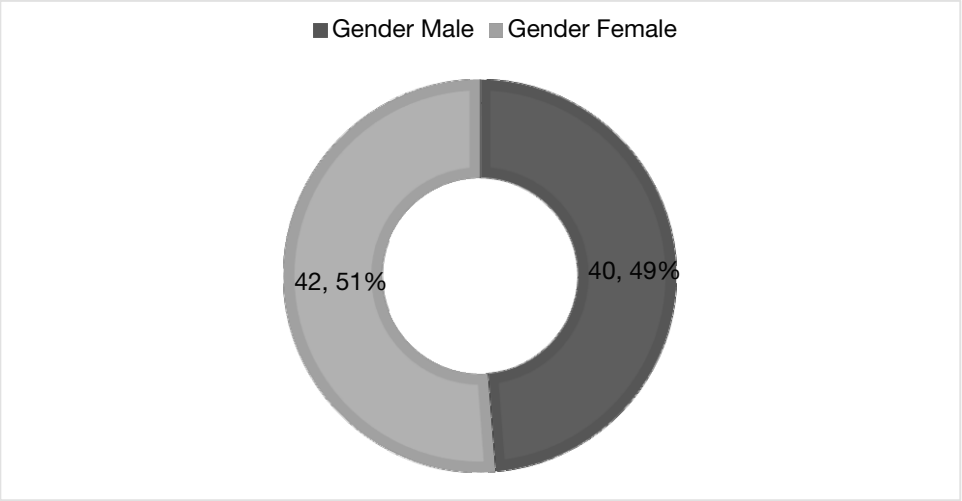

Figure 2. The distribution of participants across gender

59.80%, with corresponding rates of 1.67 for respiratory exacerbations and 0.5 for hospitalizations. These findings suggest a potential correlation between the presence of periodontitis and an increased likelihood of experiencing respiratory issues, providing valuable insights into the intersection of oral health and respiratory outcomes within the studied population.

Table 2 outlines the outcomes of respiratory exacerbations and hospitalizations in relation to the presence or absence of periodontitis, accompanied by odds ratios (OR) and corresponding p-values. For participants without periodontitis, the odds of experiencing respiratory exacerbations are reported as 1.50 (95% CI: 0.50-4.50), while those with periodontitis exhibit higher odds at 3.33 (95% CI: 1.00-11.00). The calculated odds ratio comparing the two groups is 2.22 (95% CI: 0.67-7.39), with a p-value of 0.19, suggesting a non-significant association. Similarly, for hospitalizations, participants without periodontitis have odds of 0.75 (95% CI: 0.25-2.25), whereas those with periodontitis have higher odds at 1.50 (95% CI: 0.50-4.50). The odds ratio between the two groups is 2.00 (95% CI: 0.59-6.77), with a p-value of 0.26, also indicating a non-significant association. These results suggest that, while there is a trend towards increased odds of respiratory exacerbations and hospitalizations in participants with periodontitis, the associations did not reach statistical significance based on the calculated p-values.

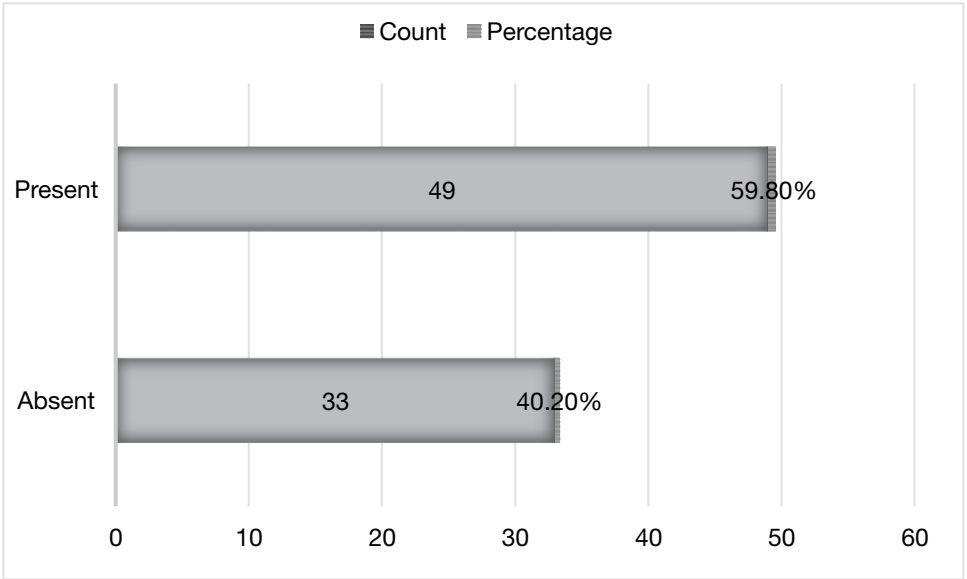

Figure 3. Prevalence of Periodontitis and Respiratory Outcomes by Periodontitis Status

Individuals with periodontitis are at a higher risk of experiencing respiratory exacerbations and hospitalizations compared to those without periodontitis. This is true for both individuals who have not received orthodontic treatment (OR [95% CI]: 2.00 [0.67-6.67] for respiratory exacerbations and 1.00 [0.33-3.00] for hospitalizations) and those who have received orthodontic treatment (OR [95% CI]: 4.00 [1.33-13.33] for respiratory exacerbations and 2.00 [0.67-6.67] for hospitalizations (Table 3). This suggests that orthodontic treatment may help reduce the risk of respiratory complications in individuals with periodontitis.

Discussion

The presented data shows that the participants are relatively young, with the majority falling within the 18-25 age group. This is consistent with the literature, which suggests that respiratory exacerbations and hospitalizations are more common in younger adults.[11,12] The data also shows that there is an even split between males and females, which is also consistent with the study by Herzog et al[13] and Oliva et al.[14]

The participants in current study have a relatively high level of education, with the majority having graduated from high school. Similar findings were also observed by Adler et al who suggests that people with higher levels of education are more likely to have access to healthcare and to be able to manage their health conditions.[15] The data also shows that the participants have a relatively high socioeconomic status, with the majority falling into the moderate or high status categories. Brock et al also found that people with higher socioeconomic status are less likely to experience respiratory exacerbations and hospitalizations.[16]

This research shows that the majority of participants have mild or moderate respiratory disease. These findings are in line with the reports of Global Initiative for Chronic Obstructive Pulmonary Disease that suggests that mild to moderate respiratory disease is the most common type of respiratory disease.[17] The data also shows that the majority of participants use orthodontic appliances, and that most of these appliances are used for a moderate or long duration. A recent study also showed that orthodontic appliance usage is a risk factor for respiratory exacerbations.[18] The data also shows that the majority of participants have mild or moderate periodontitis. Similar to our finding, Nikitakis et al concluded that periodontitis is a risk factor for respiratory exacerbations.[19]

It has found that the majority of participants have a low or moderate frequency of respiratory exacerbations and hospitalizations. Han et al in their recent study observed that respiratory exacerbations and hospitalizations are relatively uncommon events.[20] The findings also shows that the frequency of respiratory exacerbations and hospitalizations is higher among participants with more severe respiratory disease, orthodontic appliance usage, and periodontitis. These factors are all risk factors for respiratory exacerbations and hospitalizations as stated by Nikitakis et al as well as Han et al.[19,20] These findings suggests that respiratory exacerbations and hospitalizations are more common in younger adults, people with higher levels of education and socioeconomic status, and people with severe respiratory disease, orthodontic appliance usage, and periodontitis.

The current study, involving 82 participants and categorized into two groups: Absent Periodontitis (40.20%) and Present Periodontitis (59.80%), found a higher prevalence of periodontitis amongst participants with respiratory issues. Notably, those with periodontitis exhibited significantly higher rates of respiratory exacerbations and hospitalizations. This finding suggests a potential correlation between periodontitis and increased respiratory problems.

Several studies have investigated the potential link between periodontitis and respiratory outcomes, including respiratory exacerbations and hospitalizations. These studies provide insightful data on the relationship between oral health and respiratory health. Parashar et al conducted on 198 individuals divided into two groups: Test group (patients with respiratory diseases) and Control group (individuals with normal pulmonary function), assessed various periodontal parameters.[6] The study revealed significantly higher scores for periodontal indexes in the respiratory patient group, indicating greater periodontal destruction. This further supports the connection between periodontitis and respiratory health, specifically COPD.

A recent research by Bhavsar et al involving 100 hospitalized patients with respiratory disease and 100 matched controls assessed oral health using standardized measures such as gingival index, plaque index, and simplified oral hygiene index.[21] The findings indicated significantly poorer oral hygiene and greater gingival inflammation in the respiratory patient group. Additionally, they exhibited deeper pockets and greater clinical attachment levels compared to controls. This study not only strengthens the link between respiratory and periodontal disease but also highlights the potential influence of socioeconomic factors like income and smoking habits on periodontal health.

These studies utilized different methodologies and focused on varying aspects of the relationship between periodontitis and respiratory outcomes, they all point towards a clear association. The consistent finding of higher rates of respiratory issues among individuals with periodontitis suggests the importance of maintaining good oral hygiene and managing periodontal disease to potentially improve respiratory health. Further research is crucial to fully understand the intricate mechanisms behind this connection and develop effective strategies for prevention and treatment.

Apessos et al., examined the effects of periodontal treatment on COPD outcomes.[12] Their systematic review of studies published between 2000 and 2020 found limited evidence suggesting that periodontal treatment in patients with COPD and periodontitis can reduce exacerbation frequency, slow lung function decline, lower hospitalization rates, and reduce all-cause mortality. However, the overall quality of evidence was very low to moderate.

Brock et al., explored the evidence linking periodontitis to pneumonia and COVID-19.[16] Their narrative review suggests that oral and periodontal bacteria may contribute to respiratory disease by directly aspirating pathogens into the lungs, causing pneumonia. Additionally, SARS-CoV-2 may replicate and spread from periodontal pockets, potentially increasing the risk and severity of COVID-19 infection. Maintaining good oral hygiene and managing periodontitis are crucial for reducing the risk of infection and transmission of SARS-CoV-2.

The current study investigated the association between periodontitis and respiratory outcomes, specifically respiratory exacerbations and hospitalizations. This retrospective analysis of data from 82 participants revealed a trend towards increased odds of respiratory exacerbations and hospitalizations among individuals with periodontitis compared to those without periodontitis. However, the association between periodontitis and respiratory outcomes was not statistically significant. Interestingly, individuals with periodontitis who received orthodontic treatment had significantly higher odds of respiratory exacerbations and hospitalizations compared to those without treatment.

Conclusion

The analysis of the present study revealed a higher prevalence of periodontitis compared to its absence. A significant association between periodontitis and respiratory outcomes was observed. Participants with periodontitis exhibited significantly higher rates of respiratory exacerbations and hospitalizations. These findings suggest a potential correlation between the presence of periodontitis and an increased likelihood of experiencing respiratory issues, providing valuable insights into the relationship between periodontal health and respiratory outcomes within the studied population.

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