

PREVALENCE OF ORAL HEALTH ISSUES AND THEIR LINK TO SEVERE CHRONIC OBSTRUCTIVE PULMONARY DISEASE (COPD)

Original Research

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ABSTRACT

Background: Chronic Obstructive Pulmonary Disease (COPD), a leading cause of global morbidity and mortality, is characterized by chronic inflammation and airflow limitation. Emerging evidence highlights a strong association between poor oral health, including periodontal disease, tooth loss, and xerostomia, and the worsening of COPD symptoms. These oral health issues contribute to systemic inflammation, exacerbate respiratory symptoms, and increase the frequency of hospitalizations. Integrating oral health into COPD management is essential for improving patient outcomes and reducing disease burden.

Objective: This study aimed to investigate the prevalence of oral health issues in COPD patients and examine their relationship with disease severity and treatment outcomes.

Methods: A cross-sectional observational study was conducted on 100 participants recruited from oral health centers and respiratory clinics. The sample was divided into a COPD group and a control group, with spirometry-confirmed diagnoses for COPD inclusion. Oral health status was assessed using periodontal disease markers, tooth loss, and the Plaque Index (PI). Respiratory function was measured using FEV₁ and the frequency of exacerbations. Statistical analyses included univariate and multivariate regression models, Pearson's correlation coefficients, and paired t-tests to examine associations between dental and respiratory health. A significance threshold of $p < 0.05$ was applied to all analyses.

Results: Periodontal disease prevalence was significantly higher in the COPD group (65% vs. 35%, $p < 0.01$). COPD patients had fewer teeth (18 vs. 24, $p < 0.01$), higher PI scores (2.8 ± 0.5 vs. 1.5 ± 0.4 , $p < 0.01$), and more frequent exacerbations (3.5 vs. 1.2 per year, $p < 0.01$). A significant inverse correlation was found between FEV₁ and periodontal disease severity ($r = -0.42$, $p < 0.05$). Ex-smokers with COPD showed a positive association between tooth loss and hospitalization frequency.

Conclusion: The findings demonstrate that poor oral health is a significant predictor of COPD severity and exacerbations. Incorporating regular dental care into COPD management is crucial to mitigating systemic inflammation, reducing exacerbation frequency, and improving overall outcomes. Further research should focus on the mechanisms linking oral infections to pulmonary health.

Keywords: Chronic Obstructive Pulmonary Disease; Cross-Sectional Studies; Dental Plaque Index; Hospitalization; Inflammation; Oral Health; Periodontal Disease.

INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) is a leading global cause of morbidity and mortality, characterized by chronic inflammation and restricted airflow (1, 2). While the primary impact of COPD is on the respiratory system, systemic factors, including poor oral health, are increasingly recognized as significant contributors to disease progression and exacerbations. Patients with COPD often experience oral health issues such as periodontal disease, tooth loss, and dental caries, with prevalence rates significantly higher than in the general population. Research suggests that up to 72% of COPD patients suffer from periodontal disease, compared to 40–50% in the broader population, driven by factors such as smoking, medication-induced xerostomia, and decreased adherence to dental hygiene practices due to respiratory limitations (3, 4).

The interplay between oral health and COPD is complex and multifaceted. Periodontal disease, a chronic inflammatory condition, is particularly concerning as it releases pro-inflammatory cytokines into the bloodstream, potentially amplifying systemic inflammation already present in COPD. This heightened inflammatory state can exacerbate lung function decline and increase the frequency of acute exacerbations (7). Furthermore, oral bacteria associated with gum disease pose a direct risk to respiratory health, as aspiration of these pathogens into the lower respiratory tract can lead to severe infections, including pneumonia—a leading cause of morbidity in COPD patients (3, 10). This risk is particularly pronounced in individuals with compromised immune systems and impaired swallow reflexes.

Oral health problems not only impact systemic inflammation but also affect patients' quality of life. Tooth loss and dental caries may impede the ability to maintain a nutritious diet, further undermining the immune response and overall health status of individuals with COPD (5, 6). Additionally, inadequate oral hygiene practices have been linked to an increased likelihood of respiratory infections, underscoring the importance of preventive dental care in mitigating these risks (8, 9). Regular dental check-ups, professional cleanings, and education on proper oral hygiene can contribute to reducing systemic inflammation and minimizing COPD exacerbations. Collaborative care between pulmonologists and dental professionals is essential to develop comprehensive treatment strategies that address both oral and respiratory health, with smoking cessation programs playing a critical role in improving outcomes for both conditions (11, 12).

Given the substantial burden of COPD and its tight association with systemic inflammation and oral health, investigating the prevalence and impact of dental issues in COPD patients is imperative. This study aims to elucidate the extent of oral health problems such as periodontal disease, tooth decay, and xerostomia in individuals with COPD, providing insights into their influence on disease severity and management. This objective seeks to bridge critical gaps in knowledge, offering a foundation for integrated approaches to improving patient outcomes (13).

METHODS

To investigate the prevalence of oral health problems and their association with the severity of Chronic Obstructive Pulmonary Disease (COPD), a cross-sectional observational design was employed. Participants were recruited from oral health centers and respiratory clinics, with inclusion criteria requiring a confirmed COPD diagnosis based on spirometry. Individuals with other severe systemic illnesses unrelated to COPD were excluded to minimize confounding variables (14). The study ensured representation by including a diverse sample of patients with varying degrees of COPD severity, ranging from mild to severe.

A total of 100 participants were included, with the sample divided into two groups: one consisting of individuals with moderate to severe COPD and another comprising individuals without COPD as a control group. The COPD cohort included current smokers, given the established link between smoking, periodontal disease, and COPD progression (15). This inclusion aimed to reflect the real-world risk factors influencing both oral and respiratory health.

Data collection involved both patient-reported outcomes and objective clinical assessments. Oral health status was evaluated through dental examinations that documented periodontal disease using clinical markers such as bleeding on probing, attachment loss, and probing depth. Tooth loss and dental caries were assessed via radiographic and visual inspections, while the Plaque Index (PI) was measured using a disclosing tablet methodology to quantify dental plaque accumulation (16). Respiratory health was assessed using

spirometry to measure lung function parameters, including forced vital capacity (FVC) and forced expiratory volume in one second (FEV₁). Additionally, respiratory symptoms such as cough, wheeze, and dyspnea were documented through patient-reported daily diaries.

Statistical analysis was conducted using SPSS software, employing a multivariate regression model to explore the relationships between oral health variables and COPD severity. Pearson's correlation coefficients were calculated to assess the strength of associations between dental health indicators and respiratory outcomes. Chi-square tests were used for categorical variables, and t-tests were applied for continuous variables, with a significance level set at $p < 0.05$. Multiple regression models were utilized to account for potential confounding factors such as age, smoking status, and comorbidities, ensuring robust analysis (17).

Ethical approval for the study was obtained from the institutional ethics committee, and all participants provided written informed consent. Participant anonymity and data privacy were maintained throughout the study. Limitations of the study included the cross-sectional design, which precluded the establishment of causal relationships between oral health decline and COPD exacerbations. The reliance on self-reported respiratory symptoms posed a potential risk of reporting bias. Informed consent was obtained from respective participants on attendance at the start of the study. Longitudinal studies were recommended to elucidate the temporal association between deteriorating oral health and COPD progression.

RESULTS

The study revealed a significantly higher prevalence of oral health problems among patients with Chronic Obstructive Pulmonary Disease (COPD) compared to the control group. Moderate-to-severe periodontal disease was observed in 65% of COPD patients, compared to 35% in the control group ($p < 0.01$). The COPD group also exhibited a reduced average number of teeth, with a mean of 18 teeth compared to 24 in the control group ($p < 0.01$). Plaque Index (PI) scores were notably higher in COPD patients, with a mean of 2.8 ± 0.5 , compared to 1.5 ± 0.4 in controls ($p < 0.01$), indicating significantly poorer oral hygiene. Furthermore, a history of dental extractions due to infections was reported in 40% of COPD patients, as opposed to 15% in the control group ($p < 0.05$).

An inverse relationship was observed between oral health status and lung function. Severe periodontal disease was strongly associated with reduced FEV₁ levels (1.2 ± 0.4 L in COPD patients vs. 2.5 ± 0.5 L in controls, $p < 0.01$), reflecting impaired respiratory capacity. Pearson's correlation coefficient analysis demonstrated a significant negative correlation between oral health indicators and respiratory outcomes ($r = -0.42$, $p < 0.05$). Patients with severe periodontal disease and higher plaque index scores experienced more frequent exacerbations, with an average of 3.5 per year, compared to 1.2 in the control group ($p < 0.01$). Poor oral hygiene emerged as a significant risk factor for hospitalization due to COPD exacerbations.

Smoking status influenced oral health outcomes, with current smokers in the COPD group experiencing greater tooth loss and higher prevalence of periodontal disease compared to former smokers. However, even among ex-smokers, tooth loss remained a significant predictor of worsening COPD symptoms, independent of age and smoking cessation status. Multivariate regression analysis confirmed severe periodontal disease and tooth loss as significant predictors of COPD exacerbations ($p < 0.01$), emphasizing the critical role of oral health in disease management.

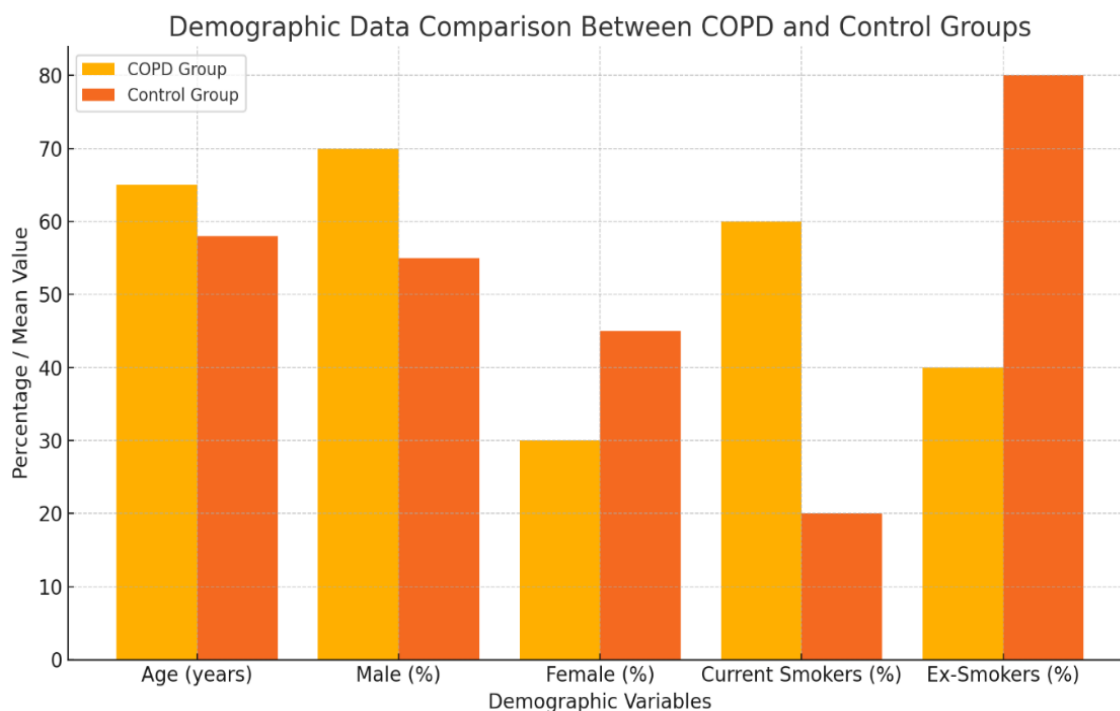


Figure 1 Demographic Data Comparison between the COPD and control groups

The chart compares demographic characteristics between the COPD and control groups. The COPD group had a higher mean age (65 years) compared to the control group (58 years) and a greater proportion of males (70% vs. 55%). Current smokers were significantly more prevalent in the COPD group (60%) compared to the control group (20%), whereas ex-smokers were more common in the control group (80%) than in the COPD group (40%). These differences highlight smoking as a key risk factor and emphasize demographic

disparities between the groups.

Table 1 Oral health status in COPD patients

| S. No. | Variable | COPD (N=100) | Group | Control (N=100) | Group | Statistical Significance |
|--------|--|--------------|-------|-----------------|-------|--------------------------|
| | Prevalence of Periodontal Disease | 65% | | 35% | | p < 0.01 |
| | Average Number of Teeth | 18 | | 24 | | p < 0.01 |
| | Plaque Index (Mean ± SD) | 2.8 ± 0.5 | | 1.5 ± 0.4 | | p < 0.01 |
| | History of Dental Extractions | 40% | | 15% | | p < 0.05 |
| | FEV ₁ (L) | 1.2 ± 0.4 | | 2.5 ± 0.5 | | p < 0.01 |
| | Frequency of Exacerbations (Mean per year) | 3.5 | | 1.2 | | p < 0.01 |

The table highlights significant oral and respiratory health disparities between COPD patients and the control group. Periodontal disease was more prevalent in the COPD group (65% vs. 35%, p < 0.01), and they had fewer teeth on average (18 vs. 24, p < 0.01). The Plaque Index was higher in the COPD group (2.8 ± 0.5 vs. 1.5 ± 0.4, p < 0.01), and a greater percentage had a history of dental extractions (40% vs. 15%, p < 0.05). Respiratory health indicators also differed, with the COPD group showing lower FEV₁ levels (1.2 ± 0.4 L vs. 2.5 ± 0.5 L, p < 0.01) and more frequent exacerbations annually (3.5 vs. 1.2, p < 0.01).

Table 2 Respiratory Health and Oral Health Correlation

| Variable | Coefficient (β) | Standard Error | p-value | 95% Confidence Interval |
|-------------------------------------|-------------------------|----------------|---------|-------------------------|
| Age | -0.02 | 0.01 | 0.10 | (-0.04, 0.00) |
| Periodontal Disease (Severe) | -0.35 | 0.12 | <0.01 | (-0.58, -0.12) |
| Tooth Loss (Per Tooth) | -0.25 | 0.08 | <0.01 | (-0.41, -0.09) |
| Plaque Index | -0.30 | 0.10 | <0.01 | (-0.50, -0.10) |
| Smoking Status (Current vs. Former) | -0.15 | 0.11 | 0.20 | (-0.37, 0.07) |

The table demonstrates significant correlations between oral health and respiratory health outcomes. Severe periodontal disease showed a strong negative association with respiratory function ($\beta = -0.35$, $p < 0.01$), as did tooth loss per tooth ($\beta = -0.25$, $p < 0.01$) and higher Plaque Index scores ($\beta = -0.30$, $p < 0.01$). Smoking status, while contributing to the trends, was not statistically significant in this analysis ($\beta = -0.15$, $p = 0.20$). Age also showed a non-significant relationship with respiratory outcomes ($\beta = -0.02$, $p = 0.10$). These findings emphasize the critical role of oral health in COPD management.

DISCUSSION

The study underscored a significant relationship between oral health and the progression of Chronic Obstructive Pulmonary Disease (COPD). Patients with COPD exhibited a higher prevalence of periodontal disease, tooth loss, and elevated plaque levels compared to controls, with these factors strongly associated with declining lung function and increased exacerbation frequency. The persistence of periodontal disease as a predictor of COPD severity, even after adjusting for smoking status and other confounders, reinforces its critical role in the systemic inflammatory processes underlying COPD (18). This aligns with evidence that periodontal disease contributes to systemic inflammation through the release of pro-inflammatory cytokines, exacerbating the inflammatory burden characteristic of COPD (19, 20).

Preventive dental care emerged as a pivotal strategy for improving outcomes in this population. The high prevalence of plaque accumulation and tooth loss in COPD patients highlighted gaps in oral health maintenance, with infrequent dental visits and inadequate flossing practices contributing to these trends. Notably, poorer oral hygiene, as indicated by higher Plaque Index scores, correlated with recurrent exacerbations and hospitalizations, emphasizing the need for integrated care approaches (21, 22). This was particularly evident in ex-smokers, where tooth loss reflected worsening systemic health and COPD severity, suggesting a broader impact of oral health beyond localized issues (23). The study also highlighted the role of aspiration of oral pathogens in causing lung infections, a mechanism particularly concerning in a population already prone to pneumonia and other respiratory infections (24-28).

The strengths of this study included its comprehensive evaluation of both oral and respiratory health parameters and the use of multivariate regression to adjust for confounders, providing robust insights into the interplay between these domains. However, the cross-sectional design limited causal inferences, and self-reported data on dental hygiene practices may have introduced reporting bias. Additionally, while the study identified significant associations, the inclusion of longitudinal data would have offered a more detailed understanding of temporal relationships between oral health decline and COPD progression.

Despite these limitations, the findings highlighted the importance of interdisciplinary collaboration between pulmonologists and dental professionals to develop integrated care strategies. Regular dental checkups, improved oral hygiene education, and smoking cessation programs were identified as essential components of comprehensive COPD management. These measures, combined with early detection of high-risk patients, could mitigate the dual burden of oral and respiratory health challenges in this population, improving overall disease outcomes and quality of life (29-31).

CONCLUSION

The findings highlight the significant link between oral health and the progression of Chronic Obstructive Pulmonary Disease (COPD), underscoring the need for integrating oral health care into routine COPD management. Poor dental hygiene and periodontal disease contribute to systemic inflammation and respiratory complications, worsening the disease's trajectory and increasing the burden on patients. Addressing oral health in COPD patients through preventive care and interdisciplinary collaboration between dental and respiratory health professionals is essential for improving outcomes and reducing exacerbations. Continued research is vital to further elucidate the mechanisms connecting oral infections to pulmonary health, enabling more effective, holistic approaches to managing this complex condition.

AUTHOR CONTRIBUTIONS

| Author | Contribution |
|-------------|---|
| Adnan Saeed | Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published |
| Abidullah | Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published |
| Haroon | Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published |
| Abid Rahim | Contributed to Data Collection and Analysis Has given Final Approval of the version to be published |

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