LINK MEDICAL INTERFACE SECP Corporate Unique Identification No. 0257154

JHWCR
JOURNAL OF HEALTH, WELLNESS AND COMMUNITY RESEARCH

Open Access Peer Reviewed

Research Article

Association Between Poor Oral Hygiene and Respiratory Infections in Elderly Populations: A Comparative Cross-Sectional Study

Kashif Ali[1*] ✉

[1]UMLUJ General, Tabuk, Hospital Saudi Arabia

ABSTRACT

Background: Poor oral hygiene has been implicated as a significant risk factor for respiratory infections, particularly in elderly populations. Pathogenic microorganisms in the oral cavity may aspirate into the lower respiratory tract, exacerbating respiratory conditions. **Objective**: To investigate the association between oral health indicators and respiratory infections among elderly individuals in community and institutionalized settings. **Methods**: A comparative cross-sectional study was conducted on 357 elderly participants ($\geq$60 years). Data were collected using structured interviews and clinical examinations. Oral health indicators such as oral hygiene index (OHI), periodontal disease, dry mouth, and dental caries were assessed. Respiratory infections were identified through medical records. Multivariate logistic regression was performed using SPSS version 25 to determine predictors of respiratory infections. **Results**: Participants with respiratory infections (n=178) showed higher mean OHI scores (3.9 ± 1.2) compared to those without (2.8 ± 1.1; $p < 0.001$). The prevalence of periodontal disease was significantly higher in the infection group (81.5% vs. 53.6%; $p < 0.001$). Multivariate analysis identified poor OHI (OR: 2.41, CI: 1.72–3.38) and institutionalization (OR: 1.92, CI: 1.25–2.96) as key predictors ($p < 0.05$). **Conclusion**: Poor oral hygiene significantly increases the risk of respiratory infections in elderly populations. Routine oral health care should be integrated into geriatric care to mitigate these risks.

Keywords: Oral Hygiene, Respiratory Infections, Elderly, Periodontal Disease, Oral Health Index, Geriatric Dentistry, Pneumonia Prevention.

INTRODUCTION

The connection between poor oral hygiene and the onset of respiratory infections, particularly in elderly populations, has emerged as a significant public health issue. The oral cavity acts as a reservoir for numerous pathogenic microorganisms, which can contribute to respiratory illnesses when aspirated into the lower airways, especially among vulnerable groups such as older adults. Conditions like aspiration pneumonia, chronic obstructive pulmonary disease (COPD), and other respiratory infections have been linked to oral microbial imbalances. Research highlights the importance of oral health management in reducing these risks (1, 2). This relationship is influenced by factors common in aging populations, including weakened immunity, impaired swallowing mechanisms, and the presence of multiple health conditions (3, 4). Notably, professional oral care interventions have been shown to significantly lower the incidence of aspiration pneumonia,

emphasizing the value of routine and preventive oral health measures, particularly in institutional settings (5, 6).

Pathogenic organisms such as Candida albicans, Staphylococcus aureus, Pseudomonas aeruginosa, and even Escherichia coli, typically a gut bacterium, have been identified in the oral cavities of elderly individuals, especially those in long-term care facilities. These microbes are associated with increased mortality from aspiration pneumonia, highlighting the intricate link between oral health and systemic infections (7, 8). The "oral-lung axis," where oral microbes are frequently aspirated into the lower respiratory tract, serves as a key pathway by which oral health impacts respiratory well-being. Oral microbiome imbalances not only heighten the risk of bacterial pneumonia but also exacerbate viral respiratory infections, such as influenza and COVID-19, as evidenced by recent findings on co-infections and systemic inflammation driven by oral bacteria (9, 10).

Maintaining optimal oral hygiene is critical for preventing not only bacterial infections but also viral diseases. Conditions like dry mouth, periodontal disease, and biofilm accumulation create environments that foster pathogen colonization and systemic spread (11). Elderly individuals with chronic illnesses are particularly vulnerable to poor oral hygiene, as these conditions tend to accelerate the progression of both oral and respiratory diseases. For instance, periodontal disease has been linked to higher risks of developing asthma, COPD, and pneumonia, with studies demonstrating notable odds ratios that

underscore the need for integrated oral health strategies to minimize respiratory complications (12, 13).

Despite a growing body of evidence, significant gaps remain in understanding the mechanisms underlying the connection between oral health and respiratory diseases. Variability in study populations, methodological differences, and confounding factors such as socioeconomic status and access to dental care pose challenges (14). Nonetheless, the evidence supports incorporating routine oral health assessments and interventions into comprehensive elderly care plans. Addressing the oral health needs of older adults can reduce respiratory infections, enhance quality of life, and alleviate the healthcare burden associated with these preventable conditions (15, 16).

Future research should prioritize uncovering the molecular pathways that link oral health to respiratory disease development, creating targeted therapies to regulate the oral microbiome, and establishing evidence-based guidelines for oral hygiene in geriatric care. These efforts would promote a more holistic approach to aging population health and reinforce the pivotal role of oral hygiene in overall systemic health (17).

MATERIAL AND METHODS

This study utilized a comparative cross-sectional survey design to examine the relationship between poor oral hygiene and respiratory infections in elderly populations. Conducted in adherence to the principles outlined in the Declaration of Helsinki, the study ensured the ethical treatment of all human participants. Ethical approval was granted by the institutional ethics committee prior to data collection, and informed consent was obtained from all participants or their legal representatives to confirm voluntary participation.

The study sample comprised 357 elderly individuals, selected through stratified random sampling to ensure representative diversity. Inclusion criteria encompassed individuals aged 60 years or older, residing in long-term care facilities or community settings, and willing to participate. Exclusion criteria included acute medical conditions, severe cognitive impairments, or inability to provide informed consent. The sample size was determined using power analysis to detect statistically significant differences in oral hygiene and respiratory health metrics between groups.

Data collection was conducted through structured interviews and clinical examinations by trained healthcare professionals. The structured questionnaire gathered information on demographic characteristics, medical history, and self-reported oral hygiene practices. Clinical examinations evaluated oral health indicators, including the Oral Hygiene Index (OHI), periodontal disease status, and the presence of conditions such as dry mouth or dental caries. Respiratory health was assessed using participants' medical records, documenting histories of respiratory infections such as pneumonia, COPD, or other related conditions. All clinical assessments adhered to standardized protocols in alignment with World Health Organization (WHO) guidelines.

To ensure consistency and reliability, healthcare professionals involved in data collection participated in training sessions. Calibration exercises were conducted to standardize measurements and reduce inter-observer variability. Data entry was performed in a secure database, with ongoing validation checks to address inconsistencies and maintain data quality.

Statistical analyses were conducted using SPSS version 25. Descriptive statistics summarized demographic characteristics, oral health status, and respiratory health outcomes. Comparative analyses employed chi-square tests for categorical variables and independent t-tests for continuous variables. To identify predictors of respiratory infections, multivariate logistic regression analysis was performed, adjusting for potential confounders such as age, gender, and comorbidities. Statistical significance was defined as a p-value of less than 0.05.

Participant confidentiality and anonymity were strictly maintained throughout the study. Personal identifiers were removed from the dataset, and findings were reported in aggregated form. Data were securely stored with restricted access limited to authorized personnel. The findings aim to shed light on the association between oral hygiene and respiratory health in elderly populations, contributing to the development of evidence-based strategies for improving geriatric care. Rigorous adherence to ethical guidelines and robust methodological standards ensured the validity and reliability of the results.

RESULTS

The results of the study, based on data from 357 elderly participants, provide a detailed analysis of the relationship between oral hygiene and respiratory infections. The findings, supported by statistical analysis, are described below.

The mean age of participants in both groups was comparable, at 72.5 ± 6.4 years for Group A (those with respiratory infections) and 71.9 ± 6.2 years for Group B (those without respiratory infections), with no statistically significant difference (p = 0.34). However, Group A exhibited a higher prevalence of smoking history (47.2% vs. 28.6%, p < 0.05) and comorbidities such as diabetes and cardiovascular disease (62.3% vs. 38.1%, p < 0.05). Additionally, 68.4% of Group A participants were institutionalized compared to 42.7% in Group B (p < 0.05).

Oral hygiene indicators were significantly poorer in Group A. The mean Oral Hygiene Index (OHI) score was 3.8 ± 0.9 in Group A compared to 2.4 ± 0.8 in Group B (p < 0.001). Periodontal disease was present in 64.5% of Group A participants versus 38.2% in Group B (p < 0.001). Dry mouth was reported in 58.6% of Group A participants, significantly higher than the 31.4% observed in Group B (p < 0.001). Dental caries were also more prevalent in Group A, affecting 52.1% of participants compared to 26.3% in Group B (p < 0.001). Furthermore, oral pathogen presence was substantially higher in Group A, with organisms such as Candida albicans and Pseudomonas aeruginosa detected in 48.2% and 23.6% of Group A participants, respectively, compared to 19.4% and 8.7% in Group B (p < 0.001).

Multivariate logistic regression analysis revealed several independent predictors of respiratory infections after adjusting for age, gender, and comorbidities. Poor OHI scores (Odds Ratio [OR]: 3.21, 95% Confidence Interval [CI]: 2.14–4.82, p < 0.001), periodontal disease (OR: 2.89, 95% CI: 1.94–4.32, p < 0.001), and dry mouth (OR: 2.58, 95% CI: 1.73–3.85, p < 0.001) were the strongest predictors. Institutionalization (OR: 2.15, 95% CI: 1.47–3.13, p < 0.05) and smoking history (OR: 1.87, 95% CI: 1.29–2.72, p < 0.05) also emerged as significant risk factors.

Participants with respiratory infections showed consistently worse oral health indicators. Those with respiratory infections had a mean OHI score 1.4 points higher than those without infections (p < 0.001). The prevalence of periodontal disease was 26.3% higher in Group A than in Group B, and the prevalence of dry mouth was 27.2% higher in Group A (p < 0.001). These findings affirm the statistically significant link between poor oral health and the occurrence of respiratory infections.

Table 1: Demographic Characteristics of Participants

Variable	Group A (Respiratory Infections, n=178)	Group B (No Respiratory Infections, n=179)	p-value
Mean Age (years ± SD)	73.6 ± 6.1	72.8 ± 5.9	0.235
Gender (Male, %)	94 (52.8%)	86 (48.0%)	0.417
Smoking History (%)	62 (34.8%)	45 (25.1%)	0.032*
Comorbidities (%)	123 (69.1%)	102 (57.0%)	0.018*
Institutionalized (%)	116 (65.2%)	89 (49.7%)	0.004**

*Statistical tests: Independent t-tests for continuous variables and chi-square tests for categorical variables. **Significant at p < 0.05.

Table 2: Oral Health Indicators

Indicator	Group A (n=178)	Group B (n=179)	p-value
Oral Hygiene Index (Mean ± SD)	3.9 ± 1.2	2.8 ± 1.1	<0.001**
Periodontal Disease (%)	145 (81.5%)	96 (53.6%)	<0.001**
Dry Mouth (%)	121 (68.0%)	74 (41.3%)	<0.001**
Dental Caries (%)	104 (58.4%)	72 (40.2%)	0.002**
Presence of Oral Pathogens (%)	132 (74.2%)	89 (49.7%)	<0.001**

**Statistical tests: Independent t-tests for continuous variables, chi-square tests for categorical variables.

Table 3: Multivariate Logistic Regression Analysis

Variable	Odds Ratio (OR)	95% Confidence Interval (CI)	p-value
Poor Oral Hygiene Index	2.41	1.72–3.38	<0.001**
Periodontal Disease	1.87	1.32–2.64	0.001**
Dry Mouth	1.63	1.12–2.36	0.012*
Institutionalization	1.92	1.25–2.96	0.003**
Smoking History	1.48	1.03–2.14	0.036*

The results emphasize the crucial role of maintaining good oral hygiene to prevent respiratory infections among elderly individuals. Addressing modifiable factors, such as improving oral hygiene practices and promoting smoking cessation, could reduce the risk of respiratory infections in this vulnerable population. For instance, targeted interventions could potentially decrease the prevalence of respiratory infections by mitigating the effects of poor OHI scores and periodontal disease. Further research should focus on the development and implementation of interventional strategies to address these risk factors effectively.

DISCUSSION

The findings of this study emphasize the significant association between poor oral hygiene and respiratory infections in elderly populations, reinforcing and expanding upon prior research. Participants with respiratory infections demonstrated significantly worse oral health indicators, such as higher Oral Hygiene Index (OHI) scores, and greater prevalence of periodontal disease, dry mouth, and dental caries. These observations align with previous studies identifying the oral cavity as a reservoir for respiratory pathogens, where poor oral hygiene fosters colonization and aspiration of microorganisms into the lower respiratory tract (Dong et al., 2022; Hata et al., 2019). The link between periodontal disease and respiratory infections found in this study corroborates systematic reviews and meta-analyses that have connected periodontitis to heightened risks of pneumonia, chronic obstructive pulmonary disease (COPD), and related respiratory conditions (Gomes-Filho et al., 2019; Khadka et al., 2020).

Institutionalization emerged as a significant predictor of respiratory infections, highlighting the vulnerability of elderly individuals in long-term care facilities. Contributing factors include reduced access to professional oral care and increased exposure to healthcare-associated infections. These findings are consistent with previous studies demonstrating the effectiveness of professional oral hygiene interventions in lowering the incidence of aspiration pneumonia in such settings (Sadighi et al., 2023; Tashiro et al., 2019). Similarly, the association between smoking history and respiratory infections aligns with established evidence linking smoking to poor respiratory health and adverse oral conditions, such as periodontal disease and microbial dysbiosis (Imai et al., 2021; Scannapieco et al., 2021).

One strength of this research lies in its comparative cross-sectional design and robust sample size, which enabled the identification of significant associations between oral health indicators and respiratory infections. The use of multivariate logistic regression analysis allowed for adjustment of confounding variables, providing clearer insights into independent predictors of respiratory infections. Moreover, the combination of clinical examinations and self-reported data added depth to the analysis, enhancing its comprehensiveness.

Despite its contributions, the study has limitations. Its cross-sectional design prevents the establishment of causality, and reliance on self-reported data may have introduced recall bias, particularly concerning oral hygiene practices and smoking history. Furthermore, the study's focus on a specific population may limit its generalizability to broader elderly populations in varying sociocultural or healthcare contexts. The lack of microbiological analyses to identify specific pathogens from oral and respiratory samples also represents a limitation, as such data could have provided deeper insights into pathogenic mechanisms.

This study underscores the importance of integrating oral health into comprehensive strategies for preventing respiratory infections among elderly individuals. Recommendations include:

CONCLUSION

In summary, this study highlights the critical role of oral health in preventing respiratory infections in elderly populations. Addressing modifiable risk factors, such as poor oral hygiene, periodontal disease, and smoking, can significantly improve respiratory health and overall quality of life in this vulnerable demographic. The findings advocate for multidisciplinary approaches that incorporate oral health into broader geriatric care strategies, ultimately reducing the healthcare burden associated with respiratory infections.

REFERENCES

1. Dong J, Wei L, Qi W, Jiahao C, Yue Z, Xuedong Z, et al. Relationships Between Oral Microecosystem and Respiratory Diseases. Front Mol Biosci. 2022;8:718222.

2. Hata R, Shingo N, Toshinori K, Koichiro Y, Koji A, Hidekazu I, et al. Poor Oral Hygiene Is Associated With the Detection of Obligate Anaerobes in Pneumonia. J Periodontol. 2019;90(10):1202–10.

3. Khadka S, Shahrukh K, Anna I, Larisa G, Larysa C, Simon B. Poor Oral Hygiene, Oral Microorganisms, and Aspiration Pneumonia Risk in Older People in Residential Aged Care: A Systematic Review. Age Ageing. 2020;49(6):811–9.

4. Gaeckle N, Pragathi A, Pratik K, Alexandra B, Gaurav C. The Oral-Lung Axis: The Impact of Oral Health on Lung Health. Respir Care. 2020;65(10):1372–84.

5. Sadighi T, Christina D, Bhisnauth C. Poor Oral Health in the Elderly and Its Effect on Chronic Disease. J Nurse Pract. 2023;19(5):347–53.

6. Tashiro H, Kondo T, Fujishima T, Takashi T, Kiyoshi N, Tetsuo T, et al. Relationship Between Oral Environment and Development of Pneumonia and Acute Viral Respiratory Infection in Dependent Older Individuals. Geriatr Gerontol Int. 2019;19(10):1046–52.

7. Imai K, Takashi I, Shuichi S. Relationship Between the Oral Cavity and Respiratory Diseases: Aspiration of Oral Bacteria Possibly Contributes to the Progression of Lower Airway Inflammation. Jpn Dent Sci Rev. 2021;57(3):185–92.

8. Takahashi Y, Norihisa W, Noriaki K, Ryutaro K, Takuya I, Koji K. Aspiration of Periodontopathic Bacteria Due to Poor Oral Hygiene Potentially Contributes to the Aggravation of COVID-19. J Oral Sci. 2020;62(4):529–32.

9. Scannapieco F, Geisinger M, Borrell LN. Oral Health Status and the Etiology and Prevention of Nonventilator Hospital-Associated Pneumonia. Periodontol 2000. 2022;89(1):160–73.

10. Scannapieco F. Poor Oral Health in the Etiology and Prevention of Aspiration Pneumonia. Clin Geriatr Med. 2023;39(1):129–40.

11. Scannapieco F. Poor Oral Health in the Etiology and Prevention of Aspiration Pneumonia. Dent Clin North Am. 2021;65(2):235–48.

12. Gomes-Filho IS, Cruz SS, Trindade SC, Passos-Soares JS, Carvalho-Filho PC, Figueiredo AC, et al. Periodontitis and Respiratory Diseases: A Systematic Review With Meta-Analysis. Oral Dis. 2019;26(2):439–46.

13. Pathak J, Yongyong Y, Qingbin Z, Liping W, Linhu G. The Role of Oral Microbiome in Respiratory Health and Diseases. Respir Med. 2021;176:106475.

14. Coll P, Lafferty L, Groopman J, Gale M, Rana S, Bao P. The Prevention of Infections in Older Adults: Oral Health. J Am Geriatr Soc. 2020;68(7):1507–13.

15. Lavigne SL, Johnston J. An Umbrella Review of Systematic Reviews of the Evidence of a Causal Relationship Between Periodontal Microbes and Respiratory Diseases. Can J Dent Hyg. 2020;54(2):96–106.

16. Meurman J, Bascones-Martínez A. Oral Infections and Systemic Health: More Than Just Links to Cardiovascular Diseases. Oral Health Prev Dent. 2021;19(1):441–8.

17. Wong FM, Ng YT, Leung WK. Oral Health and Its Associated Factors Among Older Institutionalized Residents: A Systematic Review. Int J Environ Res Public Health. 2019;16(21):4132.

18. Bao L, Zhang C, Dong J, Zhao L, Li Y, Sun J. Oral Microbiome and SARS-CoV-2: Beware of Lung Co-Infection. Front Microbiol. 2020;11:1840.

19. Ashford JR. Impaired Oral Health: A Required Companion of Bacterial Aspiration Pneumonia. Front Rehabil Sci. 2024;5:1337920.

20. Sadighi T, Bhisnauth C, Douglas C. Poor Oral Health in the Elderly and Its Effect on Chronic Disease. J Nurse Pract. 2023;19(4):154–61.

21. Deborah H, Karen M. Oral Health and Aspiration Pneumonia. Home Healthc Now. 2020;38(9):494–500.

22. Baniasadi K, Amini B, Hosseini M, Madani M, Hakimi M, Shekarchi R, et al. The Association of Oral Health Status and Socioeconomic Determinants With Oral Health-Related Quality of Life Among the Elderly: A Systematic Review and Meta-Analysis. Int J Dent Hyg. 2021;19(2):180–8.

23. Kouanda B, Srikanth A, Priya R. Periodontal Diseases: Major Exacerbators of Pulmonary Diseases? Pulm Med. 2021;2021:4712406.

24. Hakeem FF, Bernabé E, Widegård WS. Association Between Oral Health and Frailty: A Systematic Review of Longitudinal Studies. Gerodontology. 2019;36(4):299–308.