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The Risk of Rhinosinusitis In Patients With Periodontitis: A Systematic Review And Meta-Analysis

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ABSTRACT

Some studies reported a possible increased risk of rhinosinusitis in patients with periodontitis. The present systematic review and meta-analysis aimed to resolve conflicts on the association between these two important conditions.
For this purpose, a literature search was performed using PubMed, Embase, and Scopus from inception to 31 August 2023 to identify comparative observational studies that evaluated the risk of rhinosinusitis in periodontitis patients. We compared the prevalence of rhinosinusitis between subjects with and without periodontitis using pooled odds ratios (ORs) with 95% confidence intervals (CIs).
Finally, four eligible studies were included, comprising 81,225 subjects. Analysis showed that periodontitis was associated with an increased risk of rhinosinusitis (OR=2.43 [95% CI: 1.33-4.42]). Analysis of two cross-sectional studies indicated that pooled OR for rhinosinusitis in subjects with periodontitis compared with those without was OR=4.17 (95% CI: 1.45-12.02). Based on two cohort studies, the risk of rhinosinusitis was higher in subjects with periodontitis versus those without (OR=1.52 [95% CI: 1.22-1.88]). Pooling adjusted ORs for rhinosinusitis in subjects with periodontitis compared with those without also demonstrated that periodontitis was associated with an increased risk of rhinosinusitis (aOR=1.73 [95% CI: 1.22-2.24]).
According to the results, the risk of rhinosinusitis increases in patients with periodontitis. Clinicians should focus more on managing periodontitis patients with concurrent chronic rhinosinusitis to prevent further complications.

Keywords: Periodontitis, Rhinosinusitis, Systematic review

Introduction

Rhinosinusitis is a common condition in the upper respiratory tract, characterized by the inflammation of the nasal cavity and paranasal sinuses (1, 2). The symptoms of this disease can include facial pressure or pain, nasal obstruction or discharge, fever, etc. In addition, chronic rhinosinusitis can lead to orbital and intracranial serious complications, such as periorbital and orbital cellulitis or abscess, meningitis, and epidural abscess (3, 4). Rhinosinusitis is caused by a combination of environmental factors, such as allergens, smoking, and pollutants, as well as infections by microorganisms, with bacterial pathogens often being the main cause of chronic rhinosinusitis (5, 6).

Periodontitis is a severe inflammatory disease of the gingiva and one of the most prevalent dental conditions. In this disease, the tooth-supporting apparatus (esp., alveolar bone and periodontal ligament) is progressively destroyed, resulting in serious oral health complications, such as tooth loss (7, 8). Different local and systematic factors can potentially increase the risk of periodontitis; however, bacterial infections could be the main leading cause (9).

Common features exist in the pathogenesis of periodontitis and rhinosinusitis; that is, both are chronic in nature with an inflammatory basis caused by polymicrobial infections. Prior research endeavored to clarify the association between these two conditions. Some studies alluded to a direct link between periodontitis and the risk of rhinosinusitis (10, 11). It has also been stated that radiological signs of sinusitis are directly associated with periodontitis (12). However, there has yet to be a comprehensive study trying to

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elucidate this association. Therefore, we conducted a contemporaneous systematic review and meta-analysis of publications investigating the association between periodontitis and rhinosinusitis. Our findings will help clinicians in better management of the two diseases in order to avoid further complications.

Materials and Methods

Search Strategy and Eligibility Criteria: A medical literature search was performed using PubMed, Embase, and Scopus databases from inception to 31 August 2023, with no language restriction. The following keywords were used: *sinusitis* OR *rhinosinusitis* AND *periodontitis* OR *periodontal*. The search was applied to Title/Abstract. We included comparative observational studies that evaluated the association between periodontitis and rhinosinusitis. To be eligible, studies had to report the data on the risk of rhinosinusitis in subjects with periodontitis versus those without based on clinical and imaging examinations. We excluded articles with any of the following criteria: (1) Reviews, case reports, editorials, and letter to the editors; (2) Duplicate papers; (3) Surveys with unextractable information on study outcome; (4) Full-texts not being available. A recursive search of the bibliographies of all retrieved papers was carried out to find additional reports. The present systematic review and meta-analysis has been reported based on the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guideline (13). There is no PROSPERO registration number for the current meta-analysis.

Study Selection and Data Extraction: We independently screened titles and abstracts of the sources identified initially by database search for suitability assessment. Then, we obtained and evaluated the full-texts of the papers potentially related to the study outcome. Any discrepancies were resolved by consensus between the authors. After the final inclusion of eligible studies, the following data were extracted from them: first author's name, publication year, study country, study design, total sample size, number of men and women, age, number of subjects with periodontitis, number of subjects with rhinosinusitis. Non-English reports were translated by Google Translate, where required.

Risk of Bias Assessment: We used the Newcastle-Ottawa scale (NOS) for non-randomized studies to conduct the risk of bias assessment (14). This tool has questions on three main domains (selection of study groups [maximum four scores], comparability of the groups [maximum two scores], and assessment of outcome [maximum three scores]). Higher scores indicated higher quality and lower risk of bias.

Statistical Analysis: We compared the prevalence of rhinosinusitis between subjects with and without periodontitis using pooled odds ratios (ORs) with 95% confidence intervals (CIs). A random-effects model was used for pooling the data. Our quantitative interpretation for the ORs was as follows (14): 1.01-1.50 (weak association), 1.51-2.50 (moderate association), 2.51-4.00 (strong association). We investigated the heterogeneity between the studies by I-squared statistic, ranging from 0.0% to 100.0%; a p-value <0.10 was considered statistically significant (15). Subgroup analysis was conducted according to the study design. We also tried to evaluate the association between periodontitis and rhinosinusitis by pooling the ORs with confounder adjustment (aORs). We used forest plots to display the estimates of the individual studies and the results of the meta-analysis. We performed all statistical analyses using STATA (STATA Corporation, College Station, TX, USA).

Results

Search Results, Study Selection and characteristics: The search strategy primarily recovered 557 citations, of which 553 publications were excluded due to unsuitability. Finally, a total of 4 eligible papers were enrolled in this systematic review and meta-analysis (10, 11, 16, 17). Figure 1 illustrates the search strategy and article selection process according to the PRISMA. The language of all articles was English. The publication date was from 2013 to 2022. The baseline characteristics of the included studies have been represented in Table 1. The results of the risk of bias assessment have also been summarized in Table 2.

Association Between Periodontitis and Rhinosinusitis: Out of the four studies included, one was conducted in Brazil, one in Saudi Arabia, one in Taiwan, and one in South Korea. Analysis of four studies, including 81,225 subjects (48.4% men), showed that periodontitis was associated with a moderately increased risk of rhinosinusitis (OR=2.43 [95% CI: 1.33-4.42]), with a high heterogeneity between the studies (I-squared=96.4%, p<0.001) (Figure 2).

Table 1: Baseline Characteristics of the Included Studies

Study	Country	Study type	Total sample size (n)	Men (n)	Women (n)	Age (years)
Estrela, 2022(10)	Brazil	Cross-sectional	814	360	454	Mean: 49.4
Gufran, 2022(16)	Saudi Arabia	Cross-sectional	399	163	236	30-77 (Mean: 47.6)
Keller, 2013(17)	Taiwan	Cohort	55128	25588	29540	Mean: 41.5
Kim, 2022(11)	South Korea	Cohort	24884	13185	11699	≥20

Table 2: Newcastle-Ottawa Scale Quality Assessment of Included Studies

Study	Selection (out of 4)	Comparability (out of 2)	Outcome (out of 3)	Total (out of 9)
Estrela et al, 2022	4	2	2	8
Gufran et al, 2022	2	1	2	5
Keller et al, 2013	3	2	2	7
Kim et al, 2022	3	2	2	7

We also conducted subgroup analysis by study design (Figure 3). Analysis of two cross-sectional studies indicated that the pooled OR for rhinosinusitis in subjects with periodontitis compared with those without was OR=4.17 (95% CI: 1.45-12.02), showing a strong association with a high heterogeneity between the studies (I-squared=92.6%, p<0.001). Also, based on two cohort studies, the risk of rhinosinusitis was higher in subjects with periodontitis versus those without (OR=1.52 [95% CI: 1.22-1.88]), demonstrating a moderate association with a high heterogeneity between the studies (I-squared=70.2%, p=0.067).

Pooling the aORs for rhinosinusitis in subjects with periodontitis compared with those without also demonstrated that periodontitis was associated with an increased risk of rhinosinusitis (aOR=1.73 [95% CI: 1.22-2.24]), with a high heterogeneity between the studies (I-squared=78.5%, p=0.031) (Figure 4).

Discussion

The association between periodontitis and rhinosinusitis has remained unclear in the literature. To answer this question, we performed a comprehensive systematic review and meta-analysis of studies evaluating the risk of rhinosinusitis in subjects with periodontitis. After screening hundreds of articles, four eligible studies containing more than 80 thousand individuals were finally included in the present systematic review and meta-analysis. Based on the analyses, we found that subjects with periodontitis were at more than a two-fold higher risk of sinusitis than those without. Moreover, this direct association remained when we did subgroup analysis by study design (cross-sectional and cohort studies) and pooled adjusted estimates.

The mechanism of the direct relation between periodontitis and rhinosinusitis has not been clarified in the literature. Anatomically, the sinuses are located above the oral cavity; therefore, dental problems in the oral cavity might negatively affect the sinuses' health. As mentioned earlier, there are common characteristics in the etiology of periodontitis and rhinosinusitis. A possible explanation for the association of periodontitis with rhinosinusitis could be related to the inflammatory responses to the periodontal disease, involving the leukocytes, changing the expression of the cytokines or chemokines, alternating the underlying immune function, and finally enhancing the risk of rhinosinusitis in patients with periodontitis (18, 19). The microbiota in these two diseases share the biofilms formation, indicating a potential link between the two conditions. These polymicrobial biofilms, colonizing either the oral cavities of patients with periodontitis or the airways of patients with rhinosinusitis, have been indicated to be the sources of the variations in the mucosal immune response (skewing T helper 2 cells and

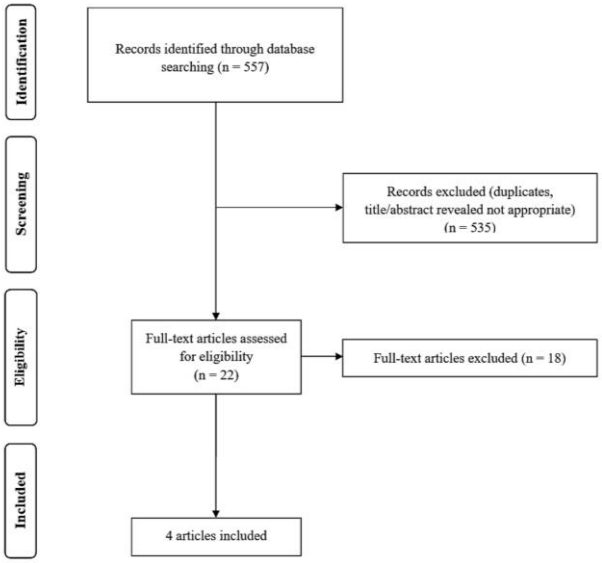

Fig. 1. PRISMA flow diagram

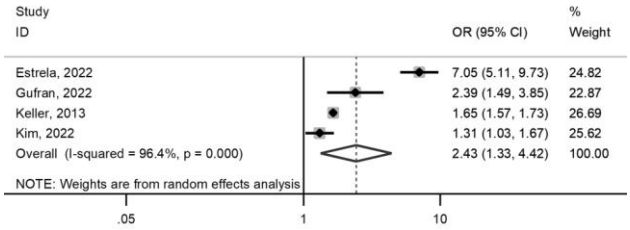

Fig. 2. The pooled odds ratio (OR) for rhinosinusitis in subjects with periodontitis compared with those without

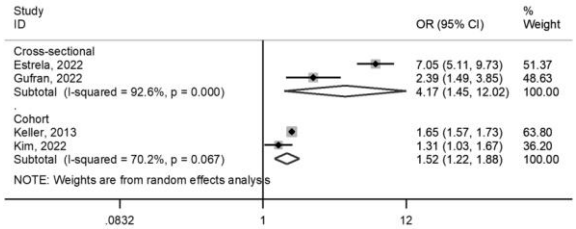

Fig. 3. The pooled odds ratio (OR) for rhinosinusitis in subjects with periodontitis compared with those without by study design

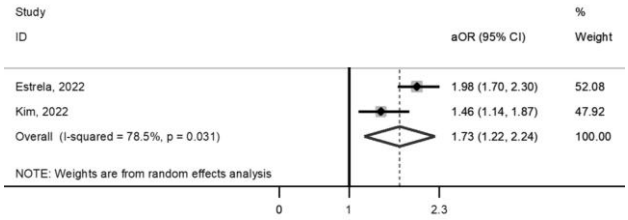

Fig. 4. The pooled adjusted odds ratio (aOR) for rhinosinusitis in subjects with periodontitis compared with those without

polarization of cytokine patterns) (11, 19), which might play an important role in the association between periodontitis and rhinosinusitis.

To the best of our knowledge, this is the first systematic review and meta-analysis assessing the connection between periodontitis and rhinosinusitis. For this purpose, we systematically searched multiple scientific literature databases using different keywords. A rigorous methodology was used for screening the identified citations in terms of eligibility. Suitability judgment and data extraction were done by reviewers independently, with disagreements resolved by consensus. For pooling the data, we used a random-effects model to provide more conservative estimates. Finally, we tried to perform subgroup analyses on the collected data.

The systematic review and meta-analysis findings have several clinical implications. Firstly, healthcare professionals should be aware of the potential association between periodontitis and rhinosinusitis and consider screening for both conditions in patients presenting with either disease. Secondly, an integrated approach to patient management is crucial, involving collaboration between dental and medical professionals to ensure comprehensive care. Early detection and management of periodontitis could reduce the risk of developing rhinosinusitis. Moreover, personalized treatment plans and patient education can be tailored to address the potential link between the two conditions. Establishing multidisciplinary clinics can further enhance patient care, allowing for a more holistic assessment and management. The study also highlights the need for further research to understand the underlying mechanisms connecting periodontitis and rhinosinusitis, with potential implications for oral health in rhinosinusitis management. These clinical implications emphasize the importance of considering the association between periodontitis and rhinosinusitis in clinical practice to improve patient outcomes and optimize healthcare management.

In the present meta-analysis, we witnessed high heterogeneity between the included surveys, which could be explained by differences in study location, populations, and interobserver agreements. It is noteworthy that the heterogeneity was not justified by the study design. It is proposed to carry out more homogeneous studies.

A limitation of this systematic review was the limited number of studies in this field (four studies), which suggests the need for further research.

The results of this systematic review and meta-analysis showed that the risk of rhinosinusitis is increased in patients with periodontitis. Therefore, it is recommended that clinicians pay more attention to the management of periodontitis patients with concurrent chronic rhinosinusitis in order to prevent further complications. Also, more comprehensive control group studies need to be conducted on this issue.

Conflict of Interest: The authors declare that there are no conflicts of interest.

Acknowledgement: Nil.

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