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Original Research

Biologic Agents in the Treatment of Severe Chronic Rhinosinusitis with Nasal Polyps in Adults: A Systematic Review and Meta-Analysis

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Clinical Question Box

Are biologic agents recommended for the treatment of severe chronic rhinosinusitis with nasal polyps (CRSwNP) in adults?

Biologic agents are recommended for the treatment of CRSwNP in adults. Strong, high-certainty evidence shows that biologics significantly improve Nasal Polyp Scores and Sino-Nasal Outcome Test-22 scores while maintaining a tolerable safety profile. Although the random-effects model did not demonstrate the superiority of any one biologic over another, dupilumab and tezepelumab consistently ranked highest in terms of efficacy. These findings support their use in patients with severe CRSwNP who do not respond adequately to conventional therapies.

Abstract

Introduction: Severe chronic rhinosinusitis with nasal polyps (CRSwNP) is a type 2 inflammatory disease that significantly impairs patients' quality of life. Biologic therapies offer targeted treatment options; however, comparative data remain limited. **Methods:** A systematic review and Bayesian network meta-analysis of randomized controlled trials (RCTs) was conducted to compare the efficacy and safety of approved biologics in adults with CRSwNP. Primary outcomes included changes in the Nasal Polyp Score (NPS), Sino-Nasal Outcome Test-22 (SNOT-22) score, and the incidence of serious adverse events (SAEs). Surface under the cumulative ranking (SUCRA) values were used to rank treatment performance. **Results:** Eight RCTs involving 2,564 patients were included. All biologics significantly reduced NPS and SNOT-22 scores compared to placebo. Dupilumab showed the greatest reduction in NPS (mean difference [MD]: −2.4; 95% credible interval [CrI]: −2.4 to −2.4) and SNOT-22 (MD: −19.2; 95% CrI: −19.2 to −19.1), followed by tezepelumab (NPS MD: −2.1; 95% CrI: −2.1 to −2.0; SNOT-22 MD: −17.0; 95% CrI: −17.1 to −16.9). GR1802 ranked highest in safety, with the lowest odds of SAEs (odds ratio [OR]: 0.06; 95% CrI: 0.001–1.0), followed by dupilumab (OR: 0.58;

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95% CrI: −0.06 to 5.5). SUCRA values confirmed dupilumab (0.807) and tezepelumab (0.730) as the top performers in terms of efficacy, and GR1802 (0.954) as the safest option. The certainty of the evidence was high, and the risk of bias was low across most studies. **Conclusion:** Biologic therapies improve symptoms and reduce polyp burden in CRSwNP. Dupilumab and tezepelumab are the most effective agents, while GR1802 demonstrates the highest safety profile. These findings support the use of individualized treatment based on specific clinical goals. Further head-to-head trials are warranted to better guide therapeutic decision-making.

Keywords: Biologic agent, Chronic rhinosinusitis with nasal polyps, CRSwNP, Dupilumab, Network meta-analysis, Tezepelumab

Introduction

Severe chronic rhinosinusitis with nasal polyps (CRSwNP) is defined as persistent inflammation of the nasal and paranasal mucosa lasting more than 12 weeks and characterized by the formation of bilateral nasal polyps.[1] It represents a distinct inflammatory phenotype of chronic rhinosinusitis, accounting for approximately one-third of all chronic rhinosinusitis cases. CRSwNP affects an estimated 2%–4% of the general adult population, with considerable variation across geographic regions.[2] The most common clinical symptoms include nasal obstruction, rhinorrhea, facial pressure, and anosmia, all of which significantly impair patients' quality of life (QoL), particularly during acute exacerbations.[3] The burden of CRSwNP extends beyond physical discomfort. The disease results in substantial healthcare utilization, repeated medical interventions, and loss of work productivity.[4] Moreover, patients often experience comorbid conditions such as asthma, allergic rhinitis, and aspirin-exacerbated respiratory disease (AERD), which further complicate management.[5] Up to 50% of patients with CRSwNP have coexistent asthma, and AERD is present in approximately 10% of cases, particularly among those with more severe or treatment-resistant disease.[6]

CRSwNP is frequently linked to type 2 inflammation, which is marked by significant eosinophilic infiltration, local immunoglobulin E (IgE) production, and increased levels of interleukins (ILs), including IL-4, IL-5, and IL-13.[7] By blocking critical signals, such as IgE-mediated mast cell activation, IL-4/IL-13–induced epithelial dysfunction, and IL-5–driven eosinophil survival, biologic therapies interrupt the inflammatory feedback loops that sustain chronic disease activity.[8] As a result, there is a marked reduction in local eosinophilic infiltration, mast cell and basophil activation, mucus hypersecretion, and epithelial barrier disruption. This leads to reversal of tissue edema, suppression of pro-fibrotic and tissue-remodeling pathways involved in polyp formation, and restoration of a healthier mucosal immune environment.[9] Conventional therapies, including intranasal corticosteroids (INCS), saline irrigations, and functional endoscopic sinus surgery (FESS), remain the cornerstone of CRSwNP management.[10,11] However, their benefits are often transient, with polyp recurrence occurring in more than half of patients within 5 years after FESS.[12] Moreover, the long-term use of systemic corticosteroids is constrained by adverse effects such as hyperglycemia, osteoporosis, and mood disturbances. Patients with severe disease may ultimately require multiple surgeries and lifelong maintenance therapy to adequately control symptoms and prevent relapse.

Advances in immunopathology have ushered in an era of precision treatment using biologic agents that target type 2 inflammation. These agents include anti-IgE (omalizumab), anti-IL-5 (mepolizumab, benralizumab, depemokimab), and anti–IL-4 receptor alpha (IL-4Rα) (dupilumab) monoclonal antibodies.[13] Their use has shown promising results in reducing polyp burden, improving nasal airflow and olfaction, and enhancing health-related QoL, especially in patients who have failed conventional therapies.[14] Biologic agents are increasingly recommended for patients who experience recurrence after FESS, have contraindications to surgery, or require multiple courses of systemic corticosteroids per year.[15] Although individual trials have demonstrated the efficacy of each biologic agent, direct head-to-head comparisons are lacking. Furthermore, treatment selection is complicated by variability in inflammatory endotypes, comorbid conditions, and biomarker profiles, such as blood eosinophil counts and total IgE levels.

Network meta-analysis (NMA) is a powerful method for synthesizing existing evidence and enabling indirect comparisons among multiple treatments when direct head-to-head trials are unavailable. This systematic review and NMA aim to evaluate and rank the efficacy and safety of currently approved biologic therapies for adults with severe CRSwNP. By integrating data from randomized controlled trials (RCTs), the study seeks to assist clinicians and guideline developers in making informed decisions regarding the optimal biologic treatment for this complex and burdensome condition.

Methods

Overview

This review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines and the PRISMA extension statement for NMA.[16,17] The protocol was prospectively registered in a public database, the Open Science Framework.[18]

Search Strategy

A comprehensive literature search was conducted in PubMed, Embase, the Cochrane Library, and Web of Science from their inception through April 30, 2025. The search strategy combined terms related to the population ("CRSwNP," "chronic rhinosinusitis," "nasal polyps"), the interventions ("biologic agents," "omalizumab," "mepolizumab," "benralizumab," "depemokimab," "dupilumab," "tezepelumab"), and study design ("randomized," "controlled," "RCT") to identify relevant RCTs. The detailed results are presented in Table S1.

Eligibility Criteria

The included studies met the following criteria: (1) RCT; (2) enrolled adult patients (≥18 years) with a confirmed diagnosis of CRSwNP; and (3) compared a biologic agent with either a placebo or another active treatment. Studies were excluded if they met any of the following criteria: (1) subgroup analyses that did not provide additional relevant information; (2) unavailable or incomplete data; or (3) non-randomized or observational study designs.

Data Extraction

Two independent reviewers (M.Z., and W.H.) screened the titles and abstracts, followed by a full-text assessment of eligible studies. Data were independently extracted using a standardized form, which included study details (author, year, country), patient demographics (sample size, age, sex), treatment regimens, follow-up duration, and outcomes of interest. Any discrepancies were resolved by consensus or adjudicated by a third reviewer (Q.M.).

Outcomes

The primary outcome was Nasal Polyp Score (NPS), while the secondary outcomes included the Sino-Nasal Outcome Test-22 (SNOT-22) score and the log ORs of serious adverse events (SAEs). The NPS assessed nasal polyp size endoscopically on a scale from 0 to 8 (0–4 per nostril), whereas the SNOT-22 measured symptom burden and QoL on a scale from 0 to 110. Log ORs were used to quantify the relative risk of SAEs across studies.

Statistical Analysis

A Bayesian random-effects NMA was conducted to compare the efficacy and safety of biologic treatments. The analyses were performed using R software (version 4.4.0; R Foundation for Statistical Computing, Vienna, Austria), with the "gemtc" package used for model construction and execution through Markov chain Monte Carlo methods, employing JAGS as the computational engine. The "dmetar" package was utilized to calculate SUCRA values and to facilitate result visualization. Treatment effects were reported as MDs for continuous outcomes and log ORs for binary outcomes,

along with their corresponding 95% credible intervals (CrIs). SUCRA values were used to rank treatments according to their relative efficacy and safety.

Risk of Bias and Certainty Assessment

The risk of bias in the included RCTs was assessed using the Cochrane Risk of Bias 2.0 tool.[19] The following domains were evaluated: the randomization process, deviations from intended interventions, missing outcome data, outcome measurement, and selection of reported results. Local inconsistency was assessed using the node-splitting method, while global inconsistency was evaluated using the design-by-treatment interaction model. The certainty of the evidence was assessed using the Grading of Recommendations Assessment, Development and Evaluation framework adapted for NMA.[20] Each comparison was rated according to risk of bias, inconsistency, indirectness, imprecision, and publication bias.

Results

Study Selection and Characteristics

A total of 1,522 records were identified through the database search. After removing 279 duplicates, 1,243 records were screened by title and abstract, and 96 full-text articles were assessed for eligibility (Fig. S1). Ultimately, eight RCTs involving 2,564 patients were included in the NMA.[21–28] The included trials evaluated seven biologic agents: benralizumab, GR1802 (a novel anti–IL-4Rα monoclonal antibody), depemokimab, dupilumab, mepolizumab, omalizumab, and tezepelumab. Study durations ranged from 16 to 52 weeks, and most studies were conducted across multiple countries, with one trial conducted in China. Key characteristics of the included studies are summarized in Table 1.

Table 1. Characteristics of enrolled studies

Author	Country	Study name	Intervention	Treatment (n)	Control (n)	Male (T)	Male (C)	Age (T)	Age (C)	Follow-up
Bachert, et al. 2019	Multi	LIBERTY NP SINUS-24, 52	Dupilumab 300 mg q2w	293	153	184	95	52.0 (14.9)	52.7 (12.6)	52w
Bachert, et al. 2022	Multi	OSTRO	Benralizumab 30 mg 4–8w	207	206	121	142	50.1 (12.4)	50.2 (13.9)	40w
Gevaert, et al. 2025	Multi	ANCHOR-1, ANCHOR-2	Depemokimab 100 mg q26w	272	256	187	178	52.4 (13.3)	51.6 (13.3)	52w
Gevaert, et al. 2020	Multi	PLOYP 1, 2	Omalizumab specified by weight and IgE	135	131	47	41	49.5 (13.3)	51.6 (11.8)	24w
Han, et al. 2021	Multi	SYNAPSE	Mepolizumab 100 mg q4w	206	201	139	125	48.6 (13.6)	48.9 (12.5)	52w
Jacobs, et al. 2025	Multi	NAVIGATOR	Tezepelumab 210 mg q4w	90	75	38	36	52.6 (12.4)	50.0 (12.4)	52w
Lipworth, et al. 2025	Multi	WAYPOINT	Tezepelumab 210 mg q4w	203	205	126	140	50.1 (13.6)	49.4 (13.7)	52w
Zheng, et al. 2025	China	NCT05873803	GR1802	36	34	24	17	46.6 (12.4)	44.2 (12.7)	16w

Note: C: control group; multi: multiple countries; T: treatment group; w: weeks.

NPS

Seven studies evaluated the primary outcome of change in NPS (Fig. 1A). All biologics demonstrated reductions compared to placebo, although the CrIs overlapped (Fig. 2A). Among them, dupilumab showed the greatest estimated reduction in NPS, with an MD of −2.4 (95% CrI: −5.4 to 0.61), followed by tezepelumab (MD: −2.1; 95% CrI: −5.4 to 0.95) and GR1802 (MD: −2.0; 95% CrI: −5.0 to 1.1).

The NMA results are presented in Table 2. No biologic agent demonstrated statistical superiority over the others. The possible efficacy rankings are shown in Fig. 3A. Dupilumab had the highest SUCRA value (0.807), followed by tezepelumab (0.730) and GR1802 (0.713), indicating superior overall efficacy. In contrast, placebo had the lowest SUCRA value (0.157). No heterogeneity was detected. The funnel plot assessing publication bias is shown in Fig. S2, with Egger's test yielding a p-value of 0.78.

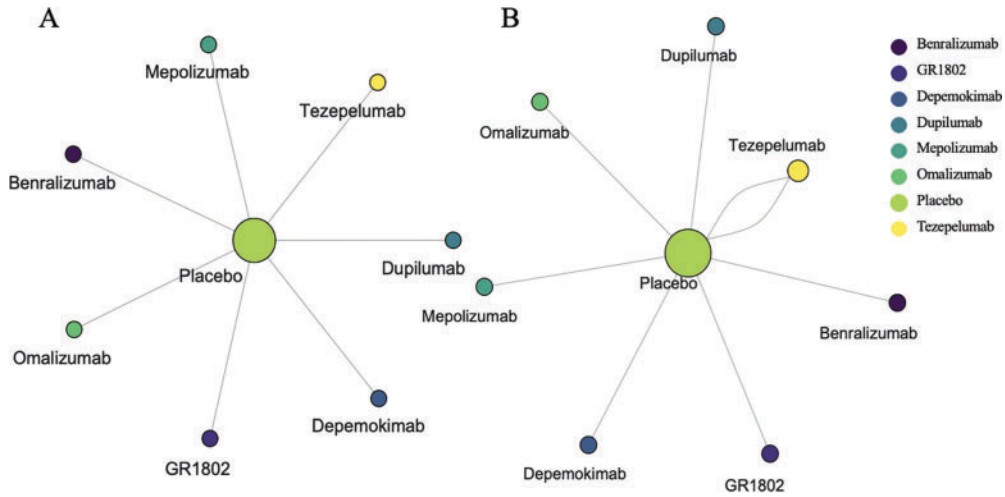

Figure 1. Network graphs of treatment comparisons. (A) NPS and (B) SNOT-22 score and serious AE.

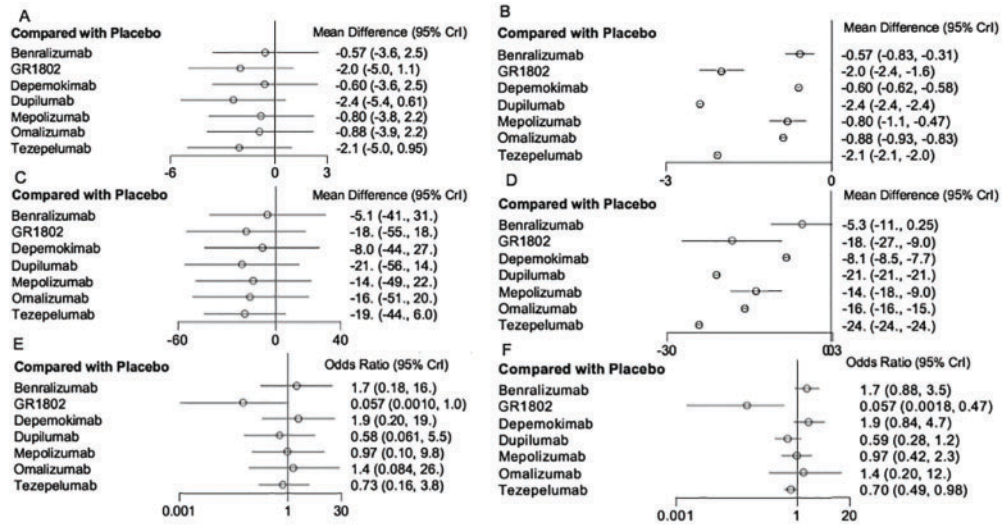

Figure 2. Outcomes by random- and fixed-effects models. (A) NPS by random model; (B) NPS by fixed model; (C) SNOT-22 score by random model; (D) SNOT-22 score by fixed model; (E) serious AE by random model; (F) serious AE by fixed model.

A fixed-effects model was used for sensitivity analysis. Direct comparisons with placebo are presented in Fig. 2B, where all biologics demonstrated reductions in NPS relative to placebo. Dupilumab showed the greatest estimated reduction, with an MD of −2.4 (95% CrI: −2.4 to −2.4), followed by tezepelumab (MD: −2.1; 95% CrI: −2.1 to −2.0). The NMA indicated that dupilumab was more

Table 2. League table for NPS, SNOT-22, and serious adverse events

NSP							
Dupilumab							
−0.32 (−4.52, 3.95)	**Tezepelumab**						
−0.40 (−4.60, 3.87)	−0.07 (−4.32, 4.11)	**GR1802**					
−1.51 (−5.76, 2.70)	−1.19 (−5.46, 2.99)	−1.12 (−5.38, 3.15)	**Omalizumab**				
−1.60 (−5.81, 2.70)	−1.27 (−5.59, 2.93)	−1.19 (−5.46, 3.02)	−0.09 (−4.29, 4.20)	**Mepolizumab**			
−1.79 (−6.02, 2.52)	−1.47 (−5.71, 2.77)	−1.39 (−5.65, 2.84)	−0.28 (−4.46, 3.94)	−0.19 (−4.49, 4.07)	**Depemokimab**		
−1.81 (−6.05, 2.43)	−1.50 (−5.72, 2.74)	−1.42 (−5.62, 2.83)	−0.30 (−4.52, 3.97)	−0.22 (−4.48, 4.07)	−0.03 (−4.26, 4.26)	**Benralizumab**	
−2.39 (−5.37, 0.64)	−2.07 (−5.09, 0.94)	−1.99 (−5.01, 0.98)	−0.88 (−3.84, 2.18)	−0.79 (−3.81, 2.24)	−0.60 (−3.59, 2.38)	−0.58 (−3.57, 2.42)	**Placebo**
SNOT-22							
Dupilumab							
−1.7 (−45.3, 40.8)	**Tezepelumab**						
−2.5 (−53.2, 48.1)	−0.9 (−44.7, 43.2)	**GR1802**					
−4.9 (−55.8, 44.6)	−3.3 (−47.6, 39.5)	−2.4 (−53.8, 47.8)	**Omalizumab**				
−7.0 (−56.8, 42.5)	−5.4 (−49.4, 37.9)	−4.4 (−55.2, 46.1)	−2.1 (−51.5, 48.0)	**Mepolizumab**			
−12.8 (−62.1, 37.4)	−11.0 (−54.0, 32.1)	−10.0 (−61.0, 40.9)	−7.7 (−57.1, 42.6)	−5.6 (−55.7, 44.7)	**Depemokimab**		
−15.6 (−66.1, 34.0)	−14.0 (−57.2, 29.4)	−13.0 (−63.6, 38.0)	−10.6 (−60.8, 39.3)	−8.7 (−59.2, 41.8)	−2.8 (−53.1, 46.6)	**Benralizumab**	
−20.8 (−55.8, 14.2)	−19.1 (−44.0, 6.0)	−18.1 (−54.8, 18.1)	−15.8 (−51.0, 20.2)	−13.7 (−49.0, 21.7)	−8.0 (−43.6, 26.8)	−5.1 (−40.5, 30.6)	**Placebo**
Log of Odds ratio							
GR1802							
−2.38 (−6.64, 1.29)	**Dupilumab**						
−2.62 (−6.64, 0.69)	−0.22 (−3.08, 2.47)	**Tezepelumab**					
−2.88 (−7.20, 0.82)	−0.50 (−3.71, 2.68)	−0.27 (−3.01, 2.60)	**Mepolizumab**				
−2.90 (−6.68, 0.00)	−0.53 (−2.83, 1.72)	−0.31 (−1.88, 1.30)	−0.03 (−2.36, 2.23)	**Placebo**			
−3.32 (−7.96, 0.74)	−0.91 (−4.60, 2.61)	−0.66 (−3.99, 2.54)	−0.40 (−4.13, 3.16)	−0.37 (−3.33, 2.40)	**Omalizumab**		
−3.47 (−7.78, 0.18)	−1.09 (−4.26, 2.07)	−0.87 (−3.59, 1.87)	−0.59 (−3.81, 2.59)	−0.55 (−2.79, 1.70)	−0.18 (−3.69, 3.48)	**Benralizumab**	
−3.56 (−7.91, 0.09)	−1.19 (−4.43, 2.04)	−0.95 (−3.69, 1.93)	−0.68 (−3.91, 2.52)	−0.65 (−2.94, 1.67)	−0.27 (−3.86, 3.46)	−0.09 (−3.32, 3.15)	**Depemokimab**

effective than tezepelumab, with an MD of −0.32 (95% CrI: −0.36 to −0.28) (Table S2). Treatment ranking probabilities are shown in Fig. S3, with dupilumab ranked highest, followed by tezepelumab and GR1802.

SNOT-22 Score

Eight studies assessed the primary outcome of change in SNOT-22 (Fig. 1B). All biologics demonstrated reductions compared to placebo, although the CrIs overlapped (Fig. 2C). Among them,

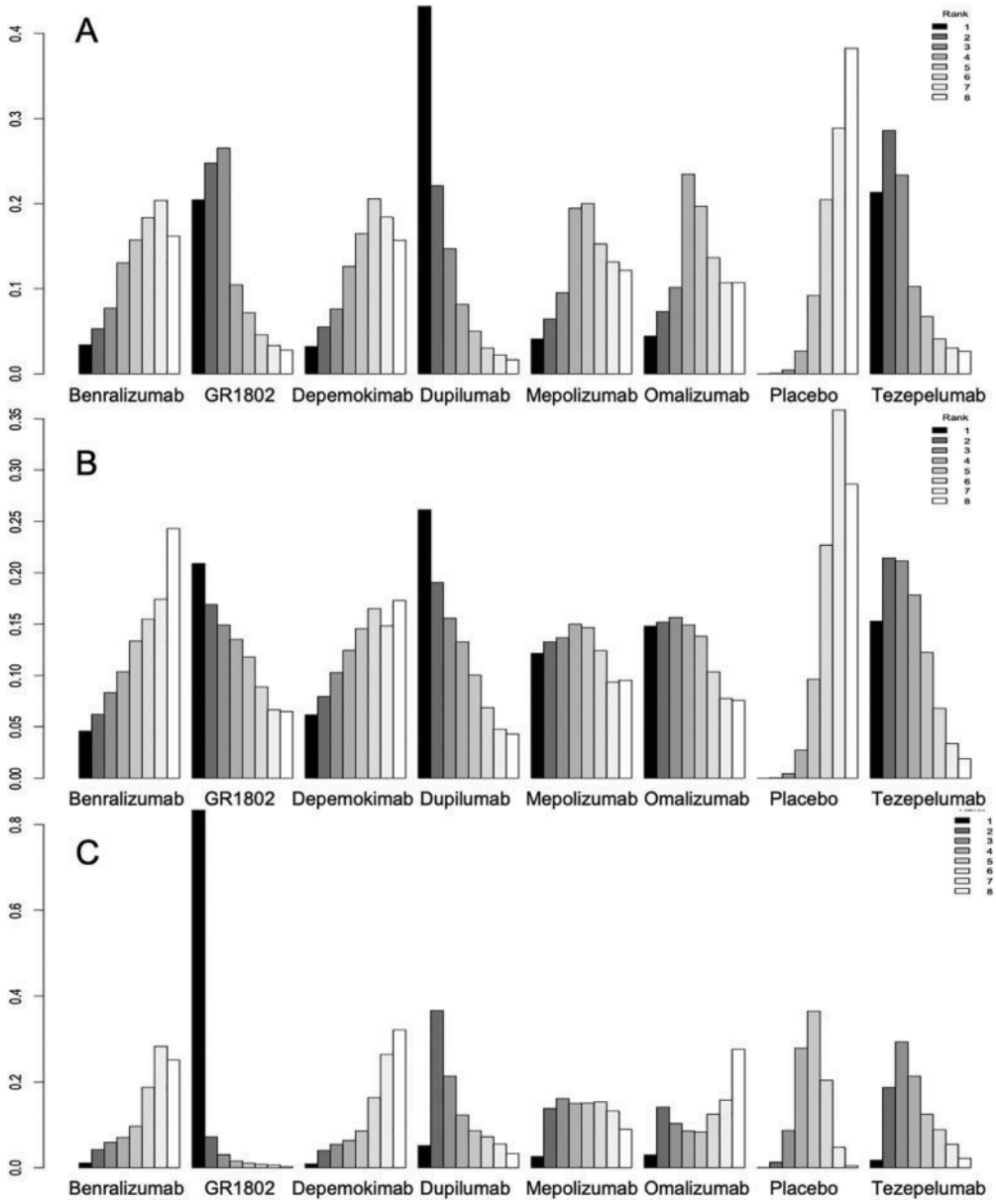

Figure 3. Treatment ranking probabilities by random-effects model. (A) NPS; (B) SNOT-22 score; (C) serious AE.

dupilumab showed the greatest estimated decrease in SNOT-22, with an MD of −21 (95% CrI: −56 to 14), followed by tezepelumab (MD: −19; 95% CrI: −44 to 6.0) and GR1802 (MD: −18; 95% CrI: −55 to 18). The NMA is presented in Table 2. No biologic agent showed superiority over the others. The probability of efficacy ranking is shown in Fig. 3B. Based on SUCRA values, dupilumab (0.681) ranked highest in efficacy, followed closely by tezepelumab (0.666) and GR1802 (0.623). Placebo had the lowest ranking at 0.176. No heterogeneity was found. The funnel plot assessing publication bias is shown in Fig. S4, with Egger's test yielding a p-value of 0.66.

A fixed-effects model was used for sensitivity analysis. Direct comparisons with placebo are presented in Fig. 2C, where all biologics demonstrated reductions in SNOT-22 scores relative to

placebo. Tezepelumab showed the greatest estimated reduction, with an MD of −24 (95% CrI: −24 to −24), followed by dupilumab (MD: −21; 95% CrI: −21 to −21). However, the NMA indicated that dupilumab was more effective than tezepelumab, with an MD of −3.2 (95% CrI: −3.7 to −2.8) (Table S3). Treatment ranking probabilities are shown in Fig. S3, with tezepelumab ranked highest, followed by dupilumab and GR1802.

SAE

Eight studies evaluated the primary outcome of change in SAE (Fig. 1B). No biologic demonstrated worse safety compared to placebo (Fig. 2E). Among them, GR1802 showed the highest safety, with an OR of 0.06 (95% CrI: 0.001–1.00), followed by dupilumab (OR: 0.58; 95% CrI: −0.06 to 5.50) and tezepelumab (OR: 0.73; 95% CrI: 0.16–3.80). The results of the NMA are presented in Table 2. No biologic agent showed a statistically significant safety advantage over the others. Safety ranking probabilities are shown in Fig. 3C. GR1802 ranked highest, with a SUCRA value of 0.954, followed by dupilumab (0.653) and tezepelumab (0.595), while depemokimab (0.239) and benralizumab (0.265) had the lowest rankings.

A fixed-effects model was used for sensitivity analysis. Direct comparisons with placebo are shown in Fig. 2F, where no biologic demonstrated worse safety outcomes than placebo. GR1802 exhibited the highest safety, with an OR of 0.005 (95% CrI: 0.002–0.47). The NMA indicated that GR1802 was more favorable than the other biologics (Table S4). Treatment ranking probabilities are presented in Fig. S7, with GR1802 ranked highest, followed by dupilumab and tezepelumab.

Risk of Bias and Certainty of Evidence

The risk of bias assessment is presented in Fig. S8. One study was rated as having some concerns, another was classified as high risk, and the remaining six studies were assessed as having a low risk of bias. The certainty of the evidence was strong across all outcomes, supporting the efficacy of biologics compared to placebo. Among these biologics, Dupilumab and Tezepelumab ranked highest in improving NPS and SNOT-22 scores while maintaining a tolerable safety profile.

Discussion

This systematic review and NMA provide a comprehensive synthesis of the current evidence on biologic agents for the treatment of CRSwNP. By integrating data from RCTs, this study offers a comparative assessment of the efficacy and safety of seven biologics, thereby addressing a critical gap created by the lack of direct head-to-head trials. The findings reaffirm the beneficial role of biologics in reducing symptom burden and improving QoL in patients with severe disease, consistent with previous clinical trial data.[29,30] Notably, this analysis offers a more comprehensive overview by including the latest agents, such as tezepelumab and GR1802, and by clearly delineating differences in safety profiles and treatment rankings. Dupilumab consistently demonstrated the highest efficacy across both NPS and SNOT-22 scores, followed closely by tezepelumab, underscoring their potential as first-line biologic options for patients with severe CRSwNP. Although GR1802's evidence is limited to a single-country, phase 2 trial with a relatively small sample size, it showed promising potential, particularly regarding safety, warranting further investigation in larger, multicenter studies. Overall, these results provide clinicians with an evidence-based framework for personalizing treatment strategies, moving beyond general efficacy comparisons toward precision-based care in the management of CRSwNP.

CRSwNP is a burdensome and heterogeneous inflammatory condition that significantly impairs QOL and presents a substantial therapeutic challenge, especially in its severe form. Traditional treatment options, such as INCSs and FESS, provide temporary relief for many patients but often prove insufficient for those with refractory disease. The frequent need for systemic corticosteroids and repeated surgeries underscores the limitations of conventional management, emphasizing the need for more targeted and lasting solutions.[31] In recent years, the emergence of biologic agents has transformed the therapeutic landscape for CRSwNP by providing a precision medicine approach that targets the underlying immunopathology of the disease.[32] These agents, designed to modulate type 2 inflammation, typically characterized by eosinophilia and elevated cytokines such as IL-4, IL-5,

and IL-13, offer new hope for patients with recalcitrant symptoms or contraindications to surgery. IL-8 is also a potential agent. Additionally, IL-8 may represent a promising therapeutic target.[33] Their targeted mechanisms of action allow for the modulation of specific immune pathways, potentially leading to sustained symptom control and improved rates of disease remission.[34]

Biomarkers such as serum eosinophil counts, total IgE levels, and fractional exhaled nitric oxide (FeNO) are increasingly recognized as valuable tools for guiding the selection of biologic therapies in CRSwNP.[35] Elevated eosinophil and IgE levels are commonly associated with type 2 inflammation, indicating a higher likelihood of response to agents such as dupilumab or omalizumab.[35] FeNO, which reflects airway eosinophilic activity, may further support treatment decisions involving therapies targeting IL-4, IL-13, or IL-5. However, current evidence suggests that no single biomarker has sufficient sensitivity or specificity to serve as a definitive guide for treatment selection.[36] Therefore, an approach based on clinical phenotypes and underlying inflammatory endotypes is crucial to optimizing outcomes and minimizing the use of less effective therapies. In addition to biological factors, practical considerations such as treatment cost, accessibility, patient adherence, and long-term safety must also be taken into account. As biologic therapies become more widely adopted, their financial impact on both healthcare systems and individual patients should be carefully evaluated.[37] Furthermore, patient education and shared decision-making are essential to promote adherence and to ensure that treatment goals are clearly understood and realistically aligned.

Several limitations merit consideration. First, there were no direct comparisons between treatments; therefore, the findings rely entirely on indirect comparisons, which should be interpreted with caution, particularly when the CrIs are wide. Second, the number of repeated surgical interventions is a crucial factor in evaluating treatment efficacy; however, this was not consistently reported across studies, making an NMA for this outcome infeasible. Third, although all patients had CRSwNP, variations in baseline characteristics, sex, and potential drug interactions across studies may have influenced treatment outcomes. Fourth, some included studies had short follow-up durations and small sample sizes, limiting the availability of data on long-term safety, especially for newer agents. Fifth, although we adjusted our search strategy to include all relevant studies and balance the screening workload, several studies may not have been included in the meta-analysis. Finally, information on cost-effectiveness is lacking, making it difficult to evaluate the economic impact of these therapies.

Conclusion

This systematic review and NMA demonstrate that biologics significantly improve outcomes in adults with CRSwNP. Dupilumab and tezepelumab were the most effective in improving NPS and SNOT-22 scores, while GR1802 exhibited the best safety profile. Although no single agent was superior across all measures, these findings support the personalized use of targeted therapies.

Abbreviations

AE	adverse event
AERD	aspirin-exacerbated respiratory disease
CRSwNP	chronic rhinosinusitis with nasal polyps
CrI	credible interval
FeNO	fractional exhaled nitric oxide
FESS	functional endoscopic sinus surgery
GRADE	Grading of Recommendations Assessment, Development and Evaluation
IgE	immunoglobulin E
IL	interleukin
IL-4Rα	interleukin-4 receptor alpha
INCS	intranasal corticosteroids
MD	mean difference
NMA	network meta-analysis
NPS	Nasal Polyp Score
OR	odds ratio

PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
QoL	quality of life
RCT	randomized controlled trial
SAE	serious adverse event
SNOT-22	Sino-Nasal Outcome Test-22
SUCRA	surface under the cumulative ranking curve

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Author Contributions

M.Z. contributed to the study design and drafting. M.Z. and W.H. contributed to the study search, quality control, data extraction, and analysis. Q.M. and K.C. worked on data interpretation and revision. All authors have read the manuscript and agree with its content and data.

Data Availability

The corresponding author shall make the datasets available upon reasonable request.

Ethical Statement

Institutional Review Board approval was waived due to the nature of the meta-analysis.

Conflict of Interest

The authors report no conflicts of interest in this work.

Supplemental Information

Supplemental information for this article can be found online at https://sup.jclinque.com/api/articles/79/download-suppl.

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