RESEARCH ARTICLE

DOI: 10.5935/0946-5448.2026008

International Tinnitus Journal. 2026;30(2):60-66

# Clinical Characteristics of Acute Rhinosinusitis in Children According to Disease Severity: Associations with Eustachian Tube Dysfunction

Shukhrat Sattarov[1],
Shokhimardon Khodjanov[1],
Shukhrat Mallaev[1],
Jamol Djuraev[1],
Sulton Akhmedov[1],
Abduqakhkhor Samadov[1],
Abdulla Tangriberdiev[1],
Maksud Mukhtorov[1],
Akmal Urinov[1],
Gulruh Shodmonkulova[1*]

## ABSTRACT

**Background:** Pediatric acute rhinosinusitis (ARS) may involve not only the sinonasal cavity but also the nasopharyngeal and middle-ear ventilation pathway. We evaluated severity-related clinical, otorhinolaryngologic, otoscopic, and imaging findings, with particular attention to changes potentially relevant to Eustachian tube and auditory function.

**Methods:** This observational analysis included 138 children aged 7–18 years treated for ARS at the multidisciplinary clinic of Tashkent State Medical University during 2023–2025. Disease was classified as mild (n=38), moderate (n=67), or severe (n=33) using a 0–10 visual analogue scale together with systemic and local clinical features. All patients underwent standardized ENT examination including bilateral otoscopy; CBCT or MSCT was performed according to clinical indications. Associations across severity groups were assessed using chi-square tests and Cramer's V.

**Results:** Purulent middle-meatus discharge increased from 36.8% in mild disease to 97.0% in severe disease and showed the strongest ENT association with severity (Cramer's V=0.495). Multisinus involvement increased from 5.3% to 69.7% (V=0.506), while pansinusitis increased from 0% to 33.3%. Otoscopy was normal in 115/138 children (83.3%); 10 (7.2%) had tympanic membrane hyperemia, 8 (5.8%) had tympanic membrane retraction, and 5 (3.6%) had exudative changes. These otoscopic abnormalities were interpreted as accompanying signs of disturbed middle-ear ventilation in the setting of nasopharyngeal inflammation.

**Conclusion:** Pediatric ARS demonstrates a graded sinonasal and radiologic severity phenotype, while a smaller subgroup shows otoscopic changes compatible with transient Eustachian tube or middle-ear ventilation disturbance. Because audiometry and tympanometry were not performed, hearing loss cannot be inferred directly; prospective studies incorporating objective hearing assessment are warranted.

**Keywords:** Acute rhinosinusitis; children; otoscopy; Eustachian tube; middle-ear ventilation; auditory function; computed tomography.

[1]Tashkent State Medical Academy, Tashkent, Uzbekistan.

***Send correspondence to:**
Gulruh Shodmonkulova

Department of Otorhinolaryngology, Tashkent State Medical University, Tashkent, Uzbekistan.
E-mail: gulruh.rustamovna@mail.ru

Paper submitted on Oct 13, 2026; and Accepted on Oct 17, 2026

## INTRODUCTION

Acute rhinosinusitis (ARS) is among the most frequent inflammatory conditions encountered in pediatric rhinology. In children it usually develops in the setting of an upper respiratory infection, but the clinical spectrum ranges from self-limited viral disease to post-viral inflammation, acute bacterial rhinosinusitis, and occasionally orbital or intracranial complications. Contemporary guidance therefore emphasizes symptom duration and evolution, overall clinical condition, and the presence of red flags rather than reliance on a single symptom or on routine imaging[1-7].

The pediatric presentation is often less specific than the adult presentation. Nasal obstruction, nasal discharge, cough, fever, headache or facial discomfort, disturbed sleep, and reduced daily activity may occur in different combinations. Anatomical maturation of the paranasal sinuses and the relatively narrow drainage pathways of childhood further influence the location and extension of inflammatory disease[8-15]. These factors make severity assessment clinically important, because the decision to observe, intensify follow-up, obtain imaging, or evaluate for complications depends on the whole phenotype rather than on symptom presence alone.

Imaging is particularly sensitive to the extent of mucosal disease, but abnormal sinus opacification can also occur during uncomplicated respiratory infections. For that reason, guidelines discourage routine computed tomography in mild, uncomplicated ARS and reserve cross-sectional imaging for severe, atypical, or potentially complicated disease[16,17]. In parallel, objective nasal examination can provide immediately available information without radiation exposure. Middle-meatus purulence, marked mucosal edema, and postnasal discharge are commonly used in clinical decision-making, yet quantitative pediatric data linking these findings to graded clinical severity remain limited.

In children, inflammation at the posterior nasal cavity and nasopharynx may also influence the pharyngeal opening of the Eustachian tube and middle-ear ventilation. Otoscopic findings such as tympanic membrane retraction, hyperemia, or an exudative appearance can therefore accompany an acute upper-airway inflammatory episode. These findings do not by themselves establish hearing loss, but they are clinically relevant because transient conductive auditory dysfunction may occur when middle-ear pressure regulation is impaired. Accordingly, the present analysis also describes the otoscopic findings recorded in the cohort and discusses their potential auditory implications.

Recent pediatric evidence has refined antimicrobial stewardship and highlighted the importance of identifying children most likely to benefit from antibiotics while avoiding unnecessary treatment in low-risk disease[18-20]. However, a practical severity phenotype integrating local otorhinolaryngologic findings with imaging extent may offer additional value for triage and monitoring. The present study therefore evaluated how objective ENT and radiologic features change across mild, moderate, and severe pediatric ARS. We hypothesized that both local inflammatory signs and anatomic disease extent would increase in a graded manner with clinical severity.

## MATERIALS AND METHODS

### Study design and participants

This observational clinical study was conducted at the multidisciplinary clinic of Tashkent State Medical University during 2023–2025. The analysis included 138 children aged 7–18 years who were evaluated and treated for acute rhinosinusitis. The study source records also included a healthy comparison group, but the present paper was deliberately restricted to children with ARS because its primary objective was to characterize severity-dependent phenotypes within the disease cohort[21,22].

### Eligibility and clinical classification

Eligible participants were children aged 7–18 years with a clinical diagnosis of acute rhinosinusitis, complete pediatric and otorhinolaryngologic evaluation, and available instrumental data when clinically indicated[23]. Chronic or prolonged rhinosinusitis, severe decompensated systemic disease, major immune deficiency, conditions that substantially interfered with outcome assessment, incomplete key data, and absence of parent/legal-guardian consent were exclusion criteria. Clinical etiologic classification followed EPOS 2020 principles: symptoms lasting less than 10 days without worsening were considered compatible with viral ARS; deterioration after approximately 5 days or persistence beyond 10 days supported post-viral ARS; bacterial disease was identified from the relevant clinical constellation rather than from discharge color alone[24-28].

### Severity assessment

Severity was stratified using a 0–10 visual analogue scale (VAS): 0–3, mild; 4–7, moderate; and 8–10, severe. Final clinical stratification also considered fever, nasal breathing impairment, pathological discharge, cough, headache or facial pain, systemic intoxication/malaise, sleep disturbance, and limitation of daily activity. This produced 38 mild (27.5%), 67 moderate (48.6%), and 33 severe (23.9%) cases[29,30].

### Otorhinolaryngologic evaluation

All participants underwent a standardized ENT examination including external inspection, anterior rhinoscopy, pharyngoscopy, bilateral otoscopy, and nasal endoscopy when clinically indicated. Nasal variables included mucosal edema, hyperemia, purulent discharge in the middle meatus, postnasal discharge, inferior turbinate enlargement, and pharyngeal hyperemia. During bilateral otoscopy, the external auditory canal and the color, position, and apparent mobility of the tympanic membrane were assessed. Otoscopic variables included

absence of pathological change, tympanic membrane hyperemia, tympanic membrane retraction, and exudative change. These ear findings were treated as associated otologic observations rather than direct measures of auditory threshold[31-35].

### Imaging

Imaging was selected on clinical grounds rather than applied as a screening test. CBCT was used primarily to define local anatomic inflammatory changes, whereas MSCT was preferentially used in severe presentations, suspected multisinus or pansinus disease, or concern for complications. Across the cohort, 89 children underwent CBCT and 49 underwent MSCT. Recorded features included mucosal thickening, fluid level, partial or complete opacification, narrowing of natural drainage pathways, multisinus involvement, pansinusitis, and sinus localization. This indication-based imaging strategy is consistent with the principle that uncomplicated pediatric ARS should not undergo routine cross-sectional imaging[36].

### Statistical analysis

Categorical variables were summarized as n (%). Differences across severity groups were assessed using chi-square tests. Strength of association was expressed with Cramer's V; approximately 0.10, 0.30, and 0.50 were interpreted as small, moderate, and strong effects, respectively, while recognizing that clinical interpretation depends on context. Two-sided $p<0.05$ was considered statistically significant. Because the study was observational and exploratory, results were interpreted as associations rather than causal effects[37-40].

## RESULTS

### Severity distribution and objective ENT findings

Of the 138 children with ARS, 38 (27.5%) were classified as mild, 67 (48.6%) as moderate, and 33 (23.9%) as severe. Objective nasal findings became progressively more frequent with increasing severity. Mucosal edema was present in 76.3% of mild, 95.5% of moderate, and 100.0% of severe cases ($p<0.001$; Cramer's $V=0.334$). Hyperemia increased from 60.5% to 82.1% and 93.9% ($p=0.002$; $V=0.303$).

The largest ENT effect was observed for purulent middle-meatus discharge: 14/38 (36.8%) in mild disease, 52/67 (77.6%) in moderate disease, and 32/33 (97.0%) in severe disease ($p<0.001$; $V=0.495$). Postnasal discharge increased from 31.6% to 56.7% and 72.7% ($p=0.002$; $V=0.301$). Inferior turbinate enlargement showed a smaller and statistically nonsignificant gradient (36.8%, 53.7%, and 57.6%; $p=0.152$; $V=0.165$), suggesting that it was less useful as a stand-alone severity marker. **(Table 1, Figure 1)**

**Table 1:** Association of objective otorhinolaryngologic findings with clinical severity.

| ENT finding | Mild n=38 | Moderate n=67 | Severe n=33 | P | Cramer V |
|---|---|---|---|---|---|
| Mucosal edema | 29 (76.3%) | 64 (95.5%) | 33 (100.0%) | <0.001 | 0.334 |
| Hyperemia | 23 (60.5%) | 55 (82.1%) | 31 (93.9%) | 0.002 | 0.303 |
| Purulent middle-meatus discharge | 14 (36.8%) | 52 (77.6%) | 32 (97.0%) | <0.001 | 0.495 |
| Postnasal discharge | 12 (31.6%) | 38 (56.7%) | 24 (72.7%) | 0.002 | 0.301 |
| Inferior turbinate enlargement | 14 (36.8%) | 36 (53.7%) | 19 (57.6%) | 0.152 | 0.165 |
| Pharyngeal hyperemia | 10 (26.3%) | 34 (50.7%) | 20 (60.6%) | 0.009 | 0.26 |

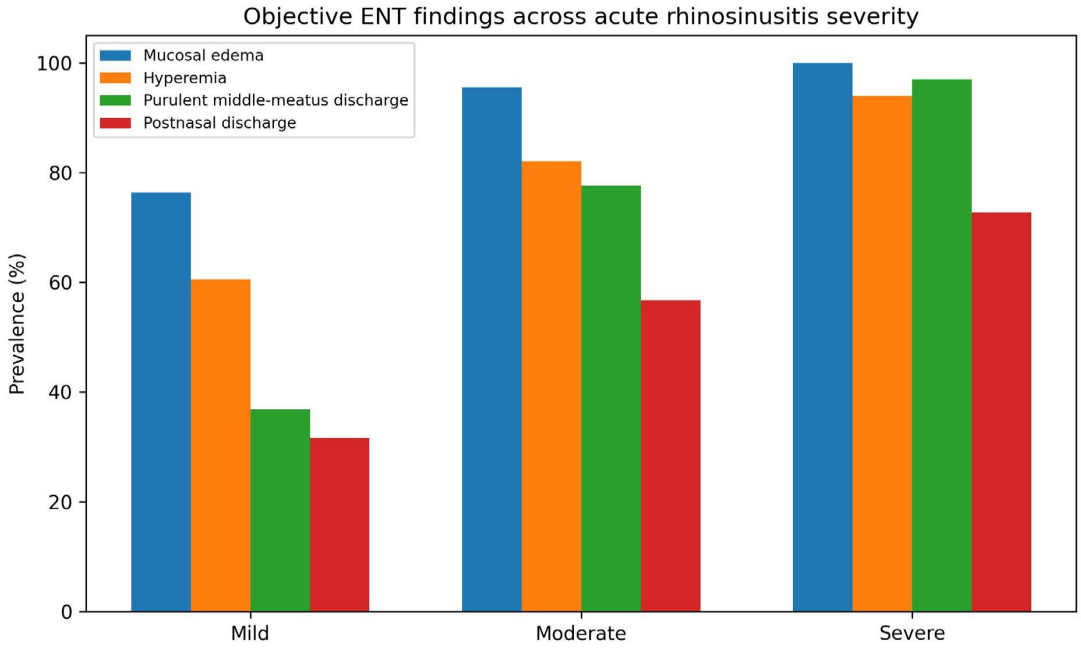



**Figure 1:** Prevalence of major objective ENT findings across mild, moderate, and severe pediatric acute rhinosinusitis.

### Imaging extent across clinical severity

Radiologic disease extent also increased in a stepwise pattern. Mucosal thickening was seen in 63.2%, 80.6%, and 93.9% of mild, moderate, and severe cases, respectively. More discriminating markers of advanced disease were fluid levels (10.5%, 38.8%, and 66.7%; $p<0.001$; $V=0.415$), complete opacification (2.6%, 13.4%, and 48.5%; $p<0.001$; $V=0.440$), and narrowing of natural sinus drainage pathways (21.1%, 53.7%, and 75.8%; $p<0.001$; $V=0.398$).

The strongest imaging association with severity was multisinus involvement, which increased from 5.3% in mild disease to 26.9% in moderate disease and 69.7% in severe disease ($p<0.001$; $V=0.506$). Pansinusitis was absent in the mild group, occurred in 7.5% of moderate cases, and in 33.3% of severe cases ($p<0.001$; $V=0.393$). Frontal and sphenoid sinus involvement was also concentrated in the severe group, supporting the concept that more extensive anatomic spread accompanies higher clinical severity. (**Table 2, Figure 2**)

### Clinical-etiologic phenotype

Using EPOS 2020 clinical criteria, 45 children were classified as viral, 56 as post-viral, and 37 as bacterial ARS. Purulent or mucopurulent discharge showed a marked etiologic gradient, occurring in 40.0% of viral, 75.0% of post-viral, and 91.9% of bacterial cases ($p<0.001$; $V=0.444$). Pathological middle-meatus secretion showed a similar pattern (44.4%, 76.8%, and 94.6%; $p<0.001$; $V=0.437$). In contrast, mucosal hyperemia did not distinguish the groups as strongly. These findings support using secretion characteristics as part of a broader clinical constellation rather than as an isolated diagnostic criterion. **(Table 3)**

### Otologic findings and potential auditory implications

Bilateral otoscopy was performed in all 138 children. No pathological otoscopic change was recorded in 115 children (83.3%). Tympanic membrane hyperemia was present in 10 (7.2%), tympanic membrane retraction in 8 (5.8%), and exudative changes in 5 (3.6%). Thus, 23/138 children (16.7%) had an otoscopic abnormality. In the source study these findings were interpreted as accompanying changes related to nasopharyngeal edema and temporary dysfunction of the Eustachian tube or middle-ear ventilation. Audiometry and tympanometry were not part of the dataset, so these otoscopic findings should not be interpreted as proof of hearing impairment. **(Table 4)**

**Table 2:** Imaging findings according to clinical severity.

| Imaging feature | Mild n=38 | Moderate n=67 | Severe n=33 | P | Cramer V |
|---|---|---|---|---|---|
| Mucosal thickening | 24 (63.2%) | 54 (80.6%) | 31 (93.9%) | 0.006 | 0.273 |
| Fluid level | 4 (10.5%) | 26 (38.8%) | 22 (66.7%) | <0.001 | 0.415 |
| Partial opacification | 12 (31.6%) | 39 (58.2%) | 26 (78.8%) | <0.001 | 0.343 |
| Complete opacification | 1 (2.6%) | 9 (13.4%) | 16 (48.5%) | <0.001 | 0.44 |
| Ostial/drainage-pathway narrowing | 8 (21.1%) | 36 (53.7%) | 25 (75.8%) | <0.001 | 0.398 |
| Multisinus involvement | 2 (5.3%) | 18 (26.9%) | 23 (69.7%) | <0.001 | 0.506 |
| Pansinusitis | 0 (0.0%) | 5 (7.5%) | 11 (33.3%) | <0.001 | 0.393 |

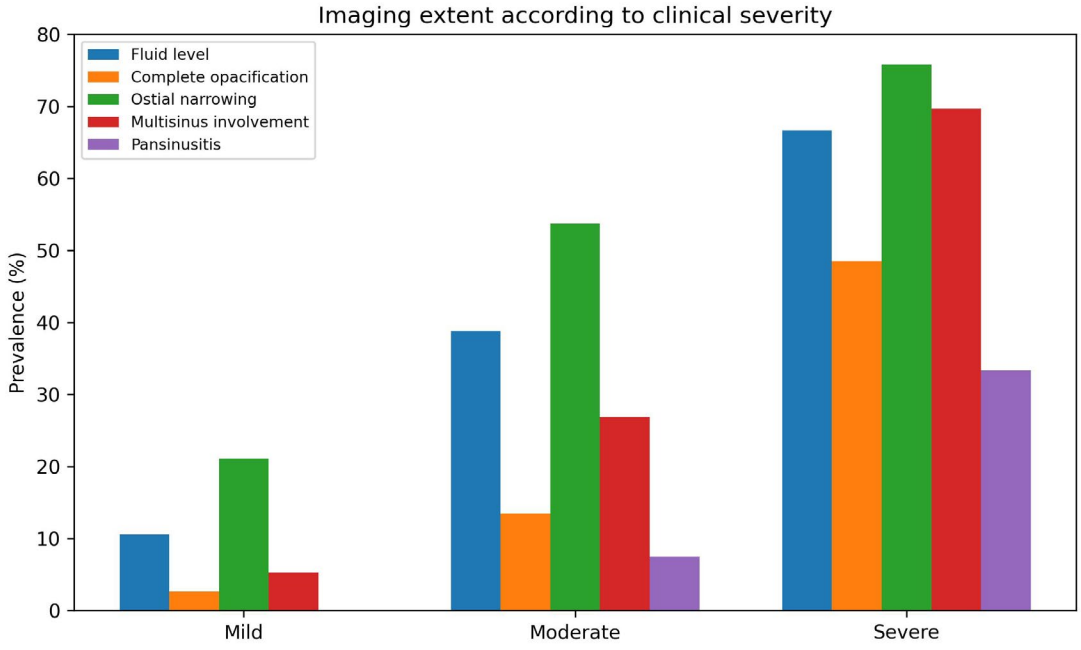



**Figure 2:** Selected imaging markers of anatomic disease extent according to clinical severity.

**Table 3:** Selected objective ENT findings by EPOS 2020 clinical-etiologic category.

| ENT finding | Viral n=45 | Post-viral n=56 | Bacterial n=37 | P | Cramer V |
|---|---|---|---|---|---|
| Mucosal edema | 37 (82.2%) | 53 (94.6%) | 36 (97.3%) | 0.028 | 0.227 |
| Hyperemia | 31 (68.9%) | 45 (80.4%) | 33 (89.2%) | 0.076 | 0.193 |
| Mucopurulent/purulent discharge | 18 (40.0%) | 42 (75.0%) | 34 (91.9%) | <0.001 | 0.444 |
| Pathological middle-meatus secretion | 20 (44.4%) | 43 (76.8%) | 35 (94.6%) | <0.001 | 0.437 |

**Table 4:** Otoscopic findings in children with acute rhinosinusitis and healthy controls.

| Otoscopic finding | ARS group (n=138) | Healthy controls (n=40) |
|---|---|---|
| No pathological change | 115 (83.3%) | 40 (100.0%) |
| Tympanic membrane hyperemia | 10 (7.2%) | 0 (0.0%) |
| Tympanic membrane retraction | 8 (5.8%) | 0 (0.0%) |
| Exudative change | 5 (3.6%) | 0 (0.0%) |

## DISCUSSION

The central finding of this study is a coherent, graded relationship between clinical severity and objective disease expression in pediatric ARS. The prevalence of mucosal edema, hyperemia, purulent middle-meatus discharge, and postnasal secretion rose with severity, while imaging demonstrated increasing fluid levels, opacification, drainage-pathway narrowing, and multisinus spread. The convergence of bedside ENT signs and anatomic disease extent provides a clinically intuitive phenotype and supports multidomain severity assessment rather than reliance on a single complaint[40].

Purulent middle-meatus discharge was the strongest local ENT correlate of severity (V=0.495). Its anatomical location is important: secretion in the middle meatus is more directly linked to drainage from the maxillary, frontal, and anterior ethmoid sinuses than nonspecific anterior nasal discharge. Nevertheless, the finding should not be interpreted as proof of bacterial infection on its own. Both EPOS and other consensus approaches emphasize symptom evolution, duration, systemic illness, and the full examination context[41,42]. In our etiologic analysis, purulent or mucopurulent secretion became progressively more common from viral to post-viral and bacterial phenotypes, but overlap remained, which reinforces this multidimensional interpretation.

Multisinus involvement had the largest radiologic effect size (V=0.506), and pansinusitis was confined to moderate and severe disease. This result is consistent with the clinical role of cross-sectional imaging: not to establish uncomplicated ARS routinely, but to clarify extent in severe, atypical, or potentially complicated cases[43-48]. The marked increase in complete opacification and fluid levels in severe disease also suggests that radiologic burden can corroborate clinical escalation when imaging is already justified. Importantly, the study design does not imply that every severe child requires imaging; imaging should remain indication-driven to minimize radiation and avoid overinterpreting incidental mucosal abnormalities[49].

The findings have implications for antimicrobial stewardship. Trials and meta-analyses show that antibiotics may benefit selected children with acute bacterial sinusitis, but indiscriminate treatment exposes many children with viral or post-viral disease to unnecessary antibiotics [24-30]. An objective examination phenotype can strengthen decisions about reassessment and escalation: for example, a child with high VAS severity, marked systemic symptoms, purulent middle-meatus secretion, and evidence of extensive sinus involvement represents a different risk profile from a child with mild symptoms and limited mucosal edema. Such phenotyping complements, rather than replaces, guideline-defined diagnostic criteria[50].

Several features of pediatric sinus disease also deserve consideration. Sinus development is age dependent, particularly for frontal and sphenoid sinuses, and chronic rhinosinusitis literature highlights the contribution of allergy, adenoid disease, asthma, mucociliary function, and local inflammatory burden to symptom expression[51,52]. Although the present study focused on acute disease, these broader factors can modify examination and imaging findings. The age range of 7–18 years reduced, but did not eliminate, developmental heterogeneity.

The otoscopic component provides an additional clinically relevant observation.

Although most children had a normal ear examination, 16.7% showed tympanic membrane hyperemia, retraction, or exudative change. The pediatric nasopharynx and Eustachian tube form a functional continuum with the upper airway, so acute inflammatory edema may transiently impair middle-ear pressure regulation. Tympanic membrane retraction and exudative change are particularly compatible with disturbed ventilation and could plausibly produce temporary conductive auditory symptoms. However, the present study did not include pure-tone audiometry, tympanometry, otoacoustic emissions, or auditory brainstem testing. Accordingly, the data support an otologic association and a rationale for hearing-oriented follow-up in symptomatic children, but not a measured diagnosis of hearing loss[53].

This study has limitations. It was conducted at a single center and used an observational design. Imaging was indication-based, which reflects clinical practice but introduces selection effects: severe children were more likely to undergo MSCT. The analysis did not use a blinded

centralized radiology review or a validated imaging score such as a pediatric-adapted Lund-Mackay framework, and multivariable prediction models were not developed[54]. Microbiologic confirmation was not available for every etiologic category, so viral, post-viral, and bacterial labels should be interpreted as clinical phenotypes. Finally, the present analysis emphasizes association with severity rather than treatment response or prognosis. In addition, otologic assessment was based on otoscopy alone; no tympanometry or audiometric testing was available, limiting conclusions about Eustachian tube function or hearing thresholds[52].

Despite these limitations, the study offers a clinically useful message: objective ENT signs and imaging extent move in the same direction as symptom-defined severity, and the strongest signals are not generic nasal inflammation but purulent middle-meatus secretion and multisinus spread. Prospective multicenter studies should test whether a simple combination of VAS severity, middle-meatus findings, and selective imaging variables can improve prediction of complications, need for treatment escalation, or delayed recovery[53,54].

## CONCLUSION

Pediatric acute rhinosinusitis demonstrates a clear severity-dependent clinical, otorhinolaryngologic, and imaging phenotype. Purulent middle-meatus discharge showed the strongest local ENT association with severity, while multisinus involvement showed the strongest radiologic association. Otoscopic abnormalities were present in 16.7% of affected children and included tympanic membrane hyperemia, retraction, and exudative change, supporting the clinical relevance of monitoring the middle ear when nasopharyngeal inflammation is prominent. These findings may indicate transient disturbance of Eustachian tube and middle-ear ventilation, but objective auditory dysfunction was not measured. Future pediatric ARS studies should integrate otoscopy with tympanometry and audiometry to define the frequency, magnitude, and reversibility of hearing changes.

## REFERENCES


1. Fokkens WJ, Lund VJ, Hopkins C, et al. European position paper on rhinosinusitis and nasal polyps 2020. Rhinology: official organ of the Int rhino soci. 2020;58(Suppl 29):1-464.
2. Leung AK, Hon KL, Chu WC. Acute bacterial sinusitis in children: an updated review. Drugs in Context. 2020;9.
3. Ramadan HH, Chaiban R, Makary C. Pediatric rhinosinusitis. Pediatr Clin North Am. 2022;69(2):275-86.
4. Siddiqui Z, Tahiri M, Gupta A, et al. The management of paediatric rhinosinusitis. Int J Pediatr Otorhinolaryngol. 2021;147:110786.
5. Badr DT, Gaffin JM, Phipatanakul W. Pediatric rhinosinusitis. Current treatment options in allergy. 2016;3(3):268-81.
6. Drago L, Pignataro L, Torretta S. Microbiological aspects of acute and chronic pediatric rhinosinusitis. J Clin Med. 2019;8(2):149.
7. Centers for Disease Control and Prevention. Outpatient Clinical Care for Pediatric Populations: Acute Sinusitis. – Atlanta: CDC, 2024.
8. American Academy of Pediatrics. Red Book: 2024–2027 Report of the Committee on Infectious Diseases. 33rd ed. – Itasca, IL: American Academy of Pediatrics, 2024.
9. American Academy of Pediatrics. Medications in Pediatrics: A Compendium of AAP Clinical Practice Guidelines and Policies. – Itasca, IL: American Academy of Pediatrics, 2020.
10. Ebell MH, McKay B, Guilbault R, et al. Diagnosis of acute rhinosinusitis in primary care: a systematic review of test accuracy. Br J Gen Pract.. 2016: 2.
11. Meltzer EO, Hamilos DL. Rhinosinusitis diagnosis and management for the clinician: a synopsis of recent consensus guidelines. In Mayo Clinic Proceedings 2011 (Vol. 86, No. 5, pp. 427-443). Elsevier.
12. Orlandi RR, Kingdom TT, Hwang PH, et al. International consensus statement on allergy and rhinology: rhinosinusitis. Int Forum Allergy Rhinol 2016 (Vol. 6, No. S1, pp. S22-S209).
13. Orlandi RR, Kingdom TT, Smith TL, et al. International consensus statement on allergy and rhinology: rhinosinusitis 2021. Int. Forum Allergy Rhinol 2021 (Vol. 11, No. 3, pp. 213-739).
14. American College of Radiology. ACR Appropriateness Criteria® Sinonasal Disease, J Am Coll Radiol. – 2017. – Vol. 14, No. 11S. – P. S550–S559.
15. Lee S, Fernandez J, Mirjalili SA, et al. Pediatric paranasal sinuses—Development, growth, pathology, & functional endoscopic sinus surgery. Clinical Anatomy. 2022;35(6):745-61.
16. Dennison SH, Ask LS, Eriksson M, et al. Serious complications due to acute rhinosinusitis in children up to five years old in Stockholm, Sweden–Still a challenge in the pneumococcal conjugate vaccine era. Int J Pediatr Otorhinolaryngol. 2019;121:50-4.
17. Zhao EE, Koochakzadeh S, Nguyen SA, et al. Orbital complications of acute bacterial rhinosinusitis in the pediatric population: a systematic review and meta-analysis. Int J Pediatr Otorhinolaryngol. 2020;135:110078.
18. Turhal G, Göde S, Sezgin B, et al. Orbital complications of pediatric rhinosinusitis: A single institution report. Turk J Pediatr. 2020;62(4):533-40.
19. Levy DA, Nguyen SA, Harvey R, et al. Hospital utilization for orbital and intracranial complications of pediatric acute rhinosinusitis. Int J Pediatr Otorhinolaryngol. 2020;128:109696.
20. Kou YF, Killeen D, Whittemore B, et al. Intracranial complications of acute sinusitis in children: the role of endoscopic sinus surgery. Int J Pediatr Otorhinolaryngol. 2018;110:147-51.
21. Otto WR, Paden WZ, Connors M, et al. Suppurative intracranial complications of pediatric sinusitis: a single-center experience. J Infect Dis. 2021;10(3):309-16.
22. Schollin Ask L, Hultman Dennison S, Stjärne P, et al. Most preschool children hospitalised for acute rhinosinusitis had orbital complications, more common in the youngest and among boys. Acta Paediatrica. 2017;106(2):268-73.
23. Zummer J., Luedke A. Pediatric sinusitis: complications and management in the emergency department, Pediatric Emergency Medicine Practice. 2024. Vol. 21, No. 8. – P. 1–28.
24. Conway SJ, Mueller GD, Shaikh N. Antibiotics for acute sinusitis in children: a meta-analysis. Pediatrics. 2024;153(5):e2023064244.
25. Shaikh N, Hoberman A, Shope TR, et al. Identifying children likely to benefit from antibiotics for acute sinusitis: a randomized clinical trial. Jama. 2023;330(4):349-58.
26. Burgstaller JM, Steurer J, Holzmann D, et al. Antibiotic efficacy in patients with a moderate probability of acute rhinosinusitis: a systematic review. European Archives of Oto-rhino-laryngology. 2016;273(5):1067-77.
27. National Institute for Health and Care Excellence. Sinusitis (acute): antimicrobial prescribing. NICE Guideline NG79. – London: NICE,

2017; updated 2025. – Electronic resource: https://www.nice.org.uk/guidance/ng79.

28. World Health Organization. The WHO AWaRe (access, watch, reserve) antibiotic book. World Health Organization; 2022 Nov 14.
29. Satdhabudha A, Utispan K, Monthanapisut P, et al. A randomized controlled study comparing the efficacy of nasal saline irrigation devices in children with acute rhinosinusitis. Asian Pac J Allergy Immunol. 2017;35(2):102-7.
30. Kalavacherla S, Hall M, Jiang W, et al. Temporal trends in pediatric acute sinusitis surrounding the COVID□19 pandemic. Otolaryngology–Head and Neck Surgery. 2024;170(3):913-8.
31. Lin SW, Wang SK, Lu MC, et al. Acute rhinosinusitis among pediatric patients with allergic rhinitis: A nationwide, population-based cohort study. PLoS One. 2019;14(2):e0211547.
32. Hopp RJ, Allison J, Brooks D. Fifty years of chronic rhinosinusitis in children: the accepted, the unknown, and thoughts for the future. Pediatric Allergy, Immunology, and Pulmonology. 2016;29(2):61-7.
33. Ge M, Liu DH, Ference EH. Pediatric chronic sinusitis: diagnosis and management. Current Opinion in Otolaryngology & Head and Neck Surgery. 2022 Feb 1;30(1):68-77.
34. Ramadan HH. Pediatric chronic rhinosinusitis. European Archives of Oto-Rhino-Laryngology. 2024;281(3):1131-7.
35. Beswick DM, Messner AH, Hwang PH. Pediatric chronic rhinosinusitis management in rhinologists and pediatric otolaryngologists. Annals of Otology, Rhinology & Laryngology. 2017;126(9):634-9.
36. Gallant JN, Basem JI, Turner JH, et al. Nasal saline irrigation in pediatric rhinosinusitis: A systematic review. Int J Pediatr Otorhinolaryngol. 2018;108:155-62.
37. Latek M, Łacwik P, Molińska K, et al. Effect of an intranasal corticosteroid on quality of life and local microbiome in young children with chronic rhinosinusitis: a randomized clinical trial. JAMA pediatrics. 2023;177(4):345-52.
38. Patel GB, Kern RC, Bernstein JA, et al. Current and future treatments of rhinitis and sinusitis. J Allergy Clin Immunol Pract. 2020;8(5):1522-31.
39. Poddighe D, Brambilla I, Licari A, et al. Pediatric rhinosinusitis and asthma. Respiratory Medicine. 2018;141:94-9.
40. Aring AM, Chan MM. Current concepts in adult acute rhinosinusitis. American family physician. 2016 ;94(2):97-105.
41. Dass K, Peters AT. Diagnosis and management of rhinosinusitis: highlights from the 2015 practice parameter. Current allergy and asthma reports. 2016;16(4):29.
42. Koch AK, Klose P, Lauche R, et al. A systematic review of phytotherapy for acute rhinosinusitis. Forschende Komplementärmedizin/Research in Complementary Medicine. 2016 Mar;23(3):165-9.
43. Bhattacharyya N. Contemporary assessment of the disease burden of sinusitis. Am J Rhinol Allergy. 2009;23(4):392-5.
44. Hopkins C, Browne JP, Slack R, et al. The Lund-Mackay staging system for chronic rhinosinusitis: how is it used and what does it predict?. Otolaryngology—Head and Neck Surgery. 2007;137(4):555-61.
45. Gerber ME, Kennedy AA. Adenoidectomy with balloon catheter sinuplasty: a randomized trial for pediatric rhinosinusitis. The Laryngoscope. 2018;128(12):2893-7.
46. Mahomva C, Anne S, Roxbury C. Efficacy of adenoidectomy for the management of chronic rhinosinusitis in children older than 7 years of age. Annals of Otology, Rhinology & Laryngology. 2022;131(8):868-73.
47. Veskitkul J, Wongkaewpothong P, Thaweethamchareon T, et al. Recurrent acute rhinosinusitis prevention by azithromycin in children with nonallergic rhinitis. J Allergy Clin Immunol Pract. 2017;5(6):1632-8.
48. Bachert C, Marple B, Schlosser RJ, et al. Adult chronic rhinosinusitis. Nature Reviews Disease Primers. 2020;6(1):86.
49. DeConde AS, Soler ZM. Chronic rhinosinusitis: epidemiology and burden of disease. Am J Rhinol Allergy. 2016;30(2):134-9.
50. Gilani S, Shin JJ. The burden and visit prevalence of pediatric chronic rhinosinusitis. Otolaryngology–Head and Neck Surgery. 2017 Dec;157(6):1048-52.
51. Rasulova N, Khaydarova G, Shodmonkulova G, et al. TGF-□1 and VEGF signaling in benign vocal fold lesions: a structured narrative review. Egypt J Otolaryngol. 2026;42(1):145.
52. Khasanov U, Khasanova L, Djuraev J, et al. Anatomical location predicts histopathological phenotype in maxillary sinus cysts: a secondary analysis of 140 surgical cases. Int Tinnitus J. 2026;30(2):1–7.
53. Shodmonkulova G, Khaydarova G, Khabilov N, et al. Hearing loss in carotid artery stenosis: influence of age and gender. Int Tinnitus J. 2025;29(2):71-5.
54. Shodmonkulova G, Khaydarova G, Yulbarisov A, et al. Vascular endothelial dysfunction as a mechanism of hearing loss in carotid artery stenosis: a scientific literature review. Egypt J Otolaryngol. 2026;42(1):106.