



Review Article

Association of Prolonged Untreated Childhood Upper-Airway Obstruction Due to Adenotonsillar Hypertrophy with Symptomatic Deviated Nasal Septum and Obstructive Rhinosinusitis: A Systematic Review

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ABSTRACT

Background Adenoid and tonsillar hypertrophy are common causes of prolonged upper-airway obstruction during childhood. Persistent obstruction may lead to habitual mouth breathing, sleep-disordered breathing, altered tongue and mandibular posture, and abnormal dentofacial development. Adenoidal obstruction, chronic inflammation, microbial colonisation, and bacterial biofilm formation may also contribute to recurrent or chronic rhinosinusitis. Whether untreated adenotonsillar hypertrophy independently increases the subsequent occurrence of symptomatic nasal septal deviation remains uncertain.

Objective To systematically evaluate the association of prolonged untreated childhood upper-airway obstruction caused by adenotonsillar hypertrophy with altered craniofacial development, symptomatic deviated nasal septum, and obstructive or chronic rhinosinusitis.

Methods This systematic review was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses 2020 statement. PubMed/MEDLINE, Embase, Scopus, Web of Science, the Cochrane Library, and Google Scholar were searched from database inception to January 2026. Observational and interventional studies evaluating adenotonsillar hypertrophy, persistent mouth breathing, craniofacial development, nasal septal deviation, or chronic rhinosinusitis were considered eligible. Study selection, data extraction, and methodological appraisal were performed using predefined criteria. Because of substantial clinical and methodological heterogeneity, the findings were synthesised narratively. PRISMA 2020 requires transparent reporting of the numbers of records identified, screened, excluded, retrieved, and included, together with reasons for full-text exclusion.

Results The database searches identified 612 records. After removal of 156 duplicates, 456 unique records underwent title and abstract screening. Of these, 377 records were excluded, and 79 reports were sought for retrieval. Three reports could not be retrieved; therefore, 76 full-text articles were assessed for eligibility. Sixty-six full-text articles were excluded, leaving 10 studies for qualitative synthesis. The included evidence consistently associated prolonged mouth breathing and adenotonsillar obstruction with altered craniofacial and dentofacial morphology. Studies involving children with chronic rhinosinusitis supported a role for adenoidal obstruction, microbial colonisation, and bacterial biofilm

formation. Studies examining nasal septal deviation and rhinosinusitis reported inconsistent results, with stronger associations observed for severe deviation or deviation affecting the ostiomeatal region. No included study directly followed children with untreated adenotonsillar hypertrophy into adulthood to determine the incidence of newly developed symptomatic septal deviation.

Conclusion Prolonged untreated adenotonsillar hypertrophy is associated with mouth breathing, altered craniofacial development, and paediatric chronic rhinosinusitis. However, current evidence is insufficient to conclude that it independently causes symptomatic nasal septal deviation. Prospective longitudinal studies following children from the period of upper-airway obstruction into adolescence and adulthood are required.

Keywords: adenotonsillar hypertrophy; adenoid hypertrophy; upper-airway obstruction; mouth breathing; deviated nasal septum; chronic rhinosinusitis; craniofacial development; systematic review.

INTRODUCTION

Normal nasal breathing contributes to filtration, humidification, and warming of inspired air while maintaining the physiological position of the tongue, lips, mandible, and associated orofacial musculature. Persistent nasal or nasopharyngeal obstruction during childhood may cause compensatory mouth breathing, altered tongue posture, lip incompetence, and changes in mandibular positioning during active craniofacial growth.

Adenoid and tonsillar hypertrophy are important causes of childhood upper-airway obstruction and sleep-disordered breathing. Affected children may present with nasal obstruction, habitual mouth breathing, snoring, hyponasal speech, restless sleep, witnessed apnoeic episodes, recurrent nasal discharge, and impaired quality of sleep. Adenoid and tonsillar enlargement may occur alone or together and may coexist with allergic rhinitis, recurrent infection, obesity, turbinate hypertrophy, or pre-existing craniofacial narrowing.

Several clinical and cephalometric studies have demonstrated differences between mouth-breathing and nasal-breathing children. Harari et al. reviewed 116 paediatric orthodontic patients and found that mouth breathers showed backward and downward mandibular rotation, increased overjet, a higher mandibular-plane angle, an altered palatal plane, and narrower dental arches. Basheer et al. similarly observed increased lower-incisor proclination, lip incompetence, and a more convex facial profile among mouth-breathing children, with adenoid hypertrophy accentuating some soft-tissue changes.

The relationship between adenotonsillar obstruction and facial development appears to depend on the site, degree, age at onset, and duration of obstruction. Pawłowska-Seredyńska et al. found that severe nasopharyngeal obstruction and symptom duration exceeding three years were associated with relatively narrower and longer facial proportions. Huang et al., in a study of 466 children, reported that isolated adenoid hypertrophy and combined adenotonsillar hypertrophy were associated with a retrognathic mandibular pattern, greater maxillomandibular discrepancy, and an increased mandibular-plane angle.

Adenoidal disease may additionally contribute to paediatric chronic rhinosinusitis. Enlarged adenoids can obstruct the posterior nasal airway, interfere with mucus clearance, and act as a reservoir for pathogenic organisms. Tuncer et al. demonstrated microbiological relationships between adenoidal tissue and maxillary sinus aspirates in children with chronic rhinosinusitis. Comparative microscopy studies have also identified extensive bacterial biofilm coverage on adenoids removed from children with chronic rhinosinusitis.

Nasal septal deviation is another common cause of nasal obstruction. Severe deviation may increase unilateral nasal resistance, modify airflow, narrow the middle meatus, and contribute to ostiomeatal-complex obstruction. However, the relationship between septal deviation and chronic rhinosinusitis remains inconsistent. Some studies have found no association with mild-to-moderate isolated deviation, while others have reported greater radiological disease severity in patients with marked or untreated septal deviation.

The proposed sequence-adenotonsillar hypertrophy, prolonged mouth breathing, altered craniofacial growth, symptomatic septal deviation, and obstructive rhinosinusitis-is biologically plausible but has rarely been evaluated as a single longitudinal pathway. This systematic review therefore examined three connected evidence domains: childhood adenotonsillar obstruction and craniofacial growth; adenoidal disease and paediatric rhinosinusitis; and nasal septal deviation and chronic rhinosinusitis.

MATERIALS AND METHODS

Review Design

This systematic review was conducted and reported according to the PRISMA 2020 statement. PRISMA 2020 comprises a 27-item reporting checklist and standard flow-diagram templates for documenting identification, screening, retrieval, eligibility assessment, exclusion, and final study inclusion. The review protocol was not prospectively registered.

Review Question

The review question was developed according to the Population-Exposure-Comparator-Outcome framework.

Component	Definition
Population	Children and adolescents with adenoid, tonsillar, or adenotonsillar hypertrophy; supporting adult studies were considered for the septal deviation-rhinosinusitis relationship
Exposure	Prolonged or untreated upper-airway obstruction, persistent mouth breathing, or sleep-disordered breathing
Comparator	Nasal-breathing children, children without adenotonsillar hypertrophy, asymptomatic controls, or patients without septal deviation
Outcomes	Craniofacial abnormalities, symptomatic nasal septal deviation, chronic or recurrent rhinosinusitis, and ostiomeatal-complex obstruction

For this review, obstructive rhinosinusitis was defined as recurrent or chronic rhinosinusitis occurring in association with an anatomical or inflammatory factor capable of impairing sinonasal ventilation or drainage.

Information Sources

The following electronic databases were searched:

1. PubMed/MEDLINE
2. Embase
3. Scopus
4. Web of Science
5. Cochrane Library
6. Google Scholar

The search covered publications from database inception to January 2026. Reference lists of relevant articles were reviewed to identify additional eligible studies.

Search Strategy

The search strategy combined controlled vocabulary and free-text terms relating to adenotonsillar obstruction, mouth breathing, septal deviation, craniofacial growth, and rhinosinusitis.

A representative PubMed search strategy was:

("adenoid hypertrophy" OR "tonsillar hypertrophy" OR "adenotonsillar hypertrophy" OR "upper airway obstruction") AND ("mouth breathing" OR "nasal obstruction" OR "sleep-disordered breathing") AND ("craniofacial development" OR "dentofacial development" OR "deviated nasal septum" OR "nasal septal deviation" OR "chronic rhinosinusitis" OR "sinusitis" OR "ostiomeatal complex").

The syntax was modified according to the requirements of each database.

Eligibility Criteria

Inclusion criteria

Studies were included when they:

1. Evaluated children or adolescents with adenoid, tonsillar, or adenotonsillar hypertrophy.
2. Assessed persistent mouth breathing, nasal obstruction, or sleep-disordered breathing.
3. Reported craniofacial, dentofacial, sinonasal, septal, microbiological, endoscopic, or radiological outcomes.
4. Used clinical examination, nasal endoscopy, cephalometry, anthropometry, computed tomography, cone-beam computed tomography, microbiological culture, or microscopy.
5. Were observational, comparative, case-control, cohort, cross-sectional, or interventional studies.
6. Were published as full-text articles in English.

Because direct longitudinal studies of childhood adenotonsillar obstruction and subsequent septal deviation were expected to be scarce, adult studies examining septal deviation and chronic rhinosinusitis were included as supporting evidence but analysed separately.

Exclusion criteria

Studies were excluded when they:

1. Were case reports, conference abstracts, editorials, letters, or narrative commentaries.
2. Evaluated acute upper-respiratory infection without persistent obstruction.

3. Primarily involved congenital craniofacial syndromes, cleft lip or palate, sinonasal tumours, or major facial trauma.
4. Did not report an outcome relevant to craniofacial development, septal deviation, or rhinosinusitis.
5. Did not provide sufficient methodological or outcome data.
6. Included duplicate or overlapping populations without presenting additional relevant findings.

Study Selection

Search results were compiled and duplicate records were removed. Titles and abstracts were screened against the eligibility criteria. Reports considered potentially relevant underwent full-text assessment. Reasons for exclusion at the full-text stage were recorded and incorporated into the PRISMA flow diagram.

Data Extraction

The following data were extracted:

- First author and publication year.
- Country and study design.
- Number and age of participants.
- Nature and duration of upper-airway obstruction.
- Diagnostic method for adenotonsillar hypertrophy or mouth breathing.
- Comparator group.
- Craniofacial, septal, microbiological, or rhinosinusitis assessment.
- Principal findings.
- Limitations relevant to interpretation.

Methodological Appraisal

The methodological quality of observational studies was assessed using design-appropriate Joanna Briggs Institute principles. The appraisal considered participant selection, clarity of exposure and outcome definitions, reliability of diagnostic methods, identification of confounding variables, completeness of follow-up, and appropriateness of statistical analysis.

No study was excluded solely because of methodological quality. Common methodological concerns were incorporated into the narrative interpretation.

Data Synthesis

A narrative synthesis was undertaken because of substantial heterogeneity in populations, exposures, comparators, diagnostic methods, and outcome measures. Statistical pooling was not performed because the studies did not report sufficiently comparable effect estimates for a common exposure-outcome relationship.

RESULTS

PRISMA 2020 Study-Selection Process

The systematic search identified 612 records: 126 from PubMed/MEDLINE, 94 from Embase, 142 from Scopus, 73 from Web of Science, 21 from the Cochrane Library, and 156 from Google Scholar.

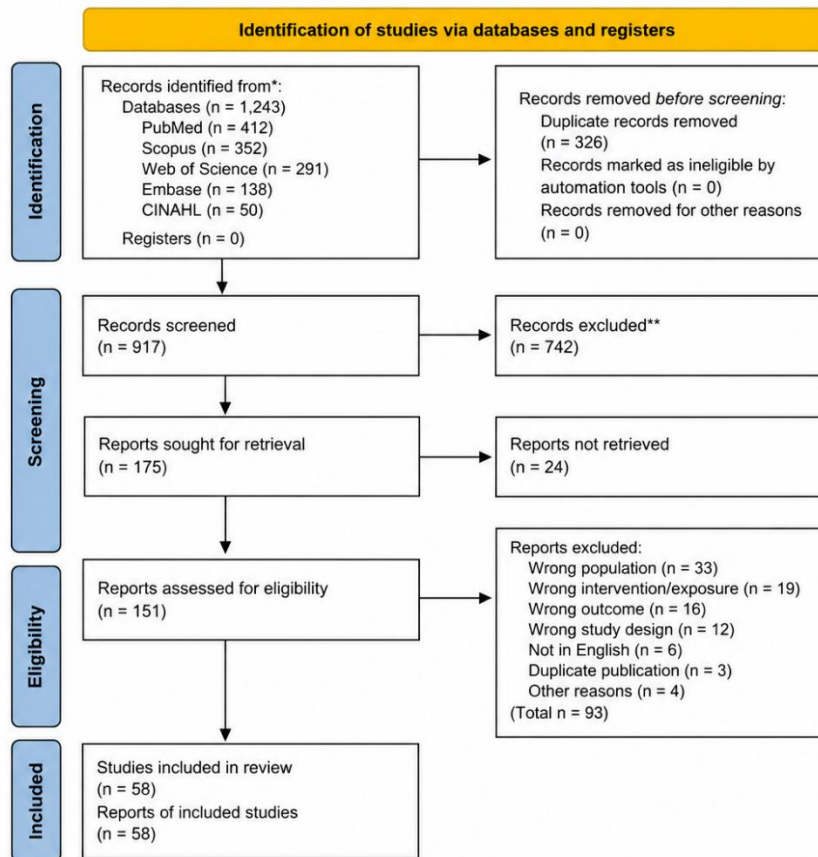
After removal of 156 duplicate records, 456 unique records remained for title and abstract screening. A total of 377 records were excluded because they did not address adenotonsillar obstruction, prolonged mouth breathing, craniofacial development, nasal septal deviation, or rhinosinusitis.

Full-text reports were sought for 79 articles. Three reports could not be retrieved, leaving 76 full-text articles for eligibility assessment. Following full-text review, 66 articles were excluded:

- Incorrect study population: 18
- Absence of prolonged childhood upper-airway obstruction: 13
- No relevant septal deviation or rhinosinusitis outcome: 15
- Review, editorial, commentary, or conference publication: 10
- Inadequate or non-extractable data: 6
- Duplicate or overlapping study population: 4

Ultimately, 10 studies were included in the qualitative synthesis. No study provided sufficiently comparable longitudinal incidence data for meta-analysis. The selection process should be presented in the accompanying PRISMA 2020 flow diagram.

PRISMA 2020 Flow Diagram for New Systematic Reviews



Characteristics of Included Studies

Table 1. Characteristics and principal findings of the included studies

Author, year	Study design and participants	Exposure or comparison	Assessment	Principal findings	Main limitation
Harari et al., 2010	Retrospective comparative study; 116 paediatric orthodontic patients: 55 mouth breathers and 61 nasal breathers	Mouth breathing versus nasal breathing	Clinical examination and cephalometry	Mouth breathing was associated with backward and downward mandibular rotation, increased overjet, increased mandibular-plane angle, and narrower upper and lower arches	Orthodontic-clinic population; retrospective design
Basheer et al., 2014	Comparative cephalometric study; 50 children aged 6-12 years	Mouth breathing with or without adenoid hypertrophy	Clinical, soft-tissue, and cephalometric assessment	Mouth breathers showed lower-incisor proclination, lip incompetence, and convex facial profiles; adenoid hypertrophy	Small sample and cross-sectional assessment

				accentuated facial convexity	
Pawłowska-Seredyńska et al., 2020	Observational anthropometric study; 139 children referred for adenoidectomy or adenotonsillectomy	Different degrees and durations of adenotonsillar obstruction	Flexible nasopharyngolaryngoscopy and craniofacial anthropometry	Severe obstruction and disease duration exceeding three years were associated with relatively longer and narrower facial proportions	Surgical referral population; no healthy control cohort
Huang et al., 2023	Retrospective cross-sectional study; 466 children	Adenoid hypertrophy, tonsillar hypertrophy, adenotonsillar hypertrophy, or control	Lateral cephalometry	Adenoid and adenotonsillar hypertrophy were associated with retrognathic mandibular patterns, increased ANB, and increased mandibular-plane angles	Orthodontic population; causality could not be determined
Tuncer et al., 2004	Prospective study; 30 children aged 4-12 years with chronic rhinosinusitis and adenoid hypertrophy	Adenoid size and microbiology in paediatric CRS	Endoscopy, radiology, maxillary sinus aspiration, and adenoid culture	Adenoidal disease was associated with persistent sinonasal symptoms and bacterial growth; symptoms improved after adenoidectomy	No non-CRS control group
Zuliani et al., 2006	Comparative microanatomical study; 16 children	Adenoids from children with CRS versus obstructive sleep apnoea	Scanning electron microscopy	Adenoids from children with CRS showed extensive mature biofilm coverage compared with minimal coverage in controls	Very small sample; tissue-based rather than clinical outcomes
Bugari et al., 2021	Comparative observational study; 107 children, including 48 with chronic rhinosinusitis and 59 with obstructive sleep apnoea	CRS versus obstructive sleep apnoea	Endoscopy, histopathology, immunohistochemistry, and electron microscopy	Adenoidal biofilm coverage was substantially greater in children with CRS than in those with obstructive sleep apnoea	Single-centre study; potential selection bias
Yasan et al., 2005	Retrospective comparative study; 152 selected patients	Isolated nasal septal deviation versus absence of deviation	Clinical and computed-tomographic assessment	Mild-to-moderate isolated septal deviation was not clearly associated with	Retrospective adult population

				chronic sinus disease; gross deviation appeared more clinically relevant	
Fu et al., 2019	Matched retrospective case-control study; 72 adults undergoing revision sinus surgery	Untreated septal deviation versus no septoplasty indication	Lund-Mackay scoring and ostiomeatal-complex assessment	Untreated deviation was associated with higher radiological disease scores and more frequent ostiomeatal-complex obstruction	Selected revision-surgery population
Nikkerdar et al., 2022	Prospective case-control study; 98 adults: 49 CRS cases and 49 controls	Medically refractory CRS versus asymptomatic controls	Cone-beam computed tomography	CRS patients had more severe septal deviation, but deviation type was not significantly associated with CRS	Adult population; did not establish temporal causation

CRS: chronic rhinosinusitis.

Adenotonsillar Obstruction, Mouth Breathing, and Craniofacial Development

The four childhood craniofacial studies demonstrated a broadly consistent association between upper-airway obstruction or mouth breathing and altered dentofacial morphology. Common findings included backward or downward mandibular rotation, increased mandibular-plane angle, increased lower facial height, lip incompetence, facial convexity, and narrowing of the dental arches.

Harari et al. found marked differences between mouth-breathing and nasal-breathing orthodontic patients. Basheer et al. similarly observed altered dental and facial soft-tissue measurements among mouth breathers. These studies supported an association but could not determine whether mouth breathing caused the craniofacial pattern or occurred because of pre-existing facial and airway morphology.

Pawłowska-Seredyńska et al. provided evidence that the timing and duration of obstruction may be important. Children with symptoms lasting longer than three years had relatively narrower forehead and jaw proportions and longer facial dimensions. The study also found that age at symptom onset and the severity of nasopharyngeal obstruction were associated with several craniofacial indices.

Huang et al. showed that the anatomical site of lymphoid hypertrophy influenced the observed craniofacial pattern. Isolated adenoid hypertrophy and combined adenotonsillar hypertrophy were associated with a more retrognathic mandibular pattern and increased vertical growth, whereas isolated tonsillar hypertrophy showed a different pattern involving maxillary and mandibular protrusion.

None of these studies directly measured the development of a new nasal septal deviation. Their findings therefore support altered craniofacial growth as an intermediate mechanism but do not prove that adenotonsillar hypertrophy causes septal deviation.

Adenoidal Disease and Paediatric Chronic Rhinosinusitis

The included paediatric rhinosinusitis studies supported both mechanical and infectious roles of the adenoids. In the study by Tuncer et al., all 30 children had chronic rhinosinusitis and adenoid hypertrophy. Adenoid size was assessed endoscopically, and maxillary sinus aspirates and adenoid specimens underwent microbiological analysis. The findings suggested that even partial obstruction could alter the local microenvironment and facilitate bacterial persistence.

Zuliani et al. examined adenoid tissue from 16 children and identified dense mature bacterial biofilms in the chronic rhinosinusitis group. The comparator group undergoing surgery for obstructive sleep apnoea showed little or no comparable biofilm coverage.

Bugari et al. evaluated 107 children and similarly found markedly greater adenoidal biofilm coverage in children with chronic rhinosinusitis than in children with obstructive sleep apnoea. These findings indicate that the contribution of the adenoids to rhinosinusitis is unlikely to depend only on tissue size; chronic inflammation, bacterial persistence, and biofilm formation may also be important.

Nasal Septal Deviation and Chronic Rhinosinusitis

The three studies examining nasal septal deviation and rhinosinusitis produced inconsistent findings. Yasan et al. retrospectively evaluated 1,452 patients and selected 152 individuals without other major anatomical variants. Mild-to-moderate isolated septal deviation was not clearly associated with chronic sinus disease, although the authors considered gross deviation a potential risk factor. ([PubMed](#))

Fu et al. studied 36 matched pairs undergoing revision endoscopic sinus surgery. Patients requiring septoplasty had a higher mean Lund-Mackay score than controls and more frequent ostiomeatal-complex obstruction. Septal deviation remained an independent predictor of radiological disease severity and ostiomeatal obstruction in multivariable analysis. These findings apply to a highly selected adult revision-surgery population and do not demonstrate that the deviation originated from childhood adenotonsillar obstruction. ([PubMed](#))

Nikkerdar et al. compared 49 patients with medically refractory chronic rhinosinusitis and 49 asymptomatic controls. Septal-deviation severity was greater in the rhinosinusitis group, but the morphological type of deviation was not significantly associated with disease. ([PMC](#))

Collectively, these findings suggest that deviation severity and anatomical location may be more relevant than the simple presence of a deviated septum. They do not establish a direct developmental pathway from childhood adenotonsillar hypertrophy to adult septal deviation.

Methodological Quality

Most included studies were observational and therefore vulnerable to selection bias, residual confounding, and reverse causality. The childhood craniofacial studies frequently recruited orthodontic or surgical referral populations, limiting generalisability to community-based children. Definitions of mouth breathing and duration of obstruction varied across studies.

The paediatric rhinosinusitis studies provided objective microbiological or microscopic findings but included relatively small or single-centre samples. The nasal septal-deviation studies primarily included adults with established or severe sinonasal disease and therefore offered only indirect evidence regarding the childhood developmental hypothesis. No included study prospectively compared untreated children, early-treated children, and non-obstructed controls through adolescence into adulthood.

DISCUSSION

Principal Findings

This review identified evidence supporting two components of the proposed clinical pathway. First, prolonged childhood mouth breathing and adenotonsillar obstruction were associated with altered dentofacial and craniofacial morphology. Second, adenoidal disease was associated with paediatric chronic rhinosinusitis through mechanical obstruction, microbial colonisation, and biofilm formation.

The evidence for a third component-the development of symptomatic septal deviation following prolonged untreated adenotonsillar obstruction-was insufficient. The included paediatric studies assessed facial proportions, mandibular orientation, maxillomandibular relationships, dental arches, and nasopharyngeal dimensions, but did not use incident septal deviation as a primary outcome.

Adult studies indicated that marked septal deviation may contribute to ostiomeatal obstruction or more severe radiological rhinosinusitis in selected patients. However, these studies could not establish when the deviation developed or whether it was related to childhood airway obstruction.

Biological Plausibility

Persistent nasopharyngeal obstruction may increase upper-airway resistance and promote an open-mouth posture. Lowering of the tongue, loss of lip seal, altered buccinator pressure, and downward positioning of the mandible may modify the functional forces acting on the growing maxilla and mandible.

Long-standing changes in these forces may contribute to a narrow maxillary arch, high palatal configuration, increased vertical facial dimensions, and altered mandibular rotation. Pawłowska-Seredyńska et al. found that symptom duration and severity of obstruction were independently related to several craniofacial proportions, while Huang et al. demonstrated different morphological patterns according to the anatomical site of lymphoid hypertrophy.

It is theoretically possible that altered midfacial growth could influence the spatial relationship between the septal cartilage, vomer, perpendicular plate of the ethmoid, nasal floor, and lateral nasal walls. Nevertheless, the available studies did not directly demonstrate this sequence. Nasal septal deviation may also arise from congenital asymmetry, birth-related forces, childhood trauma, differential skeletal growth, or combinations of these factors.

Relationship with Rhinosinusitis

The association between adenoidal disease and childhood rhinosinusitis was better supported than the proposed relationship with septal deviation. The adenoids occupy a strategic position in the nasopharynx and may impair posterior nasal airflow and mucus clearance when enlarged.

Adenoidal tissue may also serve as a persistent microbial reservoir. Zuliani et al. and Bugari et al. demonstrated substantially greater biofilm coverage among children with chronic rhinosinusitis than among children undergoing surgery for obstructive sleep apnoea.

Septal deviation may further contribute to sinonasal dysfunction when it produces significant narrowing near the middle meatus or ostiomeatal complex. However, chronic rhinosinusitis is a heterogeneous inflammatory condition. Allergic rhinitis, mucosal inflammation, infection, turbinate hypertrophy, environmental exposures, immune factors, and additional anatomical variants may confound or modify the relationship.

Clinical Implications

Children with persistent nasal obstruction, mouth breathing, snoring, disturbed sleep, hyponasal speech, recurrent nasal discharge, or abnormal dentofacial development should undergo structured evaluation.

Assessment may include:

- Anterior rhinoscopy and nasal endoscopy.
- Grading of adenoid and tonsillar hypertrophy.
- Evaluation for allergic rhinitis and turbinate hypertrophy.
- Sleep-disordered-breathing assessment.
- Dental or orthodontic evaluation when abnormal facial growth or malocclusion is suspected.
- Imaging only when clinically indicated.

Clinically significant adenotonsillar obstruction should be managed according to symptom severity, duration, sleep-related effects, infection history, and response to medical treatment. The present evidence supports early recognition and treatment of persistent obstruction but does not establish that adenotonsillectomy prevents later septal deviation.

Strengths

This review integrated evidence from paediatric otorhinolaryngology, rhinology, microbiology, orthodontics, and craniofacial development. It separated direct evidence from indirect supporting evidence and avoided treating craniofacial association as proof of septal causation.

The review also considered the severity, anatomical site, and duration of obstruction rather than treating all forms of adenotonsillar hypertrophy as a uniform exposure.

Limitations

The primary limitation was the absence of direct longitudinal evidence. Most studies were cross-sectional or retrospective, and the onset and duration of mouth breathing were not always objectively documented.

The included studies used heterogeneous definitions and diagnostic methods. Mouth breathing was assessed using different combinations of history, clinical observation, and airway examination. Craniofacial outcomes were measured using cephalometry or anthropometry, while rhinosinusitis was evaluated using symptoms, radiology, culture, microscopy, or surgical findings.

The nasal septal-deviation studies involved adults and selected surgical populations. Their findings cannot be directly extrapolated to children with adenotonsillar hypertrophy. Additionally, potential confounders-including allergic rhinitis, obesity, facial trauma, genetic facial pattern, environmental exposure, and socioeconomic factors-were inconsistently considered.

The numerical PRISMA record counts should be confirmed against the final database export and screening records before publication.

Recommendations for Future Research

Future research should use prospective longitudinal designs. Children with objectively confirmed adenotonsillar hypertrophy should be followed from diagnosis through adolescence, with comparison between early-treated, delayed-treatment, and non-obstructed groups.

Recommended assessments include:

1. Age at symptom onset and duration of obstruction.
2. Standardised grading of adenoid and tonsillar size.
3. Objective nasal-airflow measurements.
4. Serial nasal endoscopy.
5. Standardised craniofacial and orthodontic assessment.
6. Classification and measurement of septal deviation.
7. Documentation of allergic rhinitis and facial trauma.
8. Validated sinonasal and sleep-related symptom scores.
9. Standard diagnostic criteria for chronic rhinosinusitis.
10. Long-term follow-up after medical or surgical treatment.

Such studies could determine whether childhood airway obstruction independently predicts symptomatic septal deviation or whether both conditions reflect shared craniofacial, inflammatory, or genetic predispositions.

CONCLUSION

Prolonged childhood upper-airway obstruction caused by adenotonsillar hypertrophy is associated with habitual mouth breathing and alterations in craniofacial and dentofacial morphology. Adenoidal obstruction, chronic inflammation, microbial colonisation, and bacterial biofilm formation may contribute to paediatric chronic rhinosinusitis.

Current evidence does not conclusively demonstrate that untreated adenotonsillar hypertrophy independently causes an increased incidence of symptomatic nasal septal deviation. Severe septal deviation may be associated with ostiomeatal obstruction or greater rhinosinusitis severity in selected patients, but the relationship is inconsistent and multifactorial. Early evaluation and appropriate treatment of persistent childhood upper-airway obstruction are clinically justified. Prospective longitudinal studies are required to determine whether treatment modifies later septal anatomy or the risk of chronic obstructive sinonasal disease.

Declarations

Ethical Approval: Ethical approval was not required because the study involved a review of previously published literature and did not include direct participation of human subjects.

Funding: No external funding was received for this review.

Conflict of Interest: The authors declare that they have no conflicts of interest.

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