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THE IMPACT OF UPPER AIRWAY DISORDERS ON CRANIOFACIAL DEVELOPMENT IN CHILDREN: A NARRATIVE REVIEW

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ABSTRACT

Introduction: Upper airway disorders in children represent significant clinical problems that may profoundly affect craniofacial development. These conditions disrupt natural breathing patterns and trigger compensatory mechanisms that may lead to permanent structural and functional changes in the developing craniofacial complex.
Aim: The aim of this narrative review was to evaluate the impact of upper airway disorders on craniofacial development in children.
Material and methods: A narrative review was conducted using PubMed/MEDLINE and Google Scholar. A purposive, non-systematic approach was used for article selection, and a total of 23 publications were included based on clinical relevance.
Results: Upper airway disorders were associated with measurable craniofacial transformations beginning early in development. Increased vertical facial dimensions, altered sagittal skeletal relationships, and a higher prevalence of malocclusion, including anterior crossbite were the most common changes. Untreated conditions result in permanent structural abnormalities, dental health problems, and systemic complications including cognitive deficits and cardiovascular issues.
Conclusions: Early diagnosis and multidisciplinary management of upper airway disorders are essential to prevent long-term structural, functional, and systemic complications.

KEYWORDS

Upper Airway Disorders, Craniofacial Development, Children

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1. Introduction

Upper airway disorders in children include a range of conditions that obstruct or alter normal respiratory function within the nasal cavity and pharynx. These ailments fundamentally disrupt the natural breathing pattern, leading to compensatory breathing mechanisms that may significantly influence craniofacial development.

One of the most common manifestations is mouth breathing, recognized as a deleterious oral habit that typically results from upper airway obstruction and altered airflow patterns (Kolawole et al., 2006; Abreu et al., 2008a). The underlying causes often include nasal obstruction or hypertrophy of adenoids and tonsils, which disrupt physiological nasal breathing and force adaptive functional changes (Kolawole et al., 2006; Harari et al., 2010). These alterations extend beyond respiratory function and affect craniofacial morphology. Three-dimensional analyses have demonstrated that children with sleep-disordered breathing present with increased facial height, reduced mandibular prominence, and altered nasal dimensions, indicating early skeletal adaptation to impaired airway function (Al Ali et al., 2015).

Closely related to chronic mouth breathing, obstructive sleep apnea (OSA) is another significant upper airway disorder. It represents a more severe manifestation of airflow compromise and affects approximately 3% of children (Chang & Chae, 2010; Ochwat et al., 2025). Its clinical significance extends beyond sleep disturbances and includes measurable craniofacial alterations. Studies indicate that OSA contributes to hyperdivergent growth patterns and negatively affects orthodontic outcomes (Zhao et al., 2018).

Another well-defined cause of upper airway compromise that has been extensively studied is adenotonsillar hypertrophy. This major anatomical factor contributes to airway obstruction and has been linked to distinct dentofacial abnormalities, including skeletal Class III malocclusion and anterior crossbite (Cai et al., 2025).

Taken together, upper airway disorders share a common pathophysiological pathway involving chronic airway obstruction and compensatory functional adaptation. Increasing evidence suggests that environmental and functional factors significantly influence craniofacial growth, emphasizing the importance of early diagnosis and multidisciplinary management (Yu et al., 2022; Lin et al., 2022).

2. Materials and Methods

A narrative review was conducted to evaluate the relationship between upper airway disorders and craniofacial development in children. Literature searches were performed using PubMed/MEDLINE and Google Scholar.

Keywords included: *mouth breathing, obstructive sleep apnea, adenotonsillar hypertrophy, craniofacial development, malocclusion*.

A total of 23 publications were included, comprising original studies, systematic reviews, and meta-analyses. Selection criteria were based on clinical relevance and contribution to understanding airway obstruction and craniofacial growth. These publications provided the foundation for analyzing and discussing contemporary knowledge regarding how upper respiratory tract disorders influence facial development in children.

Participants: Not applicable.

Procedure: Literature analysis.

Statistical analysis: Not applicable.

AI: AI tools were used solely for language refinement.

3. Results

The results of the analyzed studies consistently indicate that upper airway disorders have a significant impact on craniofacial development in children.

3.1 Early craniofacial changes

The earliest manifestations of upper airway disorders in children present as measurable changes in facial skeletal development across all three major disorder types. These transformations include increased vertical facial dimensions, altered sagittal relationships, and abnormal dental eruption patterns (Al Ali et al., 2015; Zhao et al., 2021). Three-dimensional analyses in children with sleep-disordered breathing confirm reduced mandibular prominence and increased facial height in the affected population (Al Ali et al., 2015; Katyal et al., 2013).

Systematic evidence of initial skeletal changes specifically in mouth breathing demonstrated significantly altered sagittal relationships with lower SNA (MD: -1.63, $P < 0.0001$) and SNB (MD: -1.96, $P < 0.0001$) angles. Early vertical dimensional changes included increased PP-MP (MD: 4.92, $P < 0.0001$) and SNGoGn (MD: 4.10, $P < 0.0001$) measurements, indicating development of a more vertical growth pattern (Zhao et al., 2021). These findings are summarized in Table 1.

Table 1. Early cephalometric changes observed in mouth-breathing children (based on Zhao et al., 2021)

Parameter	Mean Difference (MD)	P-value	Growth Dimension	Clinical Interpretation
SNA (°)	-1.63	<0.0001	Sagittal	Maxillary retrusion tendency
SNB (°)	-1.96	<0.0001	Sagittal	Mandibular retrusion
PP–MP (°)	+4.92	<0.0001	Vertical	Increased mandibular plane angle
SNGoGn (°)	+4.10	<0.0001	Vertical	Vertical growth pattern (hyperdivergence)

These skeletal changes confirm that functional airway disturbances significantly influence craniofacial development.

Tonsillar hypertrophy also affects dentofacial development beginning at the mixed dentition stage, with different obstruction patterns producing distinct early morphological changes. Specifically, anteroposterior obstruction patterns showed significantly higher rates of anterior crossbite (16.67%) and skeletal Class III malocclusion (30.95%) compared to mild obstruction (0.00% and 2.78% respectively). Combined obstruction patterns demonstrated even more pronounced changes with anterior crossbite rates of 21.77% and skeletal Class III development in 34.01% of cases, accompanied by measurable increases in SNB angles (78.75° ± 3.92) and decreased ANB angles (-0.03° ± 3.65), indicating mandibular advancement as an early adaptive response (Cai et al., 2025). The distribution of malocclusion according to obstruction type is presented in Table 2 (Cai et al., 2025).

Table 2. Malocclusion prevalence according to tonsillar hypertrophy type (based on Cai et al., 2025)

Obstruction Type	Anterior Crossbite (%)	Skeletal Class III (%)	SNB (°)	ANB (°)	Key Morphological Pattern
Mild	0.00	2.78	—	—	Minimal skeletal effect
Transverse	0.00	6.00	—	—	Limited transverse impact
Anteroposterior	16.67	30.95	↑	↓	Mandibular advancement
Combined	21.77	34.01	78.75 ± 3.92	-0.03 ± 3.65	Severe skeletal imbalance

3.2 Clinical presentation

Comprehensive clinical characterization of pediatric OSA noted that the clinical presentation varies according to age (Chang & Chae, 2010). Primary symptoms include snoring, as the most common presenting complaint, accompanied by agitated sleep with frequent postural changes, excessive sweating, or abnormal sleep positions such as hyperextension of the neck or abnormal prone position (Chang & Chae, 2010; Ochwat et al., 2025). Sleep-related symptoms include night terror, sleepwalking, and enuresis frequently associated during slow-wave sleep with sleep-disordered breathing (Ochwat et al., 2025). Age-specific presentations show that excessive daytime sleepiness becomes apparent in older children, whereas hyperactivity or inattention is usually predominant in younger children (Chang & Chae, 2010). Additional symptoms include morning headache and poor appetite (Chang & Chae, 2010).

Mouth breathing is associated with nasal obstruction and may lead to various malocclusion patterns (Kolawole et al., 2006). It can also result from pathological hypertrophy of adenoids and/or tonsils (Lin et al., 2022), with different subtypes leading to their specific effects (Cai et al., 2025). While transverse obstruction patterns showed minimal skeletal impact, anteroposterior obstruction created significant sagittal changes with mandibular advancement and rotational growth adaptations (Cai et al., 2025). Combined obstruction patterns produced the most severe presentations, with both dental and skeletal compensatory changes most evident in the combined obstruction group, indicating a significant degree of craniofacial imbalance (Cai et al., 2025). Besides, tonsillar hypertrophy carries a statistically significant association with habitual snoring, sleep apnea, difficulty eating, and frequent tonsillitis in affected children (Kara et al., 2002).

3.3 Treatment

A comprehensive approach to treatment is applied in patients with obstructive sleep apnea. Management includes weight reduction, CPAP/BiPAP therapy, surgical procedures, and pharmacotherapy (Ochwat et al., 2025). OSA patients undergoing comprehensive orthodontic treatment showed significantly increased vertical measurements including mandibular plane angle (SN-GoMe), articular angle (SArGo), sum of Jarabak angles (SUM), and the lower gonial angle (NGoMe), while controls showed improvement (Zhao et al., 2018). Most critically, in the OSA group the growth pattern became more vertical, directly counteracting treatment goals, while in the non-OSA group the growth pattern became more horizontal, showing how untreated airway dysfunction negatively affects orthodontic outcomes (Zhao et al., 2018). Post-procedure monitoring of patients is important because of the potential for lingering symptoms (Ochwat et al., 2025).

Treatment for mouth breathing can be myofunctional or orthodontic. Early intervention on etiological factors of this disorder is highlighted to prevent the development or worsening of malocclusion (Grippaudo et al., 2016). While myofunctional management consisting of orofacial muscle training can be sufficient and show significant forward growth of the mandibles of participating children (Habumugisha et al., 2022), in many cases orthodontic treatments are needed to modify skeletal malocclusions (Grippaudo et al., 2016). Early intervention reduces procedure complexity and carries advantages including more stable results, increased parental satisfaction, and lower risks of enamel decalcifications and gum diseases (Grippaudo et al., 2016). Surgical treatment may be required in cases of anatomical obstruction (Chang & Chae, 2010; Guilleminault et al., 2007).

Tonsillar hypertrophy creates dental and skeletal compensatory changes that complicate orthodontic correction, particularly in combined obstruction cases where craniofacial imbalance is most pronounced (Cai et al., 2025). As the most common cause of OSAS in children, surgical intervention may be necessary as part of comprehensive treatment (Chang & Chae, 2010). Studies show that successful adenoidectomies, through changing mode of breathing from mouth to nose, lead to transformation in the facial proportions of previously mouth-breathing children with enlarged adenoids, making them more similar to those of the healthy population (Mahony et al., 2004).

3.4 Long-term consequences

Untreated upper airway disorders lead to progressive craniofacial abnormalities and systemic complications. These conditions create a cascade of harmful effects that compromise both dental health and overall development in children, with consequences extending far beyond respiratory function.

Mouth breathing is associated with a negative effect on oral health, increasing the risk of caries and periodontal disease (Kolawole et al., 2006; Jefferson, 2010). Recent studies highlight the broader public health implications of this disorder. They indicate a high prevalence of mouth breathing among children, with significant associations with malocclusion and sleep disturbances (Lu et al., 2026; Souki et al., 2009; Abreu et al., 2008b).

Another long-term dental health issue is caused by long-lasting tonsillar hypertrophy. Untreated airway obstruction can result in anterior crossbite and permanent skeletal Class III development, further complicating orthodontic treatment (Cai et al., 2025). These findings are consistent with earlier observations linking chronic airway obstruction with dentofacial abnormalities and altered craniofacial growth patterns (Mahony et al., 2004; Defabjanis, 2003).

General health problems and overall child development impediment can be caused by OSA. Studies highlight this disorder’s contribution to cognitive impairment and behavioral disturbances (Chang & Chae, 2010; Ochwat et al., 2025). Documented associations include attention deficits, difficulties with concentration, poor academic achievement, and emotional instability (Chang & Chae, 2010; Ochwat et al., 2025). Moreover, metabolic disorders and cardiovascular complications are linked with long-lasting untreated OSA (Ochwat et al., 2025). Severe cases may develop cor pulmonale, heart failure, and systemic hypertension (Chang & Chae, 2010). In younger children delayed development and failure to thrive are serious long-term consequences (Chang & Chae, 2010).

4. Discussion

Upper airway disorders play a crucial role in shaping craniofacial development in children. Functional disturbances such as mouth breathing initiate adaptive mechanisms that alter muscle balance, tongue posture, and mandibular positioning, which subsequently influence skeletal growth patterns. Over time, these functional adaptations may become structural changes, leading to persistent craniofacial abnormalities if left untreated (Zhao et al., 2021; Pacheco et al., 2015).

One of the most consistent findings across the analyzed studies is the tendency toward vertical facial growth and hyperdivergent patterns in children with airway obstruction. Reduced SNA and SNB angles, together with increased vertical measurements such as SNGoGn, indicate that impaired nasal breathing disrupts normal maxillomandibular development (Zhao et al., 2021). These findings support the concept that craniofacial growth is not solely genetically determined but is also significantly influenced by functional and environmental factors (Yu et al., 2022; Mahony et al., 2004).

Importantly, different types of airway obstruction appear to produce distinct craniofacial phenotypes. Adenotonsillar hypertrophy is more frequently associated with sagittal discrepancies, including skeletal Class III tendencies, whereas obstructive sleep apnea has been linked to vertical dysplasia and unfavorable orthodontic growth patterns (Zhao et al., 2018; Cai et al., 2025). This differentiation has important clinical implications, as it suggests that the type of airway obstruction should be considered when planning treatment strategies, enabling more targeted interventions.

Earlier studies have also emphasized the relationship between airway obstruction and dentofacial development, confirming the long-standing recognition of this clinical problem (Defabjanis, 2003). The interaction between respiratory tract dysfunction and orthodontic treatment outcomes is particularly relevant.

Several studies indicate that untreated airway disorders may compromise orthodontic effectiveness and increase the risk of relapse (Zhao et al., 2018; Grippaudo et al., 2016). This finding challenges traditional approaches that focus primarily on dental correction without addressing underlying functional causes. Studies demonstrate that conventional orthodontic care alone is insufficient and highlight the need for airway-focused treatment protocols (Zhao et al., 2018). It also reinforces the importance of an interdisciplinary approach involving orthodontists, pediatricians, and otolaryngologists.

From a clinical perspective, early diagnosis is critical. Dentists and orthodontists are often among the first healthcare professionals to observe signs of mouth breathing, altered facial proportions, or malocclusion. Recognizing these features as potential indicators of airway dysfunction may enable earlier referral and intervention. Preventive strategies, including myofunctional therapy and timely surgical management of anatomical obstructions, may significantly improve long-term outcomes (Habumugisha et al., 2022; Guilleminault et al., 2007).

Beyond craniofacial development, upper airway disorders have broader systemic implications. Obstructive sleep apnea has been associated with cognitive impairment and behavioral disturbances, as well as growth, endocrine, and cardiovascular complications in children (Chang & Chae, 2010; Ochwat et al., 2025). All of which significantly diminish the patient's quality of life (Ochwat et al., 2025). These findings emphasize that airway disorders should not be viewed solely as dental or orthodontic problems but as conditions with significant impact on overall health and development.

Despite growing awareness, a gap remains between knowledge and clinical practice, and epidemiological studies continue to demonstrate a high prevalence of untreated functional breathing disorders in children (Lu et al., 2026; Souki et al., 2009; Abreu et al., 2008b). These findings suggest that without structured early screening and intervention strategies, mouth breathing and its associated craniofacial consequences may persist and progress, reinforcing the need for proactive, multidisciplinary prevention programs (Lu et al., 2026).

Limitations

However, several limitations should be acknowledged. Most available studies are observational in nature, which limits the ability to establish causal relationships. Additionally, there is considerable heterogeneity in study design, sample size, and diagnostic criteria for airway disorders, which complicates direct comparison of results. Many studies also focus on specific subgroups of patients, reducing the generalizability of findings.

Future research should prioritize longitudinal studies that follow patients from early childhood through adolescence to better understand the progression of craniofacial changes associated with airway dysfunction. Standardization of diagnostic criteria and treatment protocols would also improve comparability between studies and facilitate the development of evidence-based clinical guidelines.

Taken together, the findings highlight the importance of early interdisciplinary screening and management of upper airway disorders. Addressing airway dysfunction at an early stage may not only improve craniofacial development but also prevent long-term functional and systemic complications.

5. Conclusions

Upper airway disorders significantly impact craniofacial development in children. Studies demonstrate that these conditions create measurable skeletal and dental changes that begin early in development and progress to permanent structural modifications if left untreated.

The evidence reveals that each disorder produces distinct but overlapping craniofacial abnormalities. The research establishes that changes of the facial skeleton are detectable early in development and follow predictable patterns that can serve as diagnostic markers. If used in clinical practice, these findings could enable clinicians to identify at-risk children before severe structural changes occur, making early intervention possible during critical developmental windows.

A multidisciplinary approach in treatment should be applied, combining airway management with appropriate orthodontic intervention. Early therapy beginning leads to less complex procedures and better outcomes.

The consequences of untreated upper airway disorders extend far beyond aesthetic considerations, encompassing serious overall health problems including cognitive deficits, behavioral changes, cardiovascular complications and growth problems. It positions early intervention as a critical public health priority, particularly given the interconnected nature of these disorders. Early screening protocols should be utilized to enable timely referral and intervention.

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REFERENCES

1. Abreu, R. R., Rocha, R. L., Lamounier, J. A., & Guerra, A. F. M. (2008). Prevalence of mouth breathing among children. *Jornal de Pediatria, 84*(5), 467–470. https://doi.org/10.2223/JPED.1806
2. Abreu, R. R., Rocha, R. L., Lamounier, J. A., et al. (2008). Etiology of mouth breathing. *Journal of Pediatrics, 84*(6), 529–535.
3. Al Ali, A., Richmond, S., Popat, H., Playle, R., Pickles, T., Zhurov, A. I., et al. (2015). The influence of snoring, mouth breathing and apnoea on facial morphology in late childhood. *BMJ Open, 5*(9), e009027. https://doi.org/10.1136/bmjopen-2015-009027
4. Cai, C.-S., Li, H., Huang, Y., Luo, B., & Chen, X. (2025). The influence of different tonsillar hypertrophy types on dentofacial and craniofacial development in children with mixed dentition. *BMC Oral Health, 25*, 7350. https://doi.org/10.1186/s12903-025-07350-y
5. Chang, S. J., & Chae, K. Y. (2010). Obstructive sleep apnea syndrome in children: Epidemiology, pathophysiology, diagnosis and sequelae. *Korean Journal of Pediatrics, 53*(10), 863–871. https://doi.org/10.3345/kjp.2010.53.10.863
6. Defabjanis, P. (2003). Impact of nasal airway obstruction on dentofacial development and sleep disturbances in children: Preliminary notes. *Journal of Clinical Pediatric Dentistry, 27*(2), 95–100. https://doi.org/10.17796/jcpd.27.2.27934221l1846711
7. Grippaudo, C., Paolantonio, E. G., Antonini, G., Saulle, R., La Torre, G., & Deli, R. (2016). Association between oral habits, mouth breathing and malocclusion. *Acta Otorhinolaryngologica Italica, 36*(5), 386–394. https://doi.org/10.14639/0392-100X-770
8. Guilleminault, C., Huang, Y. S., Glamann, C., Li, K., & Chan, A. (2007). Adenotonsillectomy and obstructive sleep apnea in children. *Otolaryngology–Head and Neck Surgery, 136*(2), 169–175. https://doi.org/10.1016/j.otohns.2006.09.021
9. Habumugisha, J., Cheng, B., Ma, S.-Y., Zhao, M.-Y., Bu, W.-Q., Wang, G.-L., Liu, Q., Zou, R., & Wang, F. (2022). A non-randomized concurrent controlled trial of myofunctional treatment in mixed dentition children with functional mouth breathing assessed by cephalometric radiographs and study models. *BMC Pediatrics, 22*, 559. https://doi.org/10.1186/s12887-022-03559-w
10. Harari, D., Redlich, M., Miri, S., et al. (2010). The effect of mouth breathing versus nasal breathing on dentofacial development. *American Journal of Orthodontics and Dentofacial Orthopedics, 137*(5), 692–698. https://doi.org/10.1016/j.ajodo.2009.07.018
11. Jefferson, Y. (2010). Mouth breathing: Adverse effects on facial growth and health. *General Dentistry, 58*(1), 18–25.
12. Kara, C. O., Ergin, H., Koçak, G., Kiliç, I., & Yurdakul, M. (2002). Prevalence of tonsillar hypertrophy and associated oropharyngeal symptoms in primary school children in Denizli, Turkey. *International Journal of Pediatric Otorhinolaryngology, 66*(2), 175–179. https://doi.org/10.1016/S0165-5876(02)00247-1
13. Katyal, V., Pamula, Y., Martin, A. J., Daynes, C. N., Kennedy, J. D., & Sampson, W. J. (2013). Craniofacial and upper airway morphology in pediatric sleep-disordered breathing: Systematic review and meta-analysis. *American Journal of Orthodontics and Dentofacial Orthopedics, 143*(1), 20–30.e3. https://doi.org/10.1016/j.ajodo.2012.08.021
14. Kolawole, K. A., et al. (2006). Mouth breathing and dentofacial development. *African Journal of Medicine and Medical Sciences*.
15. Lin, L., Zhao, T., Qin, D., Hua, F., & He, H. (2022). The impact of mouth breathing on dentofacial development: A concise review. *Frontiers in Public Health, 10*, 929165. https://doi.org/10.3389/fpubh.2022.929165
16. Lu, W., Wu, X., Yu, S., Hou, L., & Pan, X. (2026). Investigation on mouth breathing behavior of school-age children and analysis of health intervention strategies. *BMC Oral Health, 26*, 465. https://doi.org/10.1186/s12903-026-07853-2
17. Mahony, D., Karsten, A., & Linder-Aronson, S. (2004). Effects of adenoidectomy and changed mode of breathing on incisor and molar dentoalveolar heights and anterior face heights. *Australasian Orthodontic Journal, 20*(2), 93–98. https://doi.org/10.2478/aoj-2004-0012
18. Ochwat, M., Osiak, O., Piecha, A., Pawlak, J., Orłowska, S., Bednarczyk, Ł., & Stępień, A. (2025). Obstructive sleep apnoea in children: Clinical presentation, diagnosis and treatment. *Journal of Education, Health and Sport, 81*, 66650. https://doi.org/10.12775/JEHS.2025.81.66650

19. Pacheco, M. C., Fiorott, B. S., Finck, N. S., & Araújo, M. T. M. (2015). Craniofacial changes and symptoms of sleep-disordered breathing in healthy children. *Dental Press Journal of Orthodontics, 20*(3), 80–87. https://doi.org/10.1590/2176-9451.20.3.080-087.oar
20. Souki, B. Q., Pimenta, G. B., Souki, M. Q., Franco, L. P., Becker, H. M. G., & Pinto, J. A. (2009). Prevalence of malocclusion among mouth breathing children: Do expectations meet reality? *International Journal of Pediatric Otorhinolaryngology, 73*(5), 767–773. https://doi.org/10.1016/j.ijporl.2009.02.006
21. Yu, J. L., Tangutur, A., Thuler, E., Evans, M., & Dedhia, R. C. (2022). The role of craniofacial maldevelopment in the modern OSA epidemic: A scoping review. *Journal of Clinical Sleep Medicine, 18*(3), 867–876. https://doi.org/10.5664/jcsm.9866
22. Zhao, T., Ngan, P., Hua, F., Zheng, J., Zhou, S., Zhang, M., Xiong, H., & He, H. (2018). Impact of pediatric obstructive sleep apnea on the development of Class II hyperdivergent patients receiving orthodontic treatment: A pilot study. *The Angle Orthodontist, 88*(4), 441–447. https://doi.org/10.2319/110617-759.1
23. Zhao, Z., Zheng, L., Huang, X., Li, C., Liu, J., & Hu, Y. (2021). Effects of mouth breathing on facial skeletal development in children: A systematic review and meta-analysis. *BMC Oral Health, 21*, 108. https://doi.org/10.1186/s12903-021-01458-7