Cumhuriyet Dental Journal, 28(4): 617-626, 2025
DOI: https://doi.org/10.7126/cumudj.1721190

Cumhuriyet Dental Journal

| cdj.cumhuriyet.edu.tr | Founded: 1998 Available online, ISSN: 1302-5805 Publisher: Sivas Cumhuriyet Üniversitesi

Adverse Events of Procedural Sedation in Pediatric Dentistry: Scoping Review

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Review

History

Received: 18/05/2025
Accepted: 17/07/2025

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ABSTRACT

Objectives: This Scoping Review (SR) was developed with the aim of mapping, evaluating, and synthesizing the current evidence available on adverse events associated with the sedation of children undergoing dental treatments.

Materials and Methods: This SR was conducted according to the PRISMA-ScR guidelines, carried out in the PubMed, Web of Science, Scopus, and SciELO databases, and used the descriptors: "procedural sedation," "conscious sedation," "pediatric dentistry," "adverse events," and related terms associated with the boolean operators AND and OR. Articles that exclusively addressed the guiding research question were included, while duplicates and those not aligned with the theme were excluded. The research was registered in the Open Science Framework (OSF).

Results: Initially, 118 articles were identified, 66 were selected, resulting in 28 that fully met the eligibility criteria.

Conclusions: The studies included in this systematic review indicate a variety of adverse events, with frequency and severity varying according to the sedative agent used and the characteristics of the patients. Continuing research in this area is essential to develop more robust and safe guidelines for the sedation of children in dental settings.

Keywords: Procedural sedation, pediatric dentistry, adverse events

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How to Cite: Romagnolo FU, Bottesini VC, de Souza RCC, Duarte DA. (2025) Adverse Events of Procedural Sedation in Pediatric Dentistry: Scoping Review, Cumhuriyet Dental Journal, 28(4): 617-626.

Introduction

Procedural sedation in pediatric dentistry is an increasingly common practice aimed at facilitating the performance of dental treatments in children. However, its application is not without risks, and it is essential to understand the incidence and severity of adverse events associated with this intervention. Although sedation can improve the patient experience, inadequate management can lead to significant complications such as respiratory depression, allergic reactions, and cardiovascular effects.[1,2]

Although similar drugs are used for sedation in children and adults, the doses are higher in children in relation to their body weight. Often, a deeper level of sedation is required to perform a procedure on a child than on an adult. Children are predisposed to develop adverse events and have more challenging airways.[3,4]

Continuous monitoring during the procedure, which allows early detection of hemodynamic and respiratory changes, is crucial to ensure patient safety. The careful selection of drugs with doses adjusted according to the individual needs of each child and the use of appropriate sedative techniques are factors that determine the success of sedation. In addition, professional training and constant updates to guidelines that standardize and regulate the practice of sedation in dental clinics are essential to minimize risks and promote patient safety.[5,6]

Considering that procedural sedation is a standard of care for the control of pain and anxiety during pediatric dental procedures, the purpose of this scoping review (SR) was to map, evaluate and synthesize the available scientific evidence on this topic.

Materials and Methods

This SR included studies reporting adverse events during procedural sedation in children undergoing dental treatment. A protocol was written before starting the investigation and registered in the Open Science Framework (DOI: 10.17605/OSF.IO/S6FM2); the protocol was updated on October 25, 2024. This study was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-analysis Extension for Scoping Reviews (PRISMA-ScR).[Tricco et al., 2018] The study was developed based on the following guiding question: "Are adverse events associated with procedural sedation in pediatric dentistry?". The study was performed according to the PCC strategy, in which P (Population) was children, C (Concept) was adverse events under sedation, and C (Context) was dental treatment.

To select the articles, the PubMed, Web of Science, Scopus and SciELO databases were searched using health descriptors and keywords with the Boolean operators AND and OR. The search strategy was as follows: (Sedation, Dental OR Conscious Sedation OR Minimal Sedation OR Moderate Sedation OR Sedation Dentistry OR Oral Sedation OR Sedation Inhalation OR Procedural Sedation OR Conscious Sedation in Dentistry OR Sedation in Dentistry) AND (Adverse Effects OR Complications OR Side Effects OR Adverse Reactions OR Safety OR Risks OR Harm OR Unintended Effects) AND (Pediatrics OR Adolescent OR Children OR Adolescents OR Infants OR Teens OR Youth OR Pediatric Patients) AND (Dentistry OR Dental Clinics OR Dental Care OR Dental Procedures OR Dentistry for Children OR Pediatric Dentistry OR Dentist Offices). Full-length articles in English, Spanish and Portuguese published between 2014 and 2024 that studied adverse events in children undergoing procedural sedation for dental treatment in the outpatient setting were eligible for inclusion. Duplicate articles, articles that were not exclusively related to the topic of adverse events associated with procedural sedation in pediatric dentistry and articles published outside the defined publication period were excluded.

The data extracted from the studies included information on the sample size; patient age; sedative agents and techniques used; and clinical outcomes, including the efficacy and incidence of adverse events. These data were organized into tables to allow for synthesis.

Data synthesis included the description of adverse events, analysis of reported outcomes and pattern identification. The discussion addressed the clinical implications of the results, the research gaps and the relevance of these findings to the clinical practice of outpatient sedation in dentistry in pediatric patients.

The limitations of this review include the possibility of selection bias, the heterogeneity of the designs of the included studies, and the variability in the methodological quality of the studies. Because this review did not involve patients and/or animals, a waiver of submission was requested from the Research Ethics Committee (CEP) of São Leopoldo Mandic College and approved according to protocol no· 2024-0006.

Results

The initial search identified 118 articles, 28 of which met the inclusion criteria. The results ranged across the defined publication period from 2014 to 2024.

A total of 36 duplicate articles were excluded, and 16 were excluded through the screening process, leaving 66 articles for full-text evaluation. Seven articles were excluded because the study population differed from our target population (children); 18 because they did not report adverse events, only the efficacy of procedural sedation; and 13 because they were not performed in outpatient clinics. Twenty-eight studies remained that were qualified for inclusion. The flowchart of the inclusion process following the recommendations of the PRISMA-ScR guidelines is shown (Figure 1).

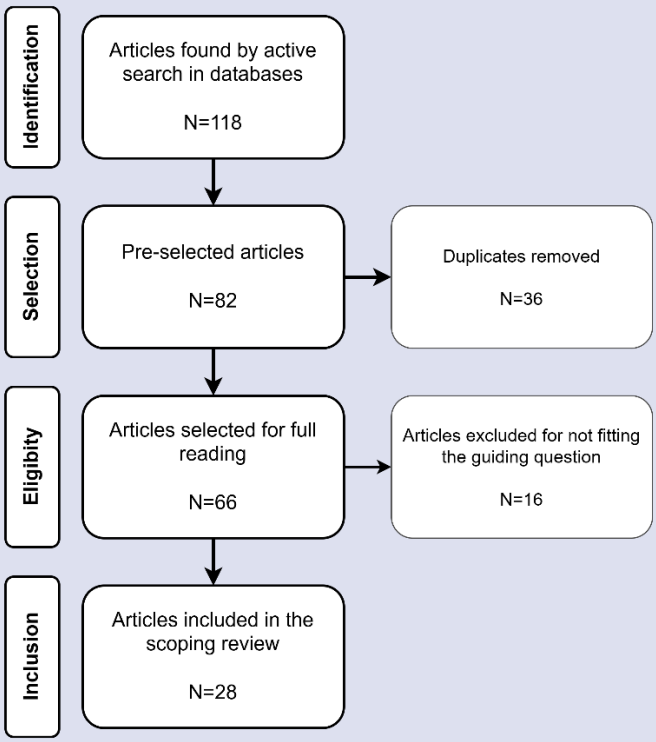


Figure 1. Flowchart illustrating the inclusion process.

Table 2. Data extracted from the selected articles

Author/Year/Country	Title	Study design	Sample	Adverse events	Considerations
Nordt et al., 2014 (United States)	Pediatric chloral hydrate poisonings and death following outpatient procedural sedation	Case report	03 children (15 months-4 years)	- Chloral hydrate poisoning - Death	Chloral hydrate is associated with significant adverse events, including death. There are a number of more effective sedative agents with more predictable safety and pharmacokinetic profiles.
Dosani et al., 2014 (United States)	Postdischarge events occurring after pediatric sedation for dentistry	Prospective observational study	50 children (2-16 years)	- Postdischarge drowsiness - Motor imbalance - Recovery time > 4 hours	Episodes of postdischarge drowsiness, motor imbalance and longer recovery time justify constant adult supervision.
Papineni McIntosh et al., 2015 (United Kingdom)	Reported side effects of intravenous midazolam sedation when used in paediatric dentistry: a review	Literature review	---	- Paradoxical reactions	No significant adverse events were recorded; paradoxical reactions were the most common event. The authors suggest the application of a standardized tool for reporting adverse events for future studies.
Kalibatienė et al., 2015 (Lithuania)	An evaluation of the effectiveness and safety of midazolam in children undergoing dental surgery	Prospective randomized controlled observational study	91 children (2-9 years)	- Hiccup - Excessive salivation	Hiccups and excessive salivation were reported. No allergic reactions, severe bradycardia or respiratory depression, desaturation less than 93%, fainting, or nausea and vomiting were reported.
Huang and Tanbonliong, 2015 (United States)	Oral Sedation Postdischarge Adverse Events in Pediatric Dental Patients	Prospective observational study	51 children (2-10 years)	- Excessive postdischarge drowsiness - Nausea - Difficulty breathing due to excessive coughing - Baseline behavior within 6 hours (56.5%) - Baseline behavior in more than 10 hours (15.2%)	Excessive postdischarge sleepiness during transit and at home and, to a lesser extent, nausea and vomiting were frequent complications. The study highlights the need for careful surveillance of the child until recovery is complete.
Gazal et al., 2016 (Saudi Arabia)	Pain and anxiety management for pediatric dental procedures using various combinations of sedative drugs: A review	Literature review	---	- **Midazolam:** Decrease in systolic BP (5%) and diastolic BP (10%) Decreased systemic vascular resistance (15-33%) Increased HR (18%) Apnea (10-77%) Hypnosis Anterograde amnesia Decreased hepatic and renal blood flow - **Ketamine:** Transient rashes (15%) Delusions/hallucinations Hypertonus Transient respiratory depression Apnea Tracheal and bronchial salivary secretions Laryngospasm Tracheal aspiration Slight increase in BP and HR Cardiovascular output **- Ketamine-Midazolam:** Severe tachycardia (0%) Hypertension (6%) Emesis Myoclonus	Ketamine-midazolam combinations are more viable and safer than fentanyl-midazolam combinations, although there is no reversal agent for ketamine.

Khinda et al., 2016 (India)	Comparative evaluation of diffusion hypoxia and psychomotor skills with or without postsedation oxygenation following administration of nitrous oxide in children undergoing dental procedures: A clinical study	Prospective observational study	60 patients (7-10 years)	- Diffusion hypoxia (group that was not oxygenated after sedation for 7 minutes)	This study showed that diffusion hypoxia only occurs clinically when the patient is not properly oxygenated (100% oxygen) after sedation.
Davidovich et al., 2017 (Israel)	Post-Discharge Events Occurring after Dental Treatment under Deep Sedation in Pediatric Patients	Prospective observational study	54 children (1-16 years)	- Drowsiness < 6 years (81.3%) - Drowsiness > 6 years (86.4%) - Nausea and vomiting (26.7%) - At least one postsedation complication (93.3%)	Although it is safe, deep sedation has complications and adverse events.
Somri et al., 2017 (Israel)	Detection of Respiratory Adverse Events in Pediatric Dental Patients Sedated With 0.75mg/Kg of Midazolam and Oxygen by Continuous Pretracheal Auscultation: A Prospective Randomized Controlled Trial	Prospective randomized controlled observational study	100 children (5-10 years)	- Respiratory adverse events (64%)	Respiratory adverse events were detected in 64% of patients. The majority were detected by auscultation. Capnography produced 28 false-positive results, while PTS produced 8%, which is considered useful for detecting respiratory adverse events during pediatric dental sedation.
Chi, 2018 (Korea)	Complications caused by nitrous oxide in dental sedation	Literature review	---	- Nausea and vomiting - Laryngospasm - Neurological symptoms	The rate of adverse events with N_2O alone was low (0–0.3%), with nausea and vomiting being the most common event. Cases of laryngospasm after high-dose N_2O treatment were reported. Patients repeatedly exposed to N_2O or those with vitamin B-12 deficiency exhibited neurological symptoms.
Kip et al., 2018 (Turkey)	Comparison of three different ketofol proportions in children undergoing dental treatment	Prospective observational study	90 children (2-12 years)	- Myoclonus - Excessive salivation - Tachycardia	A decreased proportion of ketamine in the ketofol mixture was related to a decrease in the adverse effect profile. Parental satisfaction was high, and recovery was rapid. The ketofol mixture at a 1:2 ratio was reliable.
Sado-Filho et al., 2019 (Brazil)	Randomized clinical trial on the efficacy of intranasal or oral ketamine-midazolam combinations compared to oral midazolam for outpatient pediatric sedation	Randomized clinical trial	84 children (1-7 years)	- Minor adverse events (representing little risk) in 44% - Desaturation (1 isolated case)	All regimens provided moderate sedation, with minor adverse events and marked variability in behavior. The benefit of the ketamine-midazolam combination should be investigated in studies with larger sample sizes.
Song et al., 2020 (Korea)	Safety of chloral hydrate sedation in dental practice for children: an overview	Overview	---	- Nausea and vomiting - Excessive sleepiness - Lethargy - Death	In Korea, chloral hydrate syrup is the only oral sedative that can be used in pediatric patients. The younger the age and the worse the physical condition, the deeper the level of sedation can be. The drug reaction is amplified when used in combination with other sedatives. Deaths have been reported.

Nelson et al., 2022 (United States)	Opioid and Multi-Drug Pediatric Dental Sedation: A Narrative Review	Narrative review		- Respiratory depression - Nausea and vomiting - Excessive sedation - Allergies - Cardiovascular changes - Dependence	The study suggests caution when using opioids due to the significant risk of adverse effects and dependence. The study emphasizes safe and effective approaches to sedation and protocols that avoid opioid overuse.
Bilder et al., 2022 (Israel)	Adverse events during sedation for oro-dental trauma in an Israeli paediatric emergency department	Observational study		- Desaturation - Apnea - Hypotension - Bradycardia - Obstruction of airways - Pulmonary aspiration - Laryngospasm (ketamine + propofol)	Adverse events that required intervention in the ketamine + propofol combination included prolonged desaturation, apnea, hypotension, laryngospasm, bradycardia, partial or complete airway obstruction and pulmonary aspiration. There were no serious adverse events associated with the use of ketamine alone.
Julio et al., 2021 (Brazil)	Adverse Effects Associated with the Use of Benzodiazepines for Anxiety Control in Dental Practice: A Literature Review	Literature review	---	- Anterograde amnesia - Muscle relaxation - Increase in HR - Respiratory depression (when associated) - Paradoxical effects (excitement, aggression, irritability)	Benzodiazepines were confirmed to be safe and effective. However, there is a risk of adverse events such as amnesia, anterograde amnesia, hallucinations, drowsiness, and paradoxical effects, although the incidence was low.
Zouaidi et al., 2022 (United States)	An Observational Retrospective Study of Adverse Events and Behavioral Outcomes During Pediatric Dental Sedation	Prospective Observational study	351 children (2-17 years)	- Emesis (1.3%) - Excessive sedation (0.9%) - Increased BP (0.4%) - Desaturation (0.3%) - Pulmonary mucus production (0.3%) - Hypothermia (0.3%) - Allergies (0.1%) - Partial laryngospasm (0.1%)	Potentially serious adverse effects were reported during pediatric dental sedation, but their incidence was low. A significant proportion of the sedated children exhibited agitation, resulting in some sedation failures. These events need to be tracked and examined to reduce risk and improve the quality of care.
Oza et al., 2022 (India)	Comparative Analysis of Sedative Efficacy of Dexmedetomidine and Midazolam in Pediatric Dental Practice: A Systematic Review and Meta-Analysis	Systematic review and meta-analysis	---	- Nausea and vomiting - Nasal irritation	Although dexmedetomidine is superior to midazolam in terms of efficacy and reliability, we did not obtain sufficient data regarding respiratory adverse events. We recommend that more studies be performed.
Nie et al., 2023 (China)	Oral midazolam vs. intranasal dexmedetomidine plus oral midazolam for sedation of pediatric outpatients: a double-blinded randomized controlled trial	Double-blind randomized clinical trial	83 children (3-12 years)	- Lethargy (12.5%) - Bradycardia (2.5%) - Delirium (4.7%) - Diplopia (2.3%) - Nausea and vomiting (4.7%) - Lack of coordination (2.5%) - Agitation (7.2%)	No cases of SpO_2 below 95% were observed. Adverse events were observed, but no patient required medical intervention. The incidence of adverse events was 36.3%. The symptoms of adverse events were relieved after rest. Oral midazolam + intranasal dexmedetomidine had a higher success rate.
Park et al., 2023 (South Korea)	Trends of conscious sedation in the Department of Pediatric Dentistry at the Dankook University Dental Hospital for 11 years	Observational study	6,438 children (5-11 years)	- Nausea and vomiting	As the frequency of sedation increases, the risk of complications also increases. However, there is a lack of data on the awareness and use of sedation methods among pediatric dentists. The proper selection of sedative drugs can minimize several complications.
Khan, 2023 (United Kingdom)	Postoperative Epistaxis Following Dental Treatment With Nitrous Oxide/Oxygen Sedation	Case report	1 child (12 years)	- Postoperative epistaxis	Inhaled sedation with nitrous oxide and oxygen is a common form of sedation used for dental treatment and has an excellent safety record. However, it may be associated with epistaxis in rare cases.

Salerno et al., 2023 (Italy)	Conscious Sedation for Dental Treatments in Subjects with Intellectual Disability: A Systematic Review and Meta-Analysis	Systematic review and meta-analysis	---	- Respiratory changes - Nausea and vomiting - Neurological effects - Vasovagal symptoms - Behavioral changes - Paradoxical effects - Prolonged recovery - Urinary incontinence - Bradycardia - Tachycardia	The prevalence of adverse events ranged from 3% to 37%. Considering the low risk of adverse events and deep sedation, nitrous oxide seems to be the best choice for sedation of individuals with intellectual disability. In case of failure, oral benzodiazepines may be used. General anesthesia is recommended only in more severe cases in which the above techniques are not applicable.
Gao and Wu, 2023 (China)	Procedural sedation in pediatric dentistry: a narrative review	Narrative review	---	- Nausea and vomiting - Laryngospasm - Toxicity - Respiratory depression - Paradoxical effects - Psychomotor disorders	The study reports that a single pharmaceutical agent does not provide ideal sedative results; therefore, professionals combine sedative agents. This practice offers cumulative and intensified sedative effects. Severe neurological impairments and fatalities have been reported due to the combination of more than three drugs, excessive doses or insufficient training. The key to safe sedation lies in the early detection and management of potential adverse events.
Marques et al., 2024 (Portugal)	Evaluating the Quality of Systematic Reviews on Pediatric Sedation in Dentistry: An Umbrella Review	Umbrella review	---	- Nausea and vomiting - Respiratory depression - Airway obstructions - Loss of consciousness - Desaturation - Apnea - Allergic reactions - Hallucinations	The level of evidence regarding the efficacy and safety of sedation in pediatric dentistry is acceptable (67% of moderately high quality systematic reviews). The combination with the highest safety level was the combination of nitrous oxide and midazolam (30-50%). The most frequent adverse events were nausea, vomiting and desaturation. Future systematic reviews should increase methodological consistency.
Nie et al., 2024 (China)	An evaluation of dexmedetomidine in combination with midazolam in pediatric sedation: a systematic review and meta-analysis	Systematic review and meta-analysis	---	- Nausea and vomiting - Bradycardia - Hypotension - Respiratory depression - Hallucinations - Excessive salivation (reactions were directly proportional to dose)	The dexmedetomidine-midazolam combination resulted in higher sedation success rates and a lower incidence of adverse events, indicating good clinical application in outpatient clinics.
Nascimento et al., 2024 (Brazil)	[Dental Sedation in Children with Disabilities]	Integrative review	---	- **Chloral Hydrate:** Respiratory depression Gastrointestinal disorders Cardiac arrhythmias Nausea and vomiting - **Nitrous Oxide:** Residual hypoxia Nausea and vomiting - **Benzodiazepines** (midazolam): Anterograde amnesia Paradoxical effects Hypotension	Adverse effects caused by the studied substances were observed. Professionals should consider comorbidities and the increased risk for sedation in patients with disabilities.

Salinas et al., 2024 (Mexico)	Sedation in pediatric dentistry: A scoping review	Scoping review	---	- **Dexmedetomidine:** Complex hemodynamic effects Bradycardia Hypotension - **Ketamine:** Delusions/hallucinations Arterial and intraocular hypertension Hypersecretion of mucus in the respiratory tract area Excessive salivation Increased BP and HR Increased intracranial pressure - **Midazolam:** Paradoxical effects Respiratory depression - **Nitrous Oxide:** Nausea and vomiting Diffusion hypoxia	All the drugs reviewed (dexmedetomidine, ketamine, midazolam and nitrous oxide) caused adverse events. Nitrous oxide caused the fewest adverse events, provided that the dose was appropriate and the patient had a good clinical history.
El-Rouby et al., 2024 (Egypt)	The effect of dexmedetomidine-ketamine combination versus dexmedetomidine on behavior of uncooperative pediatric dental patients: a randomized controlled clinical trial	Randomized controlled clinical trial	56 children (3-5 years)	- Anterograde amnesia	Both keto-dex combined and dex alone are effective in providing hemodynamic stability. They had comparable amnestic effects, without significant adverse events.

Publications from different countries provided varied perspectives, enriching the research with distinct cultural and social data. The distribution of these publications can show how the topic spreads worldwide, indicating where innovations are occurring and where there are research gaps.

The following data were extracted from the 28 included studies: authors, year, country, title, study design, sample (including ages of the individuals), adverse events and considerations inherent to the studies (Table 1).

Among the observed data, minor adverse events, including nausea, vomiting and excessive sleepiness, were the most frequently reported events, but these events represent little risk. Intermediate adverse events, such as bradycardia and hypotension, which pose a danger to patients if not managed promptly, were also recorded. All events were treated effectively and did not result in serious complications. However, the authors emphasized that even though these events are considered minor and intermediate events, they still present risks that should not be underestimated. For example, bradycardia and hypotension may indicate hemodynamic impairments that require immediate attention.

Serious adverse events (life-threatening events) have been reported in few studies.

Studies that addressed procedural sedation for the dental treatment of children with disabilities were included because these children may have a variety of associated health conditions, such as respiratory, cardiac, neurological and developmental problems. These comorbidities may influence the choice of sedative agent, dosage and monitoring approach during the procedure.

Discussion

The aim of this scoping review was to map the adverse events associated with procedural sedation in pediatric patients undergoing dental treatments and provide a comprehensive view of the safety and risks involved in this practice. The studies included in the analysis revealed a variety of adverse events, with frequencies and severities that varied according to the sedative agent used and the characteristics of the patients.

Procedural sedation is a widely used practice in pediatric dentistry to facilitate dental treatment in children, especially those with high anxiety or difficult behavior. Despite its proven efficacy,[8] the safety of this approach is regularly questioned, especially in relation to associated adverse events. The literature emphasizes the importance of a careful evaluation of the risks and benefits of sedation, considering the vulnerability of the pediatric population.[9,10] The most common reported adverse events included excessive drowsiness, nausea, vomiting, bradycardia, and hypotension. Although drowsiness is an expected major side effect, it requires careful monitoring, as its intensity can impact a child's recovery. It was reported that drowsiness can persist for prolonged periods and highlighted the need for management strategies to ensure safety during recovery.[11,12]

Nausea and vomiting were reported in several studies,[1,11-16] that suggested that nausea and vomiting may be exacerbated by the child's anxiety level and the choice of sedative agent. Nasal irritation was previously reported,[17] and

the management of this adverse effect is crucial, as it can cause significant discomfort and impact the overall experience of patient and their family.

Bradycardia and hypotension, although less common, were also reported,[18,19] these conditions can pose serious risks if not properly monitored. The literature suggests that children with comorbidities and those receiving high doses of sedatives are at greater risk, which emphasizes the importance of a comprehensive presedation evaluation.

In addition to physiological adverse events, some studies also reported the occurrence of anterograde amnesia, an effect that, although desirable in certain contexts for its ability to reduce anxiety, should be carefully considered.[16,20,21] Communication with guardians is essential so that they can understand these effects and the implications for their child's experience during and after sedation.

Epistaxis, or nosebleeds, is a rare adverse event that may occur during or after the administration of nitrous oxide (N_2O) in association with oxygen (O_2) in dental procedures due to vasodilatation and mucosal dryness; epistaxis was reported as an adverse event.[22] Generally, episodes of epistaxis associated with the use of nitrous oxide are mild and self-limiting, requiring no medical intervention other than simple measures, such as nasal compression, but can cause significant discomfort to the patient.

The occurrence of diffusion hypoxia when patients were not properly oxygenated during treatment with nitrous oxide also needs to be considered.[23] When N_2O administration is interrupted, the gas quickly diffuses back into the alveolar space. This process can dilute the oxygen being administered, especially if the oxygen flow is not properly adjusted during gas discontinuation. As a result, the partial pressure of oxygen (PaO_2) may temporarily decrease, leading to symptoms such as confusion, cyanosis, excessive drowsiness, dizziness, headache and, in severe cases, loss of consciousness.

Understanding the mechanisms of dental sedation, together with strict monitoring and proper management, is essential to ensure the safety of patients during and after dental procedures.

During dental sedation, some pediatric patients may experience adverse reactions, such as hiccups and excessive salivation. These symptoms may occur alone or together and may affect the child's overall experience during the procedure.[24,25]

Under prolonged sedation, the probability of hiccups may increase, especially if the patient is more relaxed and stimuli such as oral manipulation or irritation of the airways are present. The administration of sedative agents such as nitrous oxide can irritate the diaphragm, and the position of the patient or manipulation during treatment can cause changes in intrathoracic pressure, leading to episodes of hiccups. Hiccups can be uncomfortable and potentially interfere with the dental procedure, making it more difficult for both the professional and the patient.

With respect to excessive salivation, some sedative agents or even anxiety and stress can stimulate the salivary glands, leading to an increase in saliva production. Excessive salivation can complicate the procedure, hindering visibility and access to treatment areas, in addition to causing discomfort to the patient.

Serious adverse events in dental procedural sedation, although rare, require adequate attention and preparation. One of the most serious events occurring during sedation is respiratory depression, which can result in hypoxemia (low blood oxygen levels).[13,26,27] Respiratory depression may be caused by excessive administration of sedatives or interactions with other medications. Laryngospasm, an involuntary contraction of the muscles of the larynx that results in temporary closure of the upper airways, is triggered by irritation, reflex stimuli or inadequate sedation. Adverse events, including one death, were reported by several studies.[9,18,28,29] The authors related the incidence of these events to the use of the sedative agent chloral hydrate, the combination of sedative agents with opioids, the administration of three or more sedatives in excessive doses, and comorbidities in patients.

Some authors emphasized that sedation in patients with comorbidities or compromised health conditions requires special supervision due to the increased risk of complications.[14,16] These conditions can impact both the safety and efficacy of sedation.

Patients with preexisting respiratory diseases, such as asthma, chronic obstructive pulmonary disorder (COPD) or sleep apnea, are at increased risk of respiratory complications during sedation. The administration of sedatives may depress breathing and increase the risk of laryngospasm.

Patients with heart disease or hypertension may be at increased risk during sedation due to hemodynamic instability: sedatives may cause bradycardia, hypotension or arrhythmias, complicating patient management. These patients exhibit compromised perfusion; in patients with heart failure, sedation can further compromise tissue perfusion and oxygenation.

Conditions such as diabetes and kidney or liver diseases can alter the pharmacokinetics and pharmacodynamics of sedative agents.

Patients with conditions that affect swallowing, such as neurological disorders or gastrointestinal problems, are at increased risk of aspiration during sedation because the cough reflex is impaired. Patients with anxiety disorders or psychiatric conditions may respond unpredictably to sedation. Procedural sedation requires a careful and individualized approach, especially in children, compromised patients and patients with associated comorbidities.

Monitoring during sedation is essential to ensure patient safety and procedure efficacy. The objective is to detect any changes that may indicate complications as early as possible and allow quick interventions.[27]

In addition, it was highlighted the importance of guidelines in procedural sedation in dentistry.[30] Guidelines are essential to ensure safe and effective care, protecting both the patients and professionals involved.

This scoping review identified significant gaps in the literature on sedation in pediatric dentistry. Although the most common adverse events have been well documented, the variability in sedation protocols and the lack of standardization in the studies make it difficult

to generalize the findings. In addition, many studies did not address the relationship between specific patient characteristics (such as age, comorbidities, and anxiety levels) and the occurrence of adverse events, which represents an area for future research.[16,31] The studies included emphasized the need for more research on the safety of sedation in the pediatric population, especially in highly complex settings. Additional studies could identify the best practices to reduce adverse events and optimize the management of sedation in pediatric dentistry.

Conclusions

In conclusion, this scoping review highlights the importance of rigorously monitoring the adverse events associated with sedation in pediatric patients. Understanding these risks not only improves the safety of dental procedures but also contributes to more informed and evidence-based practices in pediatric dentistry. Continued research in this area is essential to develop more robust and safer guidelines for the sedation of children in dental settings.

Acknowledgements

None.

Conflicts of Interest Statement

The authors declare no conflict of interest.

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