ORIGINAL RESEARCH

Efficacy of Nitrous Oxide Anxiolysis in Managing Different Types of Behavior Patterns in Pediatric Dental Patients

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Abstract

Background: Pediatric dentistry aims to provide quality dental care for children, but fear, anxiety, and pain associated with dental procedures can hinder successful treatment. Managing children with different behavior patterns requires behavioral techniques; however, some patients may not tolerate procedures and require alternative approaches such as nitrous oxide anxiolysis. Recent updates have refined its scope, categorizing minimal sedation (anxiolysis) as a drug-induced state where patients respond normally to verbal commands.

Aim and objective: The aim of this study is to evaluate the efficacy of inhalation nitrous oxide anxiolysis for managing different types of behavior patterns in pediatric dental practice.

Materials and methods: This interventional trial included 70 children aged 3–9 years meeting the inclusion criteria, who were categorized into eight behavioral groups based on Wright's classification following a counseling visit and consent process. Anxiety and physiological assessments were conducted using the Venham Clinical Anxiety Scale (VCAS) (dentist's evaluation), Chhota Bheem–Chutki Scale (patient's self-assessment), and pulse oximeter [for pulse rate and oxygen saturation (SpO_2) levels], both pre- and posttreatment to evaluate the effectiveness of nitrous oxide sedation. Before the second visit, preappointment instructions were given to the parents. During the treatment visit, all children received restorative treatment under nitrous oxide anxiolysis, with parental presence in the operatory.

Results: The data were tabulated and analyzed using the Statistical Package for the Social Sciences (SPSS) (v26.0, IBM). Intergroup comparisons were conducted using Kruskal–Wallis analysis of variance (ANOVA).

Conclusion: This study reaffirms that nitrous oxide sedation is a safe and effective approach for managing pediatric dental anxiety, significantly reducing anxiety levels while maintaining stable physiological parameters with minimal side effects. However, a comprehensive understanding of a child's behavioral patterns allows for a more structured and child-centered approach, enabling precise modifications in treatment planning based on pre- and postsedation behavior.

Keywords: Anxiolysis, Conscious sedation, Nitrous oxide, Pharmacological behavior management.

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Introduction

Dental fear and anxiety are characterized by intense negative emotions associated with dental treatments and are prevalent among children and adolescents. They are the most common cause of behavioral management challenges and noncompliance during dental visits, making it difficult for pediatric dentists to provide effective treatment. The cornerstone of pediatric dentistry lies in the dentist's skill in guiding children through their dental experiences. Children often exhibit strong fear specifically related to certain stimuli encountered during dental procedures and acute anxiety from the uncertainty and anticipation of the treatment itself. In response to these feelings, children frequently display a wide range of negative attitudes and behaviors.[1]

Managing a child's behavior presents a unique set of challenges due to their distinct psychological characteristics. Unlike adults, children are often egocentric, spontaneous, easily distracted, and have short attention spans, making it difficult to maintain their cooperation during treatment. As a result, pediatric dentists face significant challenges in managing difficult or uncooperative behavior in young patients. Whether dealing with a child's refusal to cooperate or their inconsolable crying, finding effective strategies to provide necessary dental treatment can be daunting. These behavioral complexities require pediatric dentists to employ a variety of specialized techniques and approaches tailored to the individual child's needs and developmental level.[2]

Advanced behavior guidance mainly involves more complex interventions such as sedation and general anesthesia and is typically used when basic techniques are ineffective or in children with special healthcare needs. Both approaches are vital for delivering effective and patient-centered pediatric dental care.[3]

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Conscious sedation refers to a medically supervised state where a patient's awareness is reduced, but essential reflexes and the ability to maintain their airway remain intact.[4] Within this framework, nitrous oxide is widely used for its anxiolytic effects. Sedation is typically categorized into three levels: (1) minimal sedation (anxiolysis), where patients are relaxed but fully responsive and vital functions remain normal; (2) moderate sedation, where patients respond purposefully and can still maintain their airway and stable cardiovascular function; and (3) deep sedation, which may impair responsiveness and require airway support, although cardiovascular function is usually not affected.[5] The technique involves delivering a carefully controlled blend of nitrous oxide and oxygen at subanesthetic levels through a nasal mask using specialized equipment. Due to its low solubility and high minimum alveolar concentration, nitrous oxide acts quickly and wears off just as fast. This allows for precise control over the sedation period and enables most patients to return to their regular activities shortly after the procedure.[6]

Nitrous oxide was first synthesized by Joseph Priestley in 1772. It gained medical relevance on December 10, 1844, when American dentist, Horace Wells (father of anesthesia), observed its analgesic effects during a public demonstration and later used it for his own tooth extraction, marking the advent of modern anesthesia. By the mid-20th century, combining nitrous oxide with oxygen improved its safety and effectiveness. Its ability to reduce anxiety and pain while keeping patients conscious made it especially valuable in dental practice.[7] Nitrous oxide (N_2O) is a colorless, virtually odorless, mildly sweet-smelling gas known for its effective analgesic and anxiolytic properties. When administered, it induces central nervous system (CNS) depression and euphoria with minimal respiratory impact.[3] Its nonirritant nature and stable cardiovascular profile—marked by minimal cardiac output reduction and slight peripheral resistance increase—make it a safe and effective sedation agent for dental and surgical procedures.[8]

Although numerous studies over time have demonstrated the effectiveness of nitrous oxide sedation in managing behavior in both cooperative and noncooperative pediatric dental patients, there has been a lack of evaluation concerning its efficacy across different behavior patterns. Therefore, this study was designed to specifically assess the effectiveness of nitrous oxide anxiolysis in reducing anxiety among children with various behavior patterns. By focusing on different behavioral responses, this research aims to provide a more nuanced understanding of how nitrous oxide sedation can be tailored to better manage anxiety and improve overall patient experience in pediatric dentistry.

Materials and Methods

The study was conducted in the Department of Pediatric and Preventive Dentistry, Jaipur, Rajasthan, following approval from the Institutional Research Committee, MGUMST (MGDC/1458/JPR/2023/23). A total of 70 children aged 3–9 years were recruited, with a statistically calculated sample size of 43. Inclusion criteria comprised children with parental consent, no prior dental history, no systemic illness, and requiring only restorative treatment [ICDAS (International Caries Detection and Assessment System) score 3–4]. Children needing procedures involving local anesthesia or those with disabilities or systemic illnesses were excluded from the study.

At the initial visit, after obtaining consent, the child was examined, and a complete case history along with a detailed medical history was recorded. This included history of allergies, past adverse drug reactions, current medications (with details on dosage and administration), underlying medical conditions, and previous hospitalizations. The physical examination was done which mainly focused on the respiratory system, ensuring nasal airway patency and assessing breath sounds during inspiration and expiration.

During the counseling visit, consent was reaffirmed, and behavior patterns were assessed using Wright's classification. Based on this assessment, the children were divided into the following predefined groups:

1. Group I: Lacking cooperation.
2. Group II: Cooperative.
3. Group III: Incorrigible.
4. Group IV: Defiant.
5. Group V: Timid.
6. Group VI: Tensely cooperative.
7. Group VII: Whining behavior.
8. Group VIII: Stoic behavior.

After children were assigned to their respective groups, baseline assessments were conducted to record their anxiety levels and physiological responses. The initial anxiety assessment was carried out by a pediatric dentist using the Venham Clinical Anxiety Scale (VCAS) (Fig. 1) which categorizes observed behaviors from calm to extremely anxious, enabling systematic evaluation of the child's anxiety throughout the dental procedure. Additionally, the children's self-assessment of anxiety was measured using the Chhota Bheem–Chutki (CBC) Scale (Fig. 2), a tool designed to be relatable and understandable for young patients. It features gender-specific cartoon cards with six facial expressions ranging from happy to highly distressed; children selected the face that best reflected their current emotion, scored from 1 (happy) to 6 (running).

Physiological assessment of anxiety was performed using a pulse oximeter, which measured the children's heart rates and oxygen saturation (SpO_2) levels as indicators of anxiety and stress (Figs 3 to 7). To minimize potential bias, all clinical procedures were performed by a single calibrated operator, thereby maintaining an operator constant throughout the study and ensuring uniformity in clinical technique and treatment-related decision-making. The operator was blinded to the study groups, specifically the behavioral category of the child. An independent observer, different from the operator, was responsible for recording behavioral and clinical parameters, thereby reducing observer and performance bias. Data collection and recording were carried out by the same observer for all participants, eliminating interobserver and inter-recorder variability.

Before the second visit, parents were instructed to allow their child only clear liquids up to 2 hours before the scheduled appointment to reduce the risk of sedation-related complications. In cases of nasal congestion, parents were advised to reschedule the visit. Preappointment counseling was done according to the initial anxiety assessment of the child. On the day of the treatment, all patients, regardless of their group assignment, underwent restorative dental procedures under nitrous oxide anxiolysis (Fig. 7). The procedure was conducted in the presence of the parent in the operatory, ensuring additional comfort and reassurance for the child.

The sedation process began with a careful check of the Consed 2.0 conscious sedation machine to confirm that it is functioning correctly,

Anxiety rating scale

0. Relaxed, smiling, willing and able to converse
1. Uneasy, concerned. During stressful procedure may protest briefly and quietly to indicate discomfort. Hands remain down or partially raised to signal discomfort. Child willing and able to interpret experience as requested. Tense facial expression may have tears in eyes.
2. Child appears scared. Tone of voice, questions and answers reflect anxiety. During stressful procedure, verbal protest, quietly crying, hands tense and raised but not interfering. Child interprets situation with reasonable accuracy and continues to work to cope with anxiety.
3. Shows reluctance to enter situation, difficulty in correctly assessing situational threat. Pronounced verbal protest, crying. Protest out of proportion to threat. Copes with situation with great reluctance.
4. Anxiety interferes with ability to assess situation. General crying not related to treatment. More prominent body movement. Child can be reached through verbal communication and eventually with reluctance and great effort he begins the work of coping with threat.
5. Child out of contact with the reality of the threat. General loud crying, unable to listen to verbal communication, makes no effort to cope with threat, actively involved in escape behavior, physical restraint required.

Fig. 1: Venham Clinical Anxiety Scale used for assessment of child's anxiety by the operator

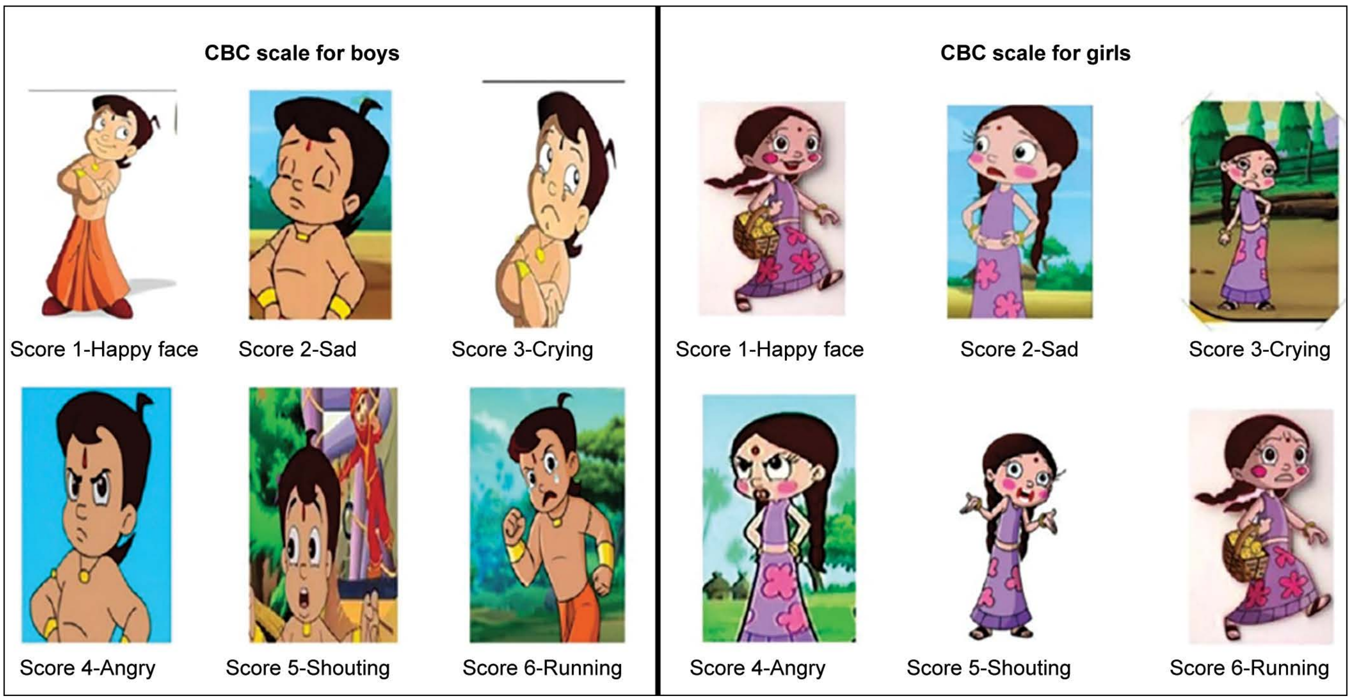

Fig. 2: The six-point self-assessment scale used for assessing the child's dental anxiety

properly calibrated, and safe to use. Parents were informed about the procedure and its advantages, and the nasal hood was gently introduced to the child to help them feel at ease (Fig. 4). Initially, 100% oxygen was given at a flow rate of 3–5 L/min for about 2–3 minutes. Once the reservoir bag was adequately filled and oxygen was delivered to the patient, nitrous oxide is slowly introduced—typically increased in 10% increments every 2–3 minutes—until the desired level of relaxation was observed (Fig. 5). Meanwhile, the child was encouraged to breathe calmly through the nose. A target mixture of 30% nitrous oxide and 70% oxygen was usually maintained, with the child monitored for sensations such as lightness or tingling (Fig. 6). The concentration was adjusted as needed to sustain the optimal level of sedation. Throughout the dental procedure, vital signs—particularly heart rate and SpO_2—were continuously monitored. Once treatment was completed, the child was given 100% oxygen for around 5 minutes to ensure full recovery and safe elimination of residual nitrous oxide.

Following the dental treatment, posttreatment assessments were conducted to evaluate changes in anxiety and physiological parameters. The same tools were used for the baseline assessment—the VCAS for clinical anxiety, the CBC Scale for the children's self-reported anxiety, and the pulse oximeter for physiological measurements.

Statistical Analysis

The compiled dataset was organized using Microsoft Excel (version 2019), and statistical analysis was conducted with the Statistical Package for the Social Sciences (SPSS) software (version 26.0, IBM). Intergroup comparisons were conducted using Kruskal–Wallis analysis of variance (ANOVA).

Fig. 3: Physiological anxiety assessment using pulse oximeter

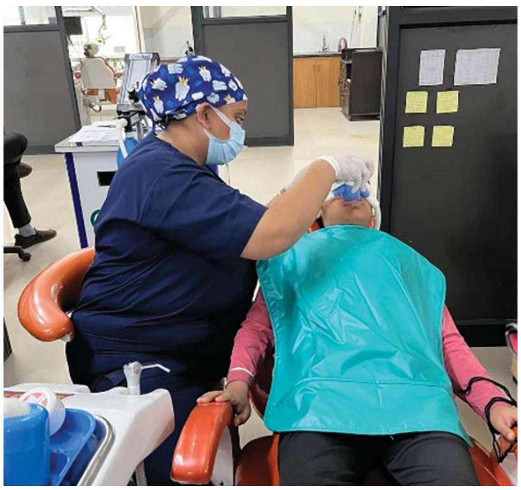

Fig. 4: Introduction of nasal hood to the child

Fig. 5: Gradual administration of nitrous oxide concentration after oxygen

Results

The study involved 70 children (34 females, 36 males) aged 3–9 years, divided into seven groups of 10 participants each.

Fig. 6: Evaluating the signs and symptoms

Fig. 7: Use of airotor handpiece for cavity preparation under the influence of nitrous oxide anxiolysis

Table 1 and Figures 8A to D depict that there was a statistically highly significant ($p < 0.01$) difference seen for the values between the groups for pretreatment CBC Anxiety Rating with higher values in incorrigible group, midtreatment pulse rate with higher values in timid group and pretreatment VCAS Ratings with higher values in incorrigible group and defiant group. There was a statistically significant ($p < 0.05$) difference seen for the values between the groups for posttreatment CBC Anxiety Rating with higher values in whining group, pretreatment pulse rate with higher values in incorrigible group, posttreatment pulse rate with higher values in tense group. There was a statistically nonsignificant ($p > 0.05$) difference seen for the values between the groups for posttreatment VCAS Ratings, pretreatment SpO_2 rate, and posttreatment SpO_2 rate.

Discussion

This study aimed to assess the efficacy of nitrous oxide anxiolysis in managing varying behavioral responses in pediatric dental patients. Over the years, extensive research has explored the role of conscious sedation in pediatric dentistry. For instance, Nathan et al.[9] demonstrated that nitrous oxide successfully minimized uncooperative behavior during stressful procedures, while Motallebi et al.[10] found it to be effective in lowering both self-

Table 1: Intergroup comparison of Chhota Bheem–Chutki Anxiety Rating, VCAS ratings, pulse rate, and SpO_2 rate at pretreatment, midtreatment, and posttreatment stages in all groups

		N	*Mean*	*Standard deviation*	*Median*	*Mean rank*	*χ^2 value*	*p-value of Kruskal–Wallis test*
Pretreatment Chhota Bheem–Chutki anxiety rating	Lacking cooperation	10	2.00	0.667	2	24.50	51.227	0.000**
	Cooperative	10	1.30	0.483	1	11.75		
	Incorrigible	10	4.50	1.354	5	55.25		
	Defiant	10	4.40	1.265	4	55.45		
	Timid	10	2.40	0.516	2	32.00		
	Tense cooperative	10	1.70	0.483	2	18.75		
	Whining behavior	10	4.00	1.491	3.5	50.80		
Posttreatment Chhota Bheem–Chutki anxiety rating	Lacking cooperation	10	1.00	0.000	1	21.50	11.414	0.022*
	Cooperative	10	1.00	0.000	1	21.50		
	Timid	10	1.30	0.483	1	28.70		
	Tense cooperative	10	1.00	0.000	1	21.50		
	Whining behavior	8	1.38	0.518	1	30.50		
Pretreatment VCAS ratings	Lacking cooperation	10	1.00	0.667	1	17.60	59.432	0.000**
	Cooperative	10	0.50	0.527	0.5	10.50		
	Incorrigible	10	4.50	0.527	4.5	60.00		
	Defiant	10	4.50	0.527	4.5	60.00		
	Timid	10	1.30	0.483	1	21.80		
	Tense cooperative	10	2.40	0.516	2	37.40		
	Whining behavior	10	2.80	0.919	3	41.20		
Posttreatment VCAS ratings	Lacking cooperation	10	0.20	0.422	0	25.30	6.11	0.191#
	Cooperative	10	0.00	0.000	0	20.50		
	Timid	10	0.30	0.483	0	27.70		
	Tense cooperative	10	0.30	0.483	0	27.70		
	Whining behavior	8	0.00	0.000	0	20.50		
Pretreatment pulse rate	Lacking cooperation	10	99.60	6.415	99.5	34.15	14.375	0.026*
	Cooperative	10	94.40	5.190	96.5	16.20		
	Incorrigible	10	103.90	6.590	103	46.05		
	Defiant	10	103.70	8.486	1.3	44.00		
	Timid	10	99.10	2.961	98.5	31.85		
	Tense cooperative	10	100.20	5.203	99.5	36.25		
	Whining behavior	10	103.50	8.847	99.5	40.00		
Midtreatment pulse rate	Lacking cooperation	10	87.10	7.156	86.5	22.15	17.431	0.002**
	Cooperative	10	84.30	4.270	84.5	14.50		
	Timid	10	95.00	2.357	95	39.65		
	Tense cooperative	10	87.90	5.384	89.5	22.40		
	Whining behavior	8	88.50	6.325	86.5	23.63		
Posttreatment pulse rate	Lacking cooperation	10	87.90	7.249	90.5	23.60	13.079	0.011*
	Cooperative	10	87.30	6.464	88.5	21.75		
	Timid	10	83.80	2.821	84	13.40		
	Tense cooperative	10	91.60	5.522	93.5	31.60		
	Whining behavior	8	93.50	4.781	92	34.06		

Contd…

Contd…

		N	*Mean*	*Standard deviation*	*Median*	*Mean rank*	*χ^2 value*	*p-value of Kruskal–Wallis test*
Pretreatment SpO_2 rate	Lacking cooperation	10	99.20	0.789	99	43.20	11.901	0.064#
	Cooperative	10	98.80	1.398	99.5	37.40		
	Incorrigible	10	97.90	0.738	98	17.55		
	Defiant	10	98.80	0.632	99	34.30		
	Timid	10	98.80	0.919	99	35.30		
	Tense cooperative	10	99.20	0.789	99	43.20		
	Whining behavior	10	98.90	0.994	99	37.55		
Midtreatment SpO_2 rate	Lacking cooperation	10	100.00	0.000	100	25.50	3.474	0.482#
	Cooperative	10	100.00	0.000	100	25.50		
	Timid	10	99.90	0.316	100	23.10		
	Tense cooperative	10	100.00	0.000	100	25.50		
	Whining behavior	8	99.88	0.354	100	22.50		
Posttreatment SpO_2 rate	Lacking cooperation	10	99.80	0.422	100	23.20	2.98	0.561#
	Cooperative	10	100.00	0.000	100	28.00		
	Timid	10	99.90	0.316	100	25.60		
	Tense cooperative	10	99.80	0.422	100	23.20		
	Whining behavior	8	99.75	0.463	100	22.00		

Kruskal–Wallis test; **indicates statistically highly significant $p < 0.01$, *indicates statistically significant $p < 0.05$, #indicates statistically nonsignificant $p > 0.05$; VCAS, Venham Clinical Anxiety Scale

reported and observed anxiety levels at the same time enhancing patient cooperation. Similarly, Mukundan and Gurunathan[11] reported a reduction in dental anxiety and improved experiences for both children and their parents with nitrous oxide sedation.

Behavior rating scales are essential tools for understanding how dental anxiety relates to child behavior during treatment. The use of Frankl's behavior rating scale[12] remains a popular choice due to its simplicity, offering four broad categories of cooperation. However, it lacks specific observational criteria. To address this, Wright[13] introduced a more refined system that classifies behavior into three groups: (1) cooperative, (2) potentially cooperative, and (3) lacking cooperative ability. In this study, Wright's scale was chosen for its greater specificity, allowing for a more detailed analysis of the effect of nitrous oxide anxiolysis. By adopting this classification system, we aimed to better understand how nitrous oxide influences different behavioral subtypes in pediatric dental patients.

Despite the wealth of research on conscious sedation, gaps remain in understanding its efficacy for specific patient groups. A study by Galeotti et al.[6] supported the use of nitrous oxide-oxygen sedation as an alternative to general anesthesia, particularly for managing precooperative, fearful, and disabled patients. Vanhee et al.[14] conducted a study comparing the behavioral responses of young children, phobic anxiety patients, individuals with mental disorders, and those with occasional indications during dental treatment under conscious sedation, using two different gas distribution methods. These studies have briefly addressed the types of patients included in our study. Therefore, our study focused on evaluating the impact of nitrous oxide anxiolysis on diverse behavioral patterns in pediatric patients, aiming to fill this knowledge gap by addressing underrepresented populations.

The use of nitrous oxide sedation in pediatric dentistry depends on a child's age, cognitive development, and anatomical maturity. Some recommend a minimum age of 4 years for the use of nitrous oxide,[15] while others have suggested 6 or 8 years, citing that behavioral management techniques are typically sufficient for children above these ages, whereas younger children (under 3 years of age) may require alternative sedation methods,[16] as they often struggle with nasal hood acceptance and breathing instructions.[17] Anatomical features such as a larger head, anterior larynx (at the level of C3–C4), narrow nasal passages, and enlarged tonsils increase the risk of airway obstruction, while physiological traits such as higher metabolic rates and lower functional reserve capacity (FRC) make children more prone to hypoxemia, particularly in the supine position.[18] These factors support excluding children under 3 years from nitrous oxide sedation.

It has been shown that none of the child anxiety scales is better than others, nor can act as a gold standard. However, using multiple anxiety scales simultaneously may be a means for achieving more realistic results.[19] In the present study, two assessment tools were utilized: (1) the VCAS and (2) the CBC Scale. The VCAS is an observation-based tool designed to evaluate dental fear and anxiety, while the CBC Scale is a self-report measure for assessing these factors. Venham's Clinical Anxiety Rating Scale[20] was chosen for this study based on its reliability and ease of use in evaluating pediatric behavior through direct observation. Previous studies by Shekhar et al.[21] and Nunna et al.[22] have confirmed its validity and practical value in pediatric dental settings, reinforcing its appropriateness for use in the current study to systematically document children's behavioral reactions during treatment.

The CBC Scale, developed and validated by Sadana et al.,[23] is a visually engaging and culturally familiar tool used to assess dental anxiety in children. The scale's effectiveness as a self-assessment tool has been further supported by studies such as those by Shankar et al.[24] and Rahaman et al.[25] Its proven reliability makes it well-suited for use in the present study.

Figs 8A to D: (A) Intergroup comparison of Chhota Bheem–Chutki Anxiety Scale; (B) Intergroup comparison of Venham Clinical Anxiety Rating Scale; (C) Intergroup comparison of pulse rate; (D) Intergroup comparison of SpO_2

Pretreatment assessments using the CBC Scale and VCAS revealed that children in the "incorrigible" and "defiant" group categories exhibited the highest anxiety levels, highlighting their resistance and need for targeted behavioral strategies. Posttreatment, anxiety levels decreased across all groups, though the "whining" group continued to show elevated anxiety, indicating partial effectiveness of sedation. These findings contrast with studies by Mozafar et al.[26] and Özen et al.,[27] where a combination of nitrous oxide and additional sedatives proved more effective in managing similar uncooperative behaviors.

Pulse rate is a key physiological marker of anxiety, with elevated rates indicating heightened stress before treatment. The American Academy of Pediatric Dentistry (AAPD) guidelines[28] recommend routine use of pulse oximetry during conscious sedation. In our study, incorrigible group had the highest pretreatment pulse rate, correlating with their elevated anxiety scores. As sedation progressed, pulse rates generally declined, though timid group showed the highest midtreatment rates, suggesting lingering nervousness. These findings align with Sharma et al.,[29] who observed a significant but clinically normal drop-in heart rate during nitrous oxide sedation. Prior studies by Li et al.,[30] and Golpayegani et al.[31] similarly reported that nitrous oxide maintains stable cardiovascular parameters, with observed changes primarily attributed to reduced anxiety rather than direct effects on heart function.

By the end of the procedure, pulse rates had stabilized for most children, indicating effective anxiety reduction. Nandini[32] in his study found that the pulse rate declined during the operative phase of treatment, when nitrous oxide was administered at a 50% concentration. Similarly, various studies have reported a decrease in postoperative pulse rate. However, tense group recorded the highest posttreatment pulse rate, indicating these children may take longer to calm down after treatment and could benefit from an extended recovery period.

Oxygen saturation was continuously monitored throughout the procedure and remained stable at all stages, indicating that nitrous oxide sedation did not cause respiratory compromise or oxygen desaturation. This supports the safety of nitrous oxide as a sedation method in pediatric dentistry. These findings align with those of Blumer et al.,[33] who reported that oxygen levels remained unaffected during sedation, even in cases of poor behavior, though such behavior was associated with elevated pulse rates.

In our study, incorrigible group, defiant group, and two children from whining group exhibited higher levels of pretreatment anxiety and demonstrated reluctance in accepting the nasal hood, posing a challenge in administering nitrous oxide sedation effectively. This is consistent with their behavioral tendencies, as children in these groups are often uncooperative, apprehensive, or resistant to dental procedures. Their refusal to accept the nasal hood underscores the need for presedation behavioral interventions and consideration of adjunctive sedation techniques alongside nitrous oxide anxiolysis to enhance treatment success and patient compliance.

Although stoic group was included in the study, no cases were identified during the research period. Stoic behavior (marked by quiet compliance and minimal visible distress, sometimes linked to past trauma) is rarely observed in the Indian pediatric population, possibly due to cultural and familial influences. In Rajasthan, joint family systems often provide a nurturing and overprotective environment, potentially reducing emotional suppression and trauma-related behavior. The absence of this group suggests that stoic responses may be uncommon, underrecognized, or underreported. Future research with a longer study duration may help capture such cases, allowing for a more comprehensive evaluation of sedation responses across all behavioral types.

Conclusion

In conclusion, based on the findings of this study, nitrous oxide anxiolysis is an effective and safe method with minimal side effects for managing different types of behavior traits seen in pediatric dental patients. It significantly reduces anxiety levels while maintaining stable physiological parameters. However, a child's temperament plays a critical role in their response to sedation, emphasizing the need for individualized, behavior-based treatment protocols.

The findings of our study emphasize the importance of tailoring sedation strategies based on a child's behavioral profile. Conscious sedation proved most beneficial in children classified as "cooperative" and those in the "lacking cooperation" group. Highly anxious children ("incorrigible" and "defiant") who refused to even accept the nasal hood may benefit from presedation behavioral interventions, such as gradual exposure, distraction techniques, and parental reassurance. Children in the "timid" group may require additional reassurance during the procedure, as their anxiety persisted midtreatment despite sedation. For "tense" and "whining" children, postsedation support measures, such as extended recovery time, calming environments, or parental presence, may help ease lingering distress.

Limitations

Although this study offers valuable insights into behavioral responses to nitrous oxide sedation, certain limitations must be acknowledged. The sample size was relatively small, and a larger study population could enhance the reliability of the findings. Additionally, the long-term impact of nitrous oxide sedation on behavioral adaptation was not examined, presenting an opportunity for future research. Comparative studies evaluating alternative sedation methods, such as oral sedatives or behavioral modification techniques, could further determine the most effective approach for managing different behavioral profiles.

Clinical Significance

Research on nitrous oxide anxiolysis demonstrates considerable clinical relevance in pediatric dentistry, particularly for managing the wide spectrum of behavior patterns seen in children. Young patients often present with varying levels of cooperation, ranging from anxious yet manageable to overtly uncooperative behaviors. In such situations, nitrous oxide proves to be a useful aid by easing fear, lowering anxiety, and promoting relaxation while maintaining full consciousness. Nevertheless, the findings also indicate that its benefits are less pronounced in children with severe behavioral difficulties or in very young patients who are unable to communicate effectively, where alternative or advanced management techniques may be necessary. Taken together, the study highlights nitrous oxide as a safe, reversible, and reliable tool in behavior guidance, capable of reducing treatment-related stress and encouraging positive dental experiences that may extend into adulthood.

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