Tikrit Journal for Dental Sciences 13(2) (2025) 390-396
https://doi.org/10.25130/tjds.13.2.11

Tikrit Journal
for
Dental Sciences

https://tjds.tu.edu.iq
Print ISSN:2073-1213
Online ISSN:3105-9384

Economic Impact of Nitrous Oxide Sedation in Pediatric Dental Care: A Cross-Sectional Survey in Baghdad

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Keywords:
Nitrous oxide sedation, economic burden, dental treatment costs.

Article Info.:

Article History:
Received: 15/4/2025
Received in revised form: 30/4/2025
Accepted: 14/5/2025
Final Proofreading: 14/5/2025
Available Online: 1/12/2025

Citation: Alsheekhly B. Economic Impact of Nitrous Oxide Sedation in Pediatric Dental Care: A Cross-Sectional Survey in Baghdad. Tikrit Journal for Dental Sciences 2025; 13(2): 390-396.
https://doi.org/10.25130/tjds.13.2.11

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Abstract

Background: Dental anxiety and uncooperative behavior among pediatric patients can reduce the delivery of preventive dental care. Nitrous oxide (N_2O) sedation is recognized as an effective behavior management tool; however, its unavailability in public healthcare centers in Iraq makes families seeking the service in private clinics, increasing the overall treatment cost.

Objective: To assess the economic impact of nitrous oxide sedation on dental treatment costs. Methods: A cross-sectional survey conducted between January and February 2025 among private dental clinics in Baghdad specified via social media. Out of 45 clinics contacted, 38 participated. Clinics provided self-reported data on the base costs for (fissure sealant, tooth extraction, filling, and pulpotomy) and the additional fee for administering N_2O sedation. The economic burden of sedation was calculated as the cost increase ratio using the formula: (Cost Increase Ratio=N_2O Sedation Cost/Base Procedure Cost).

Descriptive statistics (mean, SD), inferential statistics (One Way ANOVA) were used for analysis with SPSS. Results: Mean base procedure costs varied significantly, with tooth extractions averaging 32,370 Iraqi Dinar (ID) and pulpotomies 59,870 ID. The mean cost of N_2O sedation was 101,973 ID. The tooth extraction has the highest (3.4 x), while pulpotomy has the lowest (1.7 x) cost increase ratios.

Conclusions:Nitrous oxide sedation markedly inflates the costs of dental treatment in private clinics in Baghdad, potentially restricts families from seeking necessary dental care. These findings highlight the need for policy interventions to integrate sedation services into public healthcare, ensuring more equitable access to pediatric dental care.

Introduction:

Dental services for prevention of oral disease are essential for preserving children's oral health, aiming to stop dental problems before they arise (1). Regular dental check-ups on timing intervals, professional cleanings by dentists or hygienists , and the application of fissure sealants are essential components of preventive care, which lead to a noticeable reduction in the risk of tooth decay and gingival disease (2). Visiting dentists in early childhood can reduce the need for restorative and emergency dental care, additionally it decreases dental costs especially among high-risk children. However, the classical problem is managing child behavior during dental procedures which represents a significant challenge. Dental anxiety and uncooperative behavior can negatively affect the effective delivery of preventive services, this can compromise oral health outcomes (3,4). To solve this issue, different behavior management techniques are used, among which nitrous oxide sedation has proven to be particularly effective. During the provision of dental procedures to children, Nitrous oxide, more commonly referred to as "laughing gas," has proven to be both an effective and safe method for allowing children to relax during dental treatment procedures. From a dental point of view, this has been practiced for a long time (5,6). Despite its benefits, nitrous oxide sedation is not provided in public services by the Iraqi Ministry of Health. As a result, caregivers have no choice but to seek this service in private clinics, which means additional expenses not just for sedation, but for the primary dental procedure as well. This may lead families to avoid seeking essential dental care due to pain, the need to miss school, and more importantly, progression of dental disease, thus making it a financial burden (7). The lack of any public health provisions relating to sedation remains a serious issue in the context of offering optimally comprehensive care in preventive-pediatric dentistry in Iraq. Preventive dental services, like any other services offered to children, need to be complemented with effective behavior guidance to enable their smooth delivery (8,9). The absence of nitrous oxide sedation in public healthcare services in Iraq imposes financial challenges on families, potentially compromising children's oral health and overall well-being. This study aims to assess the economic impact of nitrous oxide (N_2O) sedation on dental treatment costs in private dental clinics in Baghdad. By quantifying the additional fees associated with N_2O sedation and evaluating its contribution to overall treatment expenses, the research seeks to provide insights into the financial implications for patients and inform policy decisions regarding sedation practices in Iraqi dental care.

Materials & Methods:

Figure 1 demonstrates the methodology of this study.

Study design

This study employed a cross-sectional survey to evaluate the economic burden of nitrous oxide (N_2O) sedation in private dental clinics in Baghdad. Data were collected from *Jan. to Feb. 2025* to quantify the additional cost of N_2O sedation and its contribution to total treatment expenses.

Sample and setting

1. Sampling Strategy:

A convenient sampling approach was used to specify private dental clinics providing N_2O sedation services by advertising on social media platforms (primarily Facebook).

Inclusion criteria: Clinics promoting N_2O sedation on their social media pages profiles during the study period.

Exclusion criteria: Clinics are non-responsive after three contact attempts or do not like to participate.

2. Participant Recruitment:

Clinics were identified through keyword searches (e.g., "nitrous oxide sedation Iraq," "dental sedation services", "laughing gas") and direct review of social media advertisements. A total of [*45*] clinics were contacted.

Data collection

1. Survey Instrument:

Clinics were asked:

"What is the cost of common dental procedures (e.g., fissure sealant, tooth extraction, fillings and pulpotomy?) (quoted in Iraqi Dinar, ID).

"What is the additional fee charged for administering nitrous oxide sedation alongside a dental procedure?"

2. Data Sources:

Responses were obtained via direct messaging on social media platforms or phone calls to clinic administrators.

Data analysis

1. Quantitative Analysis:

Descriptive statistics (mean and SD) were calculated for the reported dental services, inferential statistics (One Way ANOVA) were used to find differences between groups.

Cost Increase Ratio (economic burden) in treatment cost due to sedation was expressed using the formula: Cost Increase Ratio=N_2O Sedation Cost/Base Procedure Cost

2. Software:

Data were analyzed using The Statistical Package for the Social Science (IBM SPSS Statistics for Windows.

Ethical considerations

- Participation was voluntary, and clinics were informed about the study's purpose.
- No identifiable clinic or patient data were recorded to ensure confidentiality.
- Verbal consent was obtained from clinic representatives prior to data collection.

Results

Clinic Participation

Out of the 45 private dental clinics contacted, 38 responded to the survey (response rate: 84.4%). All participating clinics were located in Baghdad.

Cost of Common Dental Procedures

The base costs for dental procedures varied significantly ($P < 0.001$). Tooth extractions had the lowest mean cost at 32,370 Iraqi Dinar (ID) (range: 25,000–50,000 ID), while pulpotomies were the most expensive, averaging 59,870 ID (range: 25,000–75,000 ID). The mean cost of N2O was 101973 (SD 15791) as shown in (Table 1). Post hoc pairwise comparisons show significant differences among most of the treatments regarding their basic costs as shown in (Table 2).

Additional Cost (economic burden) of Nitrous Oxide (N_2O) Sedation

The economic burden of nitrous oxide (N_2O) sedation was calculated as the cost increase ratio in using the formula:

Cost Increase Ratio=N_2O Sedation Cost/Base Procedure Cost. This ratio represents how many times the total treatment cost increases when N_2O is used.

Table 3 shows that tooth extraction has the highest cost increase ratio (3.4 x), while pulpotomy has the lowest (1.7 x). The One-way ANOVA test reflected a significant difference in cost ratios between dental treatments ($p < 0.001$). Post hoc pairwise comparisons show significant differences among most of the (treatments) Table 4.

Discussion

The present study evaluated the economic impact of nitrous oxide (N_2O) sedation on dental treatment costs in private dental clinics in Baghdad. The findings highlight a substantial financial burden associated with the use of N_2O sedation, with significant increases in treatment costs across various procedures. These findings underscore the economic implications of sedation practices and the accessibility challenges faced by patients seeking pediatric dental care.

Sedation with nitrous oxide has been utilized as a successful method of alleviating anxiety and enhancing the cooperation of younger patients during dental procedures(10). Alternatively, its use in private offices is limited due to

unreasonable pricing. The data indicated that the costs associated with the sedation N_2O of the nitrogen patients increased disproportionately from 1.7x for pulpotomies to 3.4x for the more invasive procedures such as tooth extraction. These factors provide additional financial burdens for families, especially those belonging to the lower socio economic status which in turn contribute to the inequalities in dental care (11).

The high cost of N_2O sedation in private clinics will also affect the willingness to pursue treatment. Studies have noted that high treatment costs often lead to a lack of prompt decision making on the behalf of caregivers which results in a higher unmet dental healthcare need, more advanced disease states, and greater degree of surgical intervention required(12–14). This is especially worrying for Iraq where the prevalence of untreated dental caries is still retained at a high level because there is a low level of availability of comprehensive public pediatric dental services (15,16). The absence of the N_2O sedation within the public health system of Iraq worsens the situation, creating a scenario where families are forced to seek relief in the private sector and pay for comprehensive dental care out of their own pockets(17).

From a different point of view, bear in mind that policy perspective and sedation services makes it clear the need to integrate sedation services into public healthcare facilities in order to ensure accessible behavior management strategies for patients. Similarly, there are many countries that have public dental care systems that incorporated sedation services in order to overcome financial (18). If these ideas were to be undertaken in Iraq, it could potentially alleviate economic constraints, improve the dental attendance rates, and subsequently leading to enhancing oral health outcomes among school-aged children.

On another point, the disparity of the base treatment costs in private clinics which distinctly ranges from 25,000 to 75,000 Iraqi Dinar portrays a standardization gap in the private dental sector. The marking of miscalculation suggests not only disparity but also the service delivery could pose other affordability problems for patients. Conclusion like these have led to the establishment of regulatory rules and guidelines which would uniformly set sedation fees and as such, make the costs more predictable and affordable for families seeking the necessary dental treatment.

Limitations:

This study geographically limited to Baghdad, so generalizability is uncertain.

The study depended on self-reported cost data obtained through social media and direct inquiries with clinic administrators. While efforts were made to ensure accuracy, potential variations in reporting and pricing strategies among clinics may have influenced the results.

Conclusion:

The findings call for policy interventions to incorporate sedation services into public healthcare systems, training dental services providers for its use, address affordability concerns, and establish clear pricing mechanisms to ensure equitable access to pediatric dental care. Addressing these challenges is important for improving oral health outcomes and reducing disparities in access to essential dental services.

Recommendations

This study provides valuable highlights into the economic burden of N_2O sedation in private dental clinics, although future studies could expand data collection to include patient perspectives on affordability and willingness to pay for sedation services, providing a more comprehensive understanding of the financial challenges associated with N_2O sedation in Iraq.

Conflict of interest:

The author declares that he has no conflict of interest.

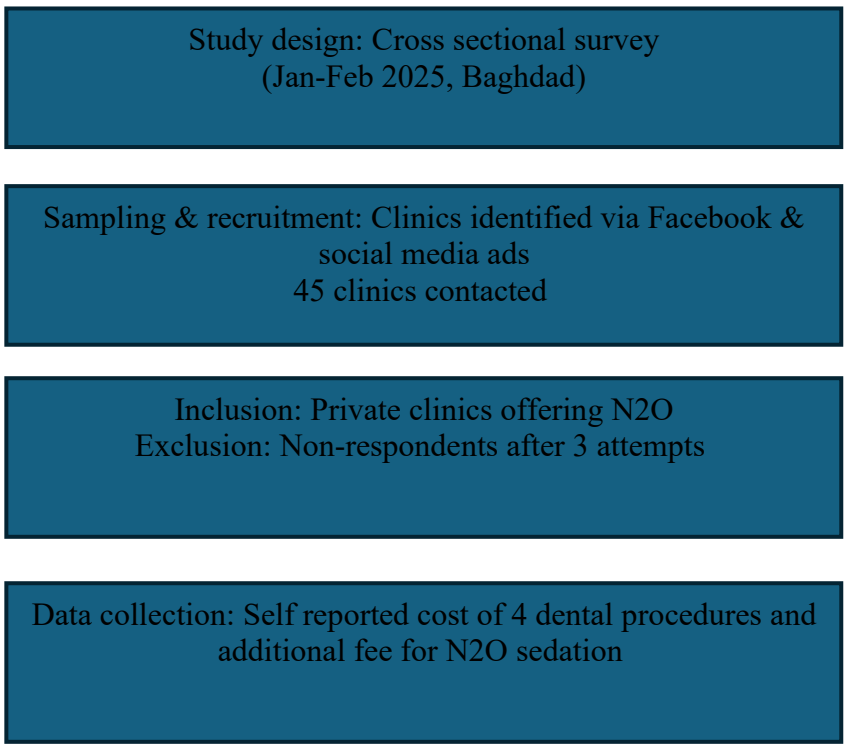

Figure (1). study design diagram

Table 1: The basic cost of different dental procedures.

Dental Treatment	N	Minimum	Maximum	Mean	SD	DF	F	P value ANOVA test
N2O	38	75000	150000	101973	15791	4	137.2	< 0.001
Extraction	38	25000	50000	32370	10249			
Fissure Sealant	38	25000	75000	55660	15647			
Filling	38	25000	75000	58030	11886			
Pulpotomy	38	25000	75000	59870	11711			

Table 2: **Post Hoc Tukey HSD Pairwise Comparisons of basic cost among dental treatments.**

Post hoc Pairwise Comparisons (Tukey HSD)				
(I) Group	(J) Group	Mean difference (I-J)	Std. Error	P-Value
Fissure Sealant	Extraction	23.2	3.0	< 0.001
	Filling	-2.3	3.0	1.0
	Pulpotomy	-4.2	3.0	**1.0**
	N2O	-46.3	3.0	< 0.001
Extraction	Filling	-25.6	3.0	< 0.001
	Pulpotomy	-27.5	3.0	< 0.001
	N2O	-69.6	3.0	< 0.001
Filling	Pulpotomy	1.8	3.0	1.0
	N2O	-43.9	3.0	< 0.001
Pulpotomy	N2O	-42.1	3.0	< 0.001

Table 3: The economic burden of using N2O with different dental procedures.

Dental Treatment	N	Minimum	Maximum	Mean	SD	DF	F	P value ANOVA test
Extraction	38	2.0	4.0	3.4x	0.8	3	73.7	< 0.001
Fissure Sealant	38	1.3	4.0	2.0x	0.8			
Filling	38	1.3	4.0	1.8x	0.4			
Pulpotomy	38	1.3	4.0	1.7x	0.4			

Table 4: **Post Hoc Tukey HSD Pairwise Comparisons of Cost Increase Ratios Among Dental Treatments**

Post hoc Pairwise Comparisons (Tukey HSD)				
(I) Group	(J) Group	Mean difference (I-J)	Std. Error	P-Value
Fissure Sealant	Extraction	-1.3	0.1	< 0.001
	Filling	0.2	3.0	1.0
	Pulpotomy	0.2	3.0	< 0.001
Extraction	Filling	1.5	3.0	< 0.001
	Pulpotomy	1.6	3.0	< 0.001
Filling	Pulpotomy	0.05	3.0	1.0

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