Assessment of Dental Fear and Anxiety in Children Undergoing Nitrous Oxide-Oxygen Inhalation Sedation visiting BPKIHS

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ABSTRACT

Introduction: Dental treatment of children is the most needed service that remains neglected because of a lack of skill to manage dental fear and anxiety (DFA). Both the non-pharmacological and pharmacological behavior management continuum should be followed to treat children.

Objective: To assess and compare DFA levels in children before and after dental treatment using nitrous oxide-oxygen inhalation sedation (NOIS), to assess and compare the change in behavior in children undergoing NOIS, and to compare the level of DFA in children undergoing invasive and non-invasive dental treatment.

Methods: DFA was measured using the Children's Fear Survey Schedule Dental Subscale (CFSS-DS), Modified Child Dental Anxiety Scale (MCDAS), and Facial Image Scale (FIS) before and after the dental treatment under NOIS. The change in children's behavior during invasive and noninvasive treatment under NOIS was assessed by Frankl Behavior Rating Scale (FBRS).

Results: A significant reduction in DFA was seen within each cohort as measured by 3 scales: CFSS-DS, MCDAS, and FIS ($P \leq 0.001$). There was also a positive change in behavior of children during the time of dental treatment under NOIS as measured by FBRS. However, there was no significant difference between invasive and non-invasive treatment groups with regard to DFA.

Conclusions: Minimal sedation provided by NOIS significantly reduced DFA in children, and there was a positive change in their behavior during the time of treatment. NOIS was effective in decreasing DFA in both invasive and non-invasive dental treatment.

Keywords: *Behavior management, children, dental fear and anxiety, nitrous oxide-oxygen inhalation sedation.*

INTRODUCTION

Pediatric dentistry is the most needed service that remains neglected because of a lack of behaviour guidance skills.[1] Dental fear and anxiety (DFA) is the main factor behind the adverse behaviour of children. DFA is an unspecific feeling of apprehension[2] and is used interchangeably due to their similarity in physiological reactions.[3]

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The importance of pharmacological behavior management is increasing[4] with nitrous oxide (N_2O) being safer[5] and used for more than 150 years.[6] N_2O is non-inflammable, colorless, non-irritating gas having anxiolytic, anesthetic, analgesic, sedative, and amnestic properties. It was discovered by Joseph Priestly and introduced into dentistry by Horace Wells.[7]

N_2O has advantages of rapid onset and reversal,[8] and is contraindicated in patients with nasal block, recent surgery, bleomycin chemotherapy, cyanocobalamin deficiency etc.[7] Most American general and pediatric dentists use nitrous oxide-oxygen inhalation sedation (NOIS).[9] No research has been published so far on N_2O use in context to Nepal. So, this study was conducted with the aims of assessing and comparing DFA levels in children before and after dental treatment using NOIS, to assess and compare the change in behavior in children undergoing NOIS, and

also to compare the level of DFA in children undergoing invasive and non-invasive dental treatment.

METHODS

An interventional clinical trial was conducted among 67 children visiting the Outpatient Department (OPD) of Pedodontics and Preventive Dentistry, B. P. Koirala Institute of Health Sciences (BPKIHS), Dharan, Nepal from October 2015 to September 2016. Normal healthy children between 5 to 14 years of age with negative and positive FBRS were included whereas special needs children and conditions contraindicated to NOIS use were excluded from this study. This study was approved by the Institutional Review Committee, BPKIHS, Dharan (Code No. 508/ 2015). To compare DFA before and after NOIS, the sample size was calculated with the references reported by Alexopoulos, E. et al.[10] and using the formula mentioned below. The mean difference between the pairs was reported as 5.5 with Standard Deviation (SD) at most 12.5. We enrolled 67 patients to be able to reject the null hypothesis that the pair difference is zero with 90% power and 5% level of significance.

$$\text{Sample size}(n) = (Z_{\alpha/2} + Z_{\beta})^2 \sigma^2 / d^2$$

Where, $Z_{\alpha/2} = 1.96$

$Z_{\beta} = 1.64$

Sigma(σ) is SD=12.5

d is mean change = 5.5

Children meeting inclusion criteria (Non-probability purposive sampling) were selected from the OPD of the Department of Pedodontics and Preventive Dentistry, BPKIHS. A full verbal explanation regarding the risks and benefits of NOIS was explained to the parent/guardian of all children during the first dental visit in the OPD. After obtaining informed consent from parent/guardian and assent from children for participation in the study, Frankl Behavior Rating (FBR) of children was assessed during the examination at the first visit and patients were recalled the next day. Parents/guardians were instructed to give light food to their children two hours prior to the treatment under NOIS. Children in assistance with their parents were asked to complete pretested standardized questionnaires containing closed-ended questions of Children's Fear Survey Schedule-Dental Subscale (CFSS-DS), Modified Child Dental Anxiety Scale (MCDAS), and also asked to point out which face children felt to be most likely on at that moment on Facial Image Scale (FIS). Procedural steps related to NOIS were explained to children by the Tell-Show-Do method. Pulse rate and oxygen saturation were monitored using a pulse oximeter throughout the procedure and up to 10 minutes after termination of NOIS. Appropriate sized disposable scavenging nasal hood was placed on the nose of children and checked for its snug fit. 100% oxygen was flown through the nasal hood before placing it on the nose. Tidal volume was determined to match the gas movement into and out of the lungs during quiet breathing by observing the movement of the reservoir bag of the portable Quantiflex DMD dental inhalation system. After that, the standard concentration of N_2O and oxygen titration was followed. N_2O was given in the increment of 10% in every three minutes up to a maximum concentration of 50%, and signs of appropriate sedation were observed in children. N_2O was titrated up to the desired level and invasive procedures (administration of local anesthesia, tooth extraction, wound suturing) and non-invasive procedures (topical fluoride application and restoration) were performed. FBR of children was assessed during the treatment. After completion of the dental treatment, 100% oxygen was administered for 5 minutes before removing the nasal hood to prevent diffusion hypoxia and recovery was assessed. Before children were discharged from the dental office, they were asked to re-complete the questionnaire (CFSS-DS, MCDAS) and point at the face they felt to be most likely after treatment on FIS again. Safe discharge was done. All children were advised for regular follow-up visits in every six months. After completion of this study obtained data were entered in the 2007 version of Microsoft Excel Sheet and analyzed using the Statistical Package for Social Sciences (SPSS version 11.5).

RESULTS

In this study, among 67 children, 34 were male (50.7 %) and 33 were female (49.3%). The mean age was 9.07 (Standard deviation 2.67) years ranging from 5 to 14 years (Figure 1).

Pre-operative and post-operative DFA levels of children were measured by CFSS-DS, MCDAS, and FIS scale. A

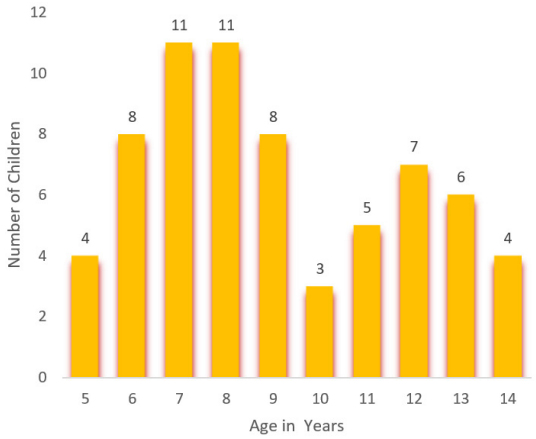

Figure 1. Age distribution of children in a number.

paired t-test was used to compare the pre-operative and the post-operative scores of CFSS-DS and MCDAS and for FIS, Wilcoxon signed ranks-test. Results from all the scales showed a significant reduction in post-operative DFA levels in children as compared to preoperative DFA (Table 1, 2, 3).

Change in behavior in children was assessed using FBRS during the first visit and during the period of treatment under NOIS. During the first visit, 25 (37.30%) children showed positive FBR, and 42 (62.70%) children showed negative FBR (Figure 2). During the period of treatment under NOIS, 41 (61.20%) children showed definitive

Table 1. Change in dental fear in children undergoing NOIS (n=67).

	Pre-operative CFSS-DS	Post-operative CFSS-DS	Mean change	Standard deviation of change	P-value[a]
Range	20-55	9-35	18.23	8.60	<0.001*
Mean ±SD	36.82±8.30	18.58±4.28			

[a]Paired t-test *Significant

Table 2. Change in dental anxiety in children undergoing NOIS (n=67).

	Pre-operative MCDAS	Post-operative MCDAS	Mean change	Standard deviation of change	P-value[a]
Range	13-34	8-18	12.52	5.40	<0.001*
Mean ±SD	23.55 ±4.97	11.03±2.52			

[a] Paired t-test *Significant

Table 3. Change in dental anxiety in children undergoing NOIS (n=67).

FIS scale	Minimum	Maximum	Median	z	P-value[a]
Pre-operative	2	5	4	-7.04	<0.001*
Post-operative	1	3	1		

[a] Wilcoxon Sign Rank test *Significant

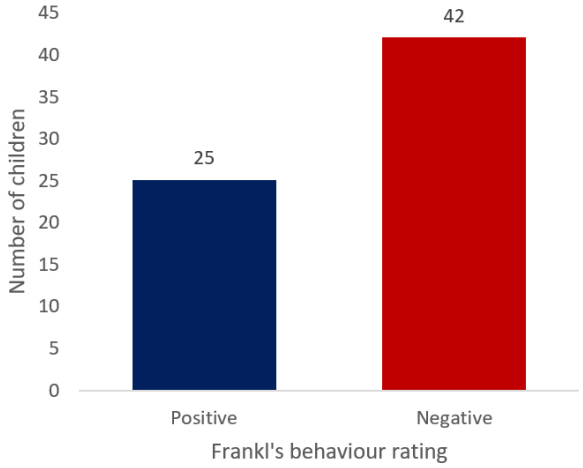

Figure 2. Frankl's behavior rating of children on first visit (n=67).

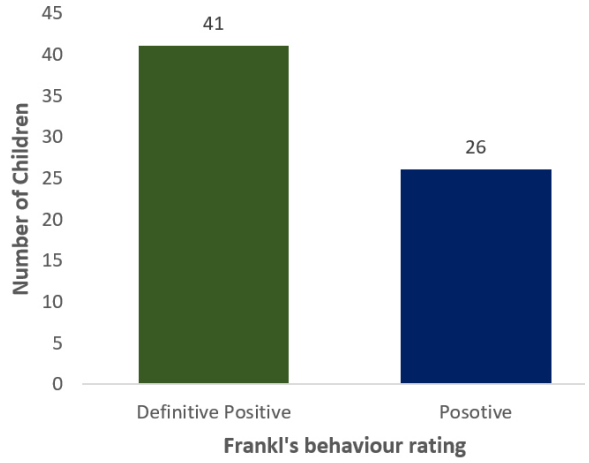

Figure 3. Frankl's behavior rating of children During NOIS (n=67).

positive FBR, and 26 (38.80%) showed positive FBR (Figure 3). The results showed that there was a positive change in behavior of children during NOIS.

Change in DFA of children was also compared between invasive and non-invasive treatment procedures. Independent sample t-test was used to compare the scores of CFSS-DS and MCDAS before and after NOIS. Results revealed that there was no significant difference between the invasive and non-invasive treatment groups with regard to DFA levels measured through CFSS-DS and MCDAS (Table 4).

Mann-Whitney U test was done to compare the FIS change among children requiring invasive and non-invasive treatment after NOIS. Results showed that there was no significant difference between the two groups regarding FIS change (p=0.529) (Table 5).

Table 4. Change in dental fear and anxiety in children during invasive and non-invasive treatment (N=67).

Scale (Change)	Degree of freedom	Mean difference	Std. Error Difference	95% Confidence Interval of the Difference		p value[a]
MCDS	65	0.31	1.35	-2.39	3.024	0.81*
CFSS-DS	65	-1.02	2.15	-5.33	3.277	0.63*

[a] Independent sample t test * Non-significant

Table 5. Change in dental fear and anxiety in children during invasive and non-invasive treatment.

FIS Change	N	Mean Rank	p value[a]
During Invasive treatment	40	35.18	0.52
During Non-Invasive treatment	27	32.26	

[a] Mann-Whitney U test * Non-significant

DISCUSSION

Dental fear and anxiety (DFA) is one of the most common problems encountered in the dental operatory and is a source of challenge for pediatric dentists. The prevalence of childhood dental fear varies from 6% to 52% depending upon how it is measured, the age of the child, and culture.[11] The American Academy of Pediatric Dentistry (AAPD) recognizes that in providing oral health care for infants, children, adolescents, and children/individuals with special health care needs, dental healthcare professionals may employ both non-pharmacological and pharmaceutical behavior guidance techniques.[12] Among pharmacologic agents, NOIS is a safe, convenient, and effective way to reduce DFA.

The result of this study showed a significant reduction in post-operative DFA in children undergoing NOIS for dental treatment which was assessed using CFSS-DS, MCDAS, and FIS scales. Arch et al reported a similar result in their study with lower post-operative DFA in children who had chosen inhalation sedation compared to those who had chosen general anesthesia.[13] In a study by Veerkamp et al, the reduction in DFA that was accomplished in extremely fearful children by the use of nitrous oxide in behavioral management techniques was more persistent than the reduction in DFA that was produced through behavior management alone.[14] Similarly, a study by Zhou et al showed that NOIS provides a safe and effective way to release pain and DFA during the treatment of acute pulpitis.[15]

In this study, the child's behavior during their first dental visit and treatment under NOIS was assessed using FBR scale. The majority of the children showed a positive change in behavior while undergoing dental treatment under NOIS. This finding was similar to that of the study by Primosch et al which showed a significant reduction in the incidence of adverse patient behaviors like crying and struggling while conversely increasing the incidence of quiet and cooperative behavior with NOIS.[16] A similar study by Foley J showed that the majority of children demonstrated good behavior during NOIS.[17] Collado et al also reported an improvement in behavior in subsequent visits of children during the use of NOIS for dental treatment.[18]

In this study, we followed the standard titration technique of NOIS and closely monitored the signs and symptoms of sedated children to prevent over-sedation of the patient. Gillman MA and Lichtigfeld FJ advocated the use of a standard titration technique instead of 50% premixed concentration.[19] Rapid induction technique with high concentrations of N_2O should only be used occasionally with intensely fearful or uncooperative children under strict vigilance to manage unwanted emergencies which otherwise normally do not occur with a low concentration of N_2O.[7] In contrast to this study, Collado et al used premixed gas (50% N_2O and 50% O_2) as well as a higher concentration of N_20.[18]

Change in DFA of children was also compared between invasive and non-invasive treatment. Among all children, 40 underwent invasive and 27 non-invasive dental treatment. No significant difference in DFA levels was found when comparing invasive and non-invasive treatments. In this study, we used a concentration of N_2O ranging from 20% to 50 % with a mean of 30.30% with SD of 8.52. In Forty-four (65.70%) children, treatment was completed receiving 30%-40% of N_2O. Bennet CR (1974)[20] has suggested that adequate sedation is likely to be achieved for most patients when inhaling between 30% and 35% N_2O. Stanley et al. found that the typical concentration a patient requires is 30% - 40% of N_2O.[21] In contrast to our study, Roberts GJ suggested the use of 47-50% or higher concentration of N_2O for an effective outcome.[22] However, Hallonsten et al. demonstrated that

concentrations higher than 60% N_2O are not necessary with standard titration.[23]

LIMITATIONS

Behavioral assessment of the study population was done using only one behavior rating scale and our inclusion/exclusion criteria were principally based on the primary objective of the study, the sample population in the invasive and non-invasive groups was not uniform.

CONCLUSIONS

Minimal sedation provided by NOIS significantly reduced DFA in children as measured by CFSS-DS, MCDAS, and FIS in this study. There was a positive change in behavior of children during the time of treatment as measured by FBR scale. NOIS was equally effective in both invasive and non-invasive dental procedures for the reduction of DFA as there was no significant difference between invasive and non-invasive treatment groups with regard to DFA levels. Thus, within the limitations of this study, we concluded that NOIS is an effective tool in the management of DFA in pediatric dental patients.

Conflict of Interest: None.

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