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Assessment of trait and state anxiety in 3-6-year old children during sequential phases of dental treatment

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Highlights

- Dental anxiety influences children's behavior in the operatory. An introductory dental visit is important for children, parents and the dental team.
- Recording a child's anxiety and behavior during successive appointments can assist in behavior management.
- Scheduling initial appointments for preventive procedures reduces children's anxiety and gains their cooperation at future dental visits.

Abstract

Aim: To assess changes in trait and state anxiety of children during sequential phases of dental treatment. **Methods:** Three hundred children, aged between 3 to < 6 years, who reported for their first dental visit were included. Both parents and children were evaluated over five sequential phases of dental treatment. Children's Fear Survey Schedule-Dental Subscale (CFSS-DS) and Modified Dental Anxiety Scale (MDAS) were used to assess child's trait anxiety. Children's Emotional Manifestation Scale (CEMS) and Facial Image Scale (FIS) were used to assess child's state anxiety. Child's behavior was rated using Frankl's Behavior Rating Scale (FBRS). Paired sample t-test, Pearson's Correlation coefficient and Spearman's Rank Correlation coefficient was performed. **Results:** Mean CFSS-DS and CEMS scores decreased significantly from the first (26.55; 10.25) to the fifth visit (24.74; 8.1) ($p<0.05$). A significant decrease in the mean FIS (state anxiety) score from the first (2.70) to fifth (2.48) visit was seen ($p<0.05$) Children's behavior differed significantly between the dental visits.($p<0.001$) There was a significant inverse correlation between behavior and both trait and state anxiety ($p<0.05$). **Conclusions:** Sequential phases of dental treatment significantly reduced trait and state anxiety.

Keywords: Behavior Rating Scale; Child; Dental Anxiety; Dental Care

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INTRODUCTION

Pediatric dentists frequently experience anxiety and fear-related responses among children. Dental fear and anxiety are main reasons for avoiding dentists. They represent different progressive degrees of the same psychological condition.[1] Anxiety is defined as a nonspecific feeling of apprehension towards a concrete situation that does not necessarily require previous experience, and is not proportional to the response that is triggered in the individual.[2] It is not attached to an object; rather it is a generalized response to an unknown threat or internal conflict and is associated with more abnormal conditions.[3] Dental anxiety denotes a state of apprehension that something dreadful would happen in relation to dental treatment, coupled with a sense of losing control.[4]

Most dentists readily recognize children with disruptive behavior during dental treatment, whereas dental fear and anxiety (DFA) may be more subtle. It is therefore necessary to assess dental anxiety at initial appointments, so that the dental team can adequately prepare children for a positive treatment experience. There are three methods to measure dental anxiety: (a) "behavioral assessment", in which the dental team rates both emotional and behavioral reactions shown by children during treatment; (b) "psychometric assessment" in which children or one of their parents complete a questionnaire, usually prior to treatment and; (c) "physiological response analysis" in which variations of parameters linked to anxiety are measured.[5] Psychometric assessment is the most common and easy method to measure childhood and adolescent DFA.[5] Pediatric dentists should select appropriate behavior management interventions in order to minimize DFA and help children develop a positive attitude towards dental health and treatment.[6]

Dental treatment frequently involves restorative and invasive procedures that are scheduled over several visits. A gradual exposure to the dental environment and to dental procedures has been shown to successfully minimize dental anxiety in children.[7-9] The reasons for dental anxiety cannot be solely attributed to the dental setting. Other personality traits can play a fundamental role in the onset of dental anxiety. These include general anxiety, mood, temperament, emotional status, parental dental fear and family social status. [1,10] Two distinct anxiety factors have been identified and labeled as state anxiety and trait anxiety. State anxiety is a transitory emotional condition in response to a perceived threat. However, trait anxiety is interpreted as measuring stable differences between individuals in their response to an anticipated threat. Trait anxiety is a relatively permanent personality characteristic.[11] It is important to differentiate a state condition (dental anxiety) from perception of fear (generalized anxiety or trait anxiety).[3]

Studies to assess dental anxiety among children have considered general anxiety itself as dental anxiety.[12-14] However, individual assessment of trait and state anxiety is lacking. Evaluation of children's anxiety and behavior at successive dental visits during different dental procedures could be useful to the dental practitioner. Therefore, the present prospective longitudinal study was carried out to determine whether gradual exposure of children to the dental environment would reduce their levels of state and trait anxiety.

METHODS

The present prospective longitudinal study was carried out at the Department of Pedodontics and Preventive Dentistry. The ethical standards of experiments of this study were in accordance with the guidelines provided by World Medical Association Declaration of Helsinki on Ethical Principles for Medical Research. Ethical clearance to conduct the study was obtained from institutional ethical review board

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[Ref.No.430/2015-16]. Prior to the study, nature of the study was explained to the parents and their written consent was taken for participation of both parents and children in the study. The sample size was estimated using the following formula:

$$n = \frac{[Z_{\alpha/2} + Z_{1-\beta}]^2}{d^2}$$

where n = estimated sample size, $Z_{\alpha/2}$ = 1.96 (for 5% significance level), $Z_{1-\beta}$ = 1.28 (for 90% power), d = 0.2 (minimum detectable difference). Therefore n =262 (rounded off to 300).

Three hundred children, aged between three to six years, who reported for their first dental visit were selected for the study. Only those children who had never accompanied their parent or any other family members to a dental clinic were included. Children exhibiting high anxiety due to medical or psychological factors were excluded. Children requiring to be treated under general anesthesia were not included. Children with special health care needs or requiring emergency treatment and extraction of teeth were excluded from the study.

The relationship between socio economic status and child's behavior has been well documented.[9,14] Socio demographic details were recorded during the first visit. All the children belonged to the upper middle class according to the Kuppuswamy's Socioeconomic Status Scale.[15] Treatment that required multiple visits necessitated the patients to attend the dental clinic for five sequential phases of dental treatment. The five sequential phases of dental treatment were as follows: 1) Introductory phase- Children were introduced to the dental chair and no operatory procedure was carried out; 2) Preventive phase - Preventive procedures including oral prophylaxis, pit and fissure sealants and fluoride application were carried out; 3) Restorative phase- Teeth were restored using glass ionomer cement and composite was done; 4) Invasive phase- Treatment that required administration of local anesthesia, including extraction and pulp therapy; 5) Recall phase- Patients were recalled within one week following the invasive phase. First to third visits were considered as 'non-invasive' phases, and the fourth visit was considered as 'invasive'.

On the first visit, parents were asked to give their response regarding their child's fear in the reception area using the parental version of Children's Fear Survey Schedule – Dental Subscale (CFSS-DS).[16] Parents answered the same questions instead of their children in the way how they assume that the children would feel in that situation.

Fifteen items that were related to the treatment and dental setting were answered by parents. Each item was scored on a 5-point response scale ranging from 1 (not afraid at all) to 5 (very afraid). The total score thus obtained fell within a range of 15 to 75 points. Scores equal to or over 45 points indicated higher levels of trait anxiety. Similarly, child's perception regarding his own trait anxiety was assessed using Modified Dental Anxiety Scale (MDAS).[17] It is a brief questionnaire consisting of five questions, which were answered with the help of the parent if the child was very young, or by the child if he or she was able to comprehend. Each item was scored on a 5-point response scale ranging from 1 (not anxious) to 5 (extremely anxious). The total score thus obtained fell within a range of 5 to 25 points. Trait anxiety was assessed on the day of the dental visit and was done before carrying out the dental procedure.

During the dental procedure, the child's state anxiety was assessed by the dentist (investigator) using Children's Emotional Manifestation Scale (CEMS).[18] It consists of five categories that are valid indicators of children's emotional behavior: facial expression, vocalization, activity, interaction and level of cooperation. Each category has five levels of intensity and is scored from 1 to 5. Thus,

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on addition of scores in each category, the total ranged from 5 (positive emotional behavior) to 25 (negative emotional behavior). Higher scores indicated the manifestation of more negative emotional behavior. Facial Image Scale (FIS) was used to assess child's state anxiety during the dental procedure.[19] This scale uses faces as an indicator of children's dental anxiety and includes one item with a response set of five faces, ranging from a very happy face at one end to a very unhappy face at the other end. Children were asked to indicate which of the faces they felt most associated with at that moment.Behavior of the child during the dental procedure was rated using Frankl - Behavior Rating Scale.[20] The scale divides observed behavior into four categories, ranging from Rating 1: definitely negative, Rating 2: Negative, Rating 3: positive and Rating 4: definitely positive. Since it has four categorizations, numerical values can be assigned to the observed behavior.[20] The proportion of children showing Frankl behavior rating was calculated at different appointments. The children's behavior was considered to be either negative (ratings 1 and 2) or positive (ratings 3 and 4).Following assessment of trait anxiety, the child was taken into the dental operatory for clinical examination and if indicated, radiographs were taken. No treatment was carried out on this first dental visit. Parents were then presented with a dental treatment plan for their child and the procedures to be carried out at the subsequent visits was briefly explained, beginning with preventive procedures, followed by restorative work and finally the procedures involving administration of local anesthesia. At the end of each visit, the parent was told of the procedure to be carried out at the next appointment.

Further, four sequential appointments were scheduled with an interval of 4-6 days between each appointment, for various phases of dental treatment. Anxiety (trait and state) and behavior were assessed at each of the dental visits in a similar manner. During the treatment procedures, the child was guided using communication and tell-show-do technique. Restoration of occlusal caries involving outer and middle third of dentin (d1 and d2 lesions, respectively)[21] that did not require to be done under local anesthetic administration were initially carried out. For caries involving the inner third of dentin (d3 lesions)[21], local anesthetic was administered only if the parent of the child requested for it. The supraperiosteal (local infiltration) technique and/ or inferior alveolar nerve block was administered as indicated for extraction and pulp therapy in the upper and /or lower primary teeth.[22]

Statistical Analysis

Paired sample T-test was applied to compare the difference in the anxiety (CFSS-DS, MDAS and CEMS) levels relative to the dental visits. Chi square test was used to compare the FBRS at different dental visits. Wilcoxon Matched Pairs test was used to assess the same for state anxiety (FIS) and behavior (FBRS) levels, respectively. Karl Pearson Coefficient of Correlation was used to assess the correlation between trait (child and parent) and state (child and dentist) anxiety levels individually at different dental visits. Spearman Rank Correlation Coefficient test was used to find out the correlation between anxiety and behavior of the child. Data obtained was tabulated and subjected to statistical analysis using Statistical Package for Social Sciences [SPSS] for Windows (version 22.0 Released 2013, Armonk, New York, IBM Corp.). Level of significance was considered to be 5% ($p<0.05$).

RESULTS

The perception of child's trait anxiety (CFSS-DS) was found to have a highest mean score of 26.55±12.52 at the first dental visit and the child's own perception of trait anxiety (MDAS) mean score was highest at the restorative phase (11.70±4.44). The lowest mean MDAS score was observed at the recall phase (10.51±5.01)(Table1).

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Table 1. Mean trait anxiety and state anxiety scores at different dental visits

Dental visit	Trait Anxiety		State Anxiety	
	CFSS-DS Mean ± SD	MDAS Mean ± SD	CEMS Mean ± SD	FIS Mean ± SD
Introductory	26.55± 12.52	11.15± 5.02	10.25± 4.56	2.70± 0.91
Preventive	26.13± 11.59	11.18± 3.97	11.10± 4.25	2.72± 0.87
Restorative	25.35± 10.97	11.70± 4.44	11.35± 4.16	2.81± 0.79
Invasive	25.99± 11.75	11.63± 4.38	13.95± 4.48	2.96± 0.90
Recall	24.74± 12.65	10.51± 5.01	8.10± 3.03	2.48± 0.84

The mean CEMS score (state anxiety) was highest at the invasive phase (13.95±4.48) and was lowest at the recall phase (8.10±3.03). The state anxiety projected by the child during the dental treatment showed a highest mean FIS score of 2.96±0.90 at the invasive phase, which gradually decreased to 2.48±0.84 at the recall phase (Table 1).

A significantly higher proportion of children (>70%) showed positive behavior at the introductory and preventive dental visits. There was a 10% reduction in children who showed positive behavior at the restorative visit. Whereas, negative behavior was seen in a higher number of children during the 4th visit (invasive). At the 5th (recall) visit, nearly 99% of children showed positive behavior. Overall, a significant difference was observed in behavior of the children between dental visits ($p<0.001$) (Tables 2a & 2b).

Table 2a. Proportion of children showing positive ratings and negative ratings according to Frankl behavior rating scale

Dental visit	No. of children with positive behavior		Chi-square	p value	No. of children with negative behavior		Chi square	p value
	Rating				Rating			
	+3 n (%)	++4 n(%)			-1 n(%)	--2 n(%)		
Introductory	59 (19.67)	162 (54)			63	16		
Preventive	26 (8.67)	188 (62.67)			71	15		
Restorative	17 (5.67)	171 (57)	103.856	<0.001*	98	14	12.881	<0.011*
Invasive	1 (0.33)	91 (30.33)			148	60		
Recall	113 (37.67)	183 (61)			3	1		

*statistically significant values (p-value <0.05)

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Table 2b. Proportion of children showing positive and negative behavior according to Frankl behavior rating scale

	Children with positive behavior Rating + and ++		Children with negative behavior Rating - and - -		Chi square	p value
Dental visit	N	%	N	%		
Introductory	221	73.67	79	26.33	328.242	<0.001*
Preventive	214	71.33	86	28.67		
Restorative	188	62.67	112	37.33		
Invasive	92	30.67	208	69.33		
Recall	296	98.67	4	1.33		

*statistically significant values (p-value <0.05)

On comparison of trait anxiety observed at different visits, the mean CFSS-DS score at recall phase was found to be significantly lower than the first and fourth visits (p<0.05). The child's trait anxiety (MDAS score) was significantly lower during the preventive phase in comparison to that of the restorative phase (p=0.019) and invasive phase (p=0.045). At the recall visit, it was significantly lower than that observed during the 2nd, 3rd and 4th visits (p<0.05) (Table 3).

The mean CEMS score (state anxiety) at the fourth visit (invasive phase) was found to be significantly higher than that of the previous visits (p<0.05). It was lowest at the recall phase (p=0.0001) (Table 4).

Table 3. Comparison of trait anxiety between dental visits

Dental visit		Trait anxiety			
		CFSS-DS		MDAS	
		Paired t	p value	Paired t	p value
1st Introductory	2nd	0.7464	0.4560	-0.1171	0.9068
	3rd	1.8634	0.0634	-1.8922	0.0594
	4th	0.7639	0.4455	-1.5517	0.1218
	5th Recall	2.0515	0.0411*	1.7225	0.0860
2nd Preventive	3rd	1.6357	0.1029	-2.3659	0.0186*
	4th	0.2409	0.8098	-2.0150	0.0448*
	5th	1.9189	0.0559	2.1847	0.0297*
3rd Restorative	4th	-1.4429	0.1501	0.2999	0.7644
	5th	1.0992	0.2725	4.0600	0.0001*
4th Invasive	5th	2.1934	0.0290*	4.3013	0.0001*

*statistically significant values (p-value <0.05)

Table 4. Comparison of state anxiety between dental visits

Dental visit		CEMS	
		Paired t	p value
1st Introductory	2nd	-3.9238	0.0001*
	3rd	-4.0481	0.0001*
	4th	-10.6107	0.0001*
	5th Recall	8.165	0.0001*
2nd Preventive	3rd	-1.1682	0.2437
	4th	-9.2891	0.0001*
	5th	11.8842	0.0001*
3rd Restorative	4th	-9.3113	0.0001*
	5th	12.8924	0.0001*
4th Invasive	5th	21.9210	0.0001*

*statistically significant values (p-value <0.05)

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The mean FIS score at the fourth visit (invasive phase) was found to be significantly higher than that of the previous visits ($p<0.05$). At both introductory and recall visits, the mean FBRS score was significantly higher than that of the other visits ($p<0.05$) (Table 5). There was a significant correlation between CFSS-DS and MDAS at all the visits ($p<0.05$). Also, a significant correlation was also observed between CEMS and FIS at all the visits ($p<0.05$) (Table 6).

Table 5. Comparison of state anxiety and behavior between dental visits using Wilcoxon Matched Pairs test

Dental visit		State anxiety FIS		Behavior FBRS	
		Z-value	p value	Z-value	p value
	2nd	0.1470	0.8831	2.8402	0.0045*
	3rd	1.7727	0.0763	4.3155	0.0001*
1st Introductory	4th	3.6103	0.0003*	9.6749	0.0001*
	5th Recall	2.8277	0.0047*	8.3502	0.0001*
	3rd	1.4911	0.1360	2.4926	0.0127*
2nd Preventive	4th	3.5870	0.0003*	8.7229	0.0001*
	5th	3.4769	0.0005*	10.2011	0.0001*
	4th	2.3347	0.0196*	7.9821	0.0001*
3rd Restorative	5th	5.0855	0.0001*	11.0252	0.0001*
4th Invasive	5th	7.2759	0.0001*	13.7272	0.0001*

*statistically significant values (p-value <0.05)

Table 6. Correlation between scales used to assess trait anxiety and state anxiety

Dental visit	Trait anxiety CFSS-DS and MDAS		State anxiety CEMS and FIS	
	r value	p value	r value	p value
Introductory	0.5438	0.0001*	0.3765	0.0001*
Preventive	0.5378	0.0001*	0.3844	0.0001*
Restorative	0.4809	0.0001*	0.3080	0.0001*
Invasive	0.5099	0.0001*	0.3320	0.0001*
Recall	0.5050	0.0001*	0.1942	0.0007*

*statistically significant values (p-value <0.05)

Spearman's rank correlation coefficient showed a significant inverse correlation between child's behavior and both trait and state anxiety at each of the dental visits ($p<0.05$). Trait anxiety and FIS showed a weak inverse correlation with FBRS. A strong inverse correlation was observed only between CEMS and FBRS (Tables 7 and 8).

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Table 7. Correlation of behavior (FBRS) with trait anxiety

Dental visit	CFSS-DS and FBRS		MDAS and FBRS	
	rho value	p value	rho value	p value
Introductory	-0.434	0.0001*	-0.440	0.0001*
Preventive	-0.476	0.0001*	-0.449	0.0001*
Restorative	-0.307	0.0001*	-0.297	0.0001*
Invasive	-0.242	0.0001*	-0.250	0.0001*
Recall	-0.135	0.0196*	-0.221	0.0001*

*statistically significant values (p-value <0.05)

Table 8. Correlation of behavior (FBRS) with state anxiety

Dental visit	CEMS and FBRS		FIS and FBRS	
	rho value	p value	rho value	p value
Introductory	-0.797	0.0001*	-0.466	0.0001*
Preventive	-0.729	0.0001*	-0.329	0.0001*
Restorative	-0.663	0.0001*	-0.312	0.0001*
Invasive	-0.726	0.0001*	-0.293	0.0001*
Recall	-0.737	0.0001*	-0.174	0.0025*

*statistically significant values (p-value <0.05)

DISCUSSION

General anxiety which includes dental anxiety could be the reason for increased anxiety expressed by children to their parents prior to a dental visit. According to the "Latent Inhibition" theory, children tend to become less anxious if they have had more neutral visits (e.g., check-up, cleaning) before exposure to invasive dental treatments (e.g., restorations, extractions).[10,23] Therefore, this study was conducted, to assess how acquired experiences can influence dental anxiety and behavior in a child, when various phases of dental treatment are carried out in a sequential manner.

The most frequently used measuring instrument for determination of dental fear and anxiety in children is the CFSS-DS.[24,25] This scale has a high reliability, a simple and fast application, and represents a cost-effective way for evaluation. In younger children who cannot read or answer a questionnaire, it is necessary to rely on a proxy report, preferably given by their parents. In most studies, parental version of CFSS-DS has been used to assess dental fear in young children and has shown satisfactory reliability and validity.[25]

In the present study, a second scale (MDAS) was also used to measure trait anxiety prior to the procedure. MDAS has reasonable psychometric properties, low instrumental effects and can be integrated into dental practice as a clinical tool to screen for dental anxiety.[26] Trait anxiety (MDAS) was seen to increase for procedures requiring administration of local anesthesia. However, on completion of the treatment procedure at the end of each visit, the children appeared to be more relaxed and the same could have been conveyed to their parents. Therefore, the trait anxiety was seen to reduce prior to each of the successive visits, and was significantly less at the fifth appointment (recall visit). Successive dental appointments following an initial introductory visit, could have allowed parents and their children to prepare for and respond to subsequent stressful dental procedures. This is in

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accordance with previous studies [7,8,23] that have recommended the need for scheduling invasive treatment procedures at latter appointments.

Age, general fears and maternal dental fear, have been found to have a significant impact on the variance of CFSS-DS.[27] Majority of parents of younger children are reasonably able to rate their child's dental fear accurately. However, parents tend to estimate the dental fear of their children slightly higher than their children.[24] In the present study, a significant correlation was observed between MDAS and the parental rating (CFSS-DS).

Familiarization with the dental environment and treatment provided has been shown to decrease negative behavior in children.[7] In this study, state anxiety was highest during the administration of local anesthesia and significantly reduced at the recall visit. At each visit, the children's behavioral response was seen to change and was influenced by the treatment procedure that was carried out. A child's response to stressful procedures can be varied. The emotional responses of children in the dental operatory need to be understood as a multidimensional phenomenon with behavioral, subjective, and physiological components.[28] The CEMS scale used in this study is an objective tool to document children's emotional responses during stressful medical procedures.[18] It is known to have a relationship with the projective technique (FIS).[29] Therefore, at each dental visit, direct observation of child's behavioral response by the investigator was found to be consistent with that of the child's choices on the Facial Image Scale (FIS). The FIS is a valid means of assessing child dental anxiety status in a clinical context.

The Frankl behavior rating scale is a functional notation method that is quantifiable, reliable and communicates patient's behavioral information in some way.[30] In this study, behavior of the children was seen to change according to the procedures performed at each dental visit.

Negative behavior was seen in a significantly higher proportion of children only during procedures involving administration of local anesthesia. It reflected the trait and state anxiety levels as assessed by the parent, child and the investigator. The investigator's rating of state anxiety (CEMS) was strongly associated with the child's behavior at all dental visits. It may be because the CEMS is an objective tool that accurately assesses the child's emotions towards various dental procedures.[18] In this age group of children, trait anxiety may be influenced by their general fears and their inability to distinguish it from dental fears.[27] Although a behavioral rating scale does not have a prognostic value, it records the child's actual performance during a dental procedure. Therefore, it prepares a clinician for the child's behavior on future visits and to guide the behavior during treatment.[30]

In the present study, physiological parameters of the children were not recorded. The timing of dental appointments was not the same for all children and it could have influenced the outcome of the study. The effect of different non-pharmacological management techniques including distraction therapy on anxiety levels and behavior in children could be investigated. Anxious parents tend to estimate the dental fear of their children significantly higher than non-anxious parents.[24] Maternal dental fears were not assessed in this study. Further, all clinicians do not perceive behavior in precisely the same manner and they tolerate children's behavior differently.[30]

The results of this study indicate the need for assessment of trait and state anxiety of a child by both parents and the dental team in order to predict the child's behavioral response and apply appropriate behavior management techniques. Based on this study, only an introductory visit for parents and children is not able to reduce dental anxiety in young children. Scheduling successive

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appointments to perform dental treatment from relatively painless to more invasive procedures can improve a child's behavior in the dental office.

CONCLUSIONS

Trait anxiety (CFSS-DS and MDAS) and state anxiety (CEMS and FIS) of children were related to their behavior. Sequential phases of dental treatment reduced trait and state anxiety in 3 to 6-year-old children and resulted in their cooperative behavior. An introductory dental visit is important for children and parents. Recording a child's anxiety and behavior during successive appointments can assist the dental team in behavior management.

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