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Original Article

Correlation of Dental Anxiety Measured by Children Drawing: Hospital Scale and SEM Scale with the Intelligence Quotient Levels Measured by Binet Kamat Test among Children Aged 6–9 Years

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Abstract

Objective: Dental anxiety and intelligence quotient (IQ) are multifactorial entities that affect the behavior of the child in the dental clinic. This study aims to correlate dental anxiety measured by the Children Drawing: Hospital (CD:H) Scale and SEM with the IQ levels measured by the Binet Kamat Test among children aged 6–8 years.

Materials and Methods: This cross-sectional study included 100 children, aged 6–8 years that required pulp therapy. The child's IQ was tested by the Binet Kamat Test. Then pulp therapy of the mandibular molar was performed under local anesthesia. After the treatment session, each child was asked to draw a picture of a person in a dental clinic. The child was given a paper and eight crayons. CD:H scale and Human figure drawing test were used along with the SEM and Frankel scales. Two blinded examiners did the scoring of the drawings: A pediatric dentist and a psychologist. Correlation of the IQ and dental anxiety was done after the collection of results from both tests.

Results: Dental anxiety measured by the CD:H scale by the psychologist showed a statistically significant relationship.

Conclusion: Dental anxiety measured by the CD:H scale by the psychologist showed a positive correlation.

Keywords: Dental anxiety, drawing, Frankl scale, intelligence quotient, SEM scale

Introduction

Avoidance of dental treatment is a common result of dental anxiety, which develops in the early years of life and may persist into adulthood.[1] The cause of anxiety may vary; some children show signs of fear concerning particular stimuli, whereas other children may have generalized anxiety.[2] However, in both circumstances, children's emotional responses are comparable.[3]

A number of factors have been identified in the literature as contributing to dental anxiety, including personality traits, fear of pain, past traumatic experiences, the influence of anxious parents or peers who may instill unwarranted fear in a person, and finally, hematophobia.[4]

An important task for a pediatric dentist is to identify the child's emotions that underlie their behaviors while receiving dental care. An alternative approach for pediat-

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ric dentists is to evaluate children's artwork that expresses their emotions. It has been discovered that employing children's drawings as a tool for evaluation can help gauge the subjective emotions of hospitalized children.[3]

In clinical settings, the Binet Kamat Test of Intelligence (BKT) has been one of the most frequently used tests in certain countries for several decades. It is simple to administer, score, and interpret; affordable and a valid measure of intelligence, compared to other well-known, comprehensive IQ tests, such as Wechsler's tests.[5]

To the best of our knowledge, there have been scarce studies associating the intelligence quotient (IQ) with dental anxiety among children. According to Rud and Kisling children with lesser IQs showed more fearful behavior.[6] Therefore, it appears possible that there is an association between IQ and dental anxieties. There are no studies regarding the correlation between IQ and dental anxiety among the Indian population where this combination of the CD:H scale and the Binet Kamat Test is used.

Many times, children with higher IQs call us bluff, when we use euphemisms, and hence pediatric dentists must find different management techniques to earn their trust so that children feel more secure during the treatment. Therefore, understanding a child's IQ level can help pediatric dentists decide whether to treat them under sedation or routine dental office circumstances. Hence, it can be hypothesized that children with a lower IQ are more anxious than children with a higher IQ.[6]

Thus, the main aim of this study is to measure dental anxiety using different scales, such as the Children Drawing: Hospital (CD:H) scale and the SEM scale, and to correlate it with the IQ measured by the Binet Kamat Test.

Materials and Methods

The study design approval and ethical clearance were obtained from the Institutional Review Board. This study is registered with the clinical registry of that country.

Study design

The allocation and elimination of the patients according to inclusion and exclusion criteria are explained in the STROBE flow diagram (Fig. 1). This study was designed as a cross-sectional, observational study to correlate dental anxiety with IQ, in children aged between 6 and 9 years undergoing pulp therapy in the mandibular teeth region under local anesthesia. This clinical trial was conducted in the Department of Pediatric and Preventive Dentistry at a dental institution from January to December 2022.

The sample size was calculated using GPower software (version 3.9.1.2) based on data obtained from the pilot study conducted. The minimum sample size was calculated as 80, which was rounded off to 100, considering a 20% loss of sample. Children without any experience of earlier dental treatment, decayed primary teeth requiring pulp therapy, Healthy children, according to ASA physical status category 1, parents and children, who gave verbal informed consent, respectively, for their participation in the study, and the children who agreed to draw a picture were included in the study. Children with compromised mental and physical health histories, Frankl scale: extremely negative children and children whose IQ score was <70 which suggested intellectual disability were excluded from the study.

The pulse rate of the subjects was measured before, during, and after the pulp therapy treatment.

The subjects were scored by two blinded, but trained personalities, i.e., a pediatric dentist, and a psychologist using the CD:H scale.[3]

The Frankel Behavior Rate was used to assess the behavior of the child by a trained pediatric dentist for the selection of the study group participants. Extremely negative children were excluded from the study.

The IQ was tested by the Binet Kamat Test, which includes various question series related to language, memory, reasoning, conceptual thinking, visuomotor intelligence, and social intelligence.[5] The questions were divided according to age groups. Each child was asked questions from a question set starting at 3 years of age, then proceeding to the next year, such as 4 years or 5 years, until the child stopped answering.

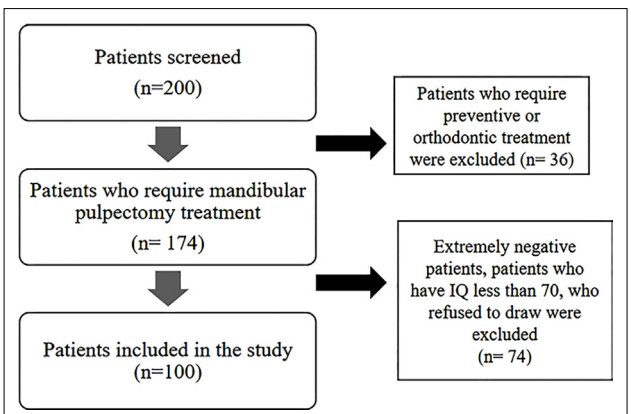

Figure 1. STROBE flow diagram

Table 1. Comparison of changes in pulse rate throughout the procedure (mean±SD)

Interval	Mean±SD	F value	Pairwise comparisons		
			Pre versus during	Pre versus post	During versus post
Pre-operative	86.18±9.37	0.001*	0.001*	0.001*	1.000 (NS)
During treatment	91.50±10.31				
Post-operative	91.85±9.99				

Repeated measure ANOVA test. *: Indicates significant difference at p≤0.05. SD: Standard deviation, NS: Non-significant difference

Procedure

The Binet Kamat Test was used to gauge the child's intellect level during their first therapy session. Following the administration of local anesthesia, all the children had their pulpectomies, as recommended by the intraoral diagnosis. In addition, to SEM, the CD:H scale was used as a self-reported measurement. SEM and pulse rates are objective assessments of the discomfort during the treatment procedures to estimate the construct rationality of the CD:H and human drawing figure. In the current study, the SEM scale has been assessed by one trained pediatric dentist, who was blind to the scoring of the drawings. Total outcomes were calculated by adding the scores attained during the test. Each child was asked to create a representation of a patient in a dental office at the end of the treatment. Each child received an A4 sheet of paper and a box of eight dry-colored crayons that were placed in front of him on a table and chair of appropriate height. "Can you sketch a person in the dental office?" – was one of the instructions given to the child when asked to draw. The child was also told that he could draw as long as he wanted and that a picture of him would be taken after the drawing. If the child had any questions, the answers were neither given in a way that would affect the child's perception nor were the initial instructions repeated. The paper sheet was collected when the child had done sketching and labeled with the patient's number, the test date, the child's birthdate, and the gender on the back.

Scoring of the drawing

An experienced pediatric dentist and a psychologist were two blinded examiners, who scored the drawings. CD:H Scoring Guide, Rating Scale, and the CD:H score sheet were utilized to score these drawings.[7,8] A recognized manual has been utilized in scoring the drawing, which consists of specific directions and examples to assist.[8] The scoring of the drawing consists of three sections. Part A includes 14 items scored on a scale of 1–10, where 1 determines the lowest level of anxiety and 10 is the highest level. Part B is evaluated by giving extra scores for the presence of any of the eight items considered to be pathological signs. Part C is a gestalt score that involves a total rating by the scorer of the child's anxiety on a 1–10 scale by employing specific identifiers. The level of anxiety according to the CD:H score sheet is as follows: 19: <43: very low stress, 44–83; low stress, 84–129; average stress, 130–167; above average; and 168 and over very high stress. The relationship between the IQ and dental anxiety was done after the collection of results from both tests and statistical analysis.

Statistical analysis

The data were analyzed using SPSS v20 software. The level of significance was kept at 5%. Demographic details of the study subjects were presented using descriptive statistics. The change in pulse before, during, and after was analyzed using a repeated measure ANOVA test. The comparison of SEM score, BKT score, and CD:H score among male and female subjects was done using the Mann–Whitney test and independent t-test. The association between the intelligent quotient (BKT score), SEM score, and CD:H score was done using the linear regression method.

Results

Among the total number of participants, the ratio of males and females was almost equal (54 males and 46 females). When the pre-operative and post-operative pulse rates were compared, the pulse rate showed an increase from the pre-operative period to the post-operative period, and this increase was found to be statistically significant (Table 1). There was a non-significant difference in pulse rate before, during, or after among the genders or all three age groups (Table 2).

There was no difference in CD:H score (anxiety levels) measured by pediatric dentist and psychologist between male and female subjects. Whereas, CD:H score was found to be maximum in 6–7-year-old subjects, followed by 8–9-year-old subjects, and least in 7–8-year-old subjects; however, there was a non-significant dif-

Table 2. Comparison of pulse rate according to age groups

Variable	Age groups	n	Mean±SD	p
Pre-operative	6–7	26	86.35±9.08	0.990 (NS)
	7–8	26	86.27±9.58	
	8–9	48	86.04±9.65	
During treatment	6–7	26	93.77±10.2	0.431 (NS)
	7–8	26	90.65±9.70	
	8–9	48	90.73±10.71	
Post-operative	6–7	26	95.54±10.43	0.079 (NS)
	7–8	26	89.73±9.90	
	8–9	48	91.00±9.47	

One-way ANOVA test

ference in CD:H score among three age groups measured by both pediatric dentist and psychologist (Table 3). The intraclass correlation coefficient showed almost perfect agreement between CD:H scores measured by pediatric dentist and psychologist.

There was a non-significant difference in BKT (IQ) scores between male and female subjects. When IQ was compared by age group, BKT score was found to be maximum in 6–7-year-old subjects, followed by 8–9-year-old subjects, and least in 7–8-year-old subjects; however, there was a non-significant difference in BKT score among the three age groups (Table 4).

An assessment of the association of intelligent quotient (BKT score) with SEM score and CD:H score was done. SEM test scores showed a negligible negative correlation with BKT scores. One unit increase in SEM test score was associated with a 0.771 unit decrease in BKT score. The CD:H score (anxiety levels measured by a pediatric dentist) showed a negligible positive correlation with the BKT score. One unit increase in CD:H score was associated with a 0.093 unit increase in BKT score. CD:H score (anxiety levels measured by a psychologist) showed a significant but negligible positive correlation with the BKT score. One unit increase in CD:H score was associated with a 0.132 unit increase in BKT score (Table 5).

Table 3. Age-wise comparison of CD:H score calculated by pediatric dentist and psychologist

Variable	Age	n	Mean	SD	p
CD:H pediatric dentist	6–7	26	129.85	31.710	0.195 (NS)
	7–8	26	115.88	25.619	
	8–9	48	121.94	26.501	
CD:H psychologist	6–7	26	142.38	24.972	0.075 (NS)
	7–8	26	125.54	27.225	
	8–9	48	133.06	26.650	

One-way ANOVA test

Table 4. Age-wise comparison of intelligence quotient score calculated by BKT

Variable	Age	n	Mean	SD
BKT score	6–7	26	96.92	14.789
	7–8	26	93.04	15.220
	8–9	48	95.69	12.856

One-way ANOVA test. BKT: Binet Kamat Test

Discussion

Dental anxiety is an extreme and irrational negative emotional state experienced by patients, whereas dental fear typically denotes a normal unpleasant emotional reaction to specific hazardous stimuli happening in settings related to dental treatment.[9] Dental anxiety is influenced by a variety of factors, including age, ethnicity, parental knowledge, and others.[10] One such factor can be the IQ of the patient.

In the current research, the CD:H scale was used to assess patients' levels of anxiety. Children's ability to draw develops with age and reveals the subconscious material easily. Through drawing, children can easily express their desired emotions, such as happiness and future dreams, as well as their unwanted emotions, such as fear and anxiety.[11] Pre-schoolers frequently sketch heads that are abnormally huge, but by the age of 7 or 8, the head is typically depicted in proportion to the body.[12] Children who draw big heads on their designs

Table 5. Correlation of intelligent quotient BKT score with SEM score and CD:H score

Independent variable	r value	Unstandardized β	p	95% CI	
				Lower	Upper
SEM test score	−0.042	−0.771	0.675	−4.413	2.870
CD:H (pediatric dentist)	0.187	0.093	0.063	−0.005	0.192
CD:H (psychologist)	0.253	0.132	0.011*	0.031	0.232

Linear regression method. *: Indicates significant difference at p≤0.0. SEM: Sound, Eye, Motor test

beyond the age of 8, frequently wish they were wiser and accomplished more.[13] Koppitz[14] stated that a tiny head on a drawing is a sign of intense logical insufficiency. A smile or a frown can convey happiness or despair, and putting emphasis on the lips can signify difficulties speaking or expressing oneself or being too reliant. Drawing eyes without pupils can indicate that the child finds it difficult to interact and socialize with others. Adolescent girls frequently add cosmetic adornments to their eyes.[12] Some of them showed smaller illustrations of dentists and their surroundings compared to the children sitting in dental chairs, showing how much weight children give to their anxieties and fears.[12]

The SEM scale, developed by Wright, is an objective technique that measures auditory, visual, and motor responses[15] to measure comfort or pain in children. According to the patient's drawing, this scale was used to determine whether the patient was in distress or experiencing anxiety.[16]

The use of a pulse oximeter for calculating pulse can be effective to measure dental fear not just before and after the treatment but also during it.[17] In a study done by Goldstein et al[18], an increase in heart rate was observed during dental treatment, which was consistent with this study. Ladder's research found that an anxious patient's pulse rate elevates by 10–20 beats per minute.[19] There was no significance seen among the age groups or between males and females.

BKT was considered one of the finest IQ tests.[20] Some of the latest tests have drawbacks, which make them difficult to use in the child population. BKT can be used successfully in institutional and hospital settings where most of the population is from rural or lower socioeconomic backgrounds or is from a middle-to-lower socioeconomic class. In other words, the BKT IQ test results are more reliable than those from other tests.[21]

Providing children with oral health care during the COVID-19 pandemic and augmented social restrictions could be a challenging task. Dental fear and anxiety are common at appointments, and 7–8% of children in pre-school and early elementary school exhibit them to the extent that they could impede dental operations. The present study was conducted during the pandemic and was therefore indirectly affected by it. The schools were closed for at least a year and a half, affecting the general IQ of the children.[22]

When BKT was correlated with the CD:H scores calculated by the pediatric dentist, a non-significant positive correlation was seen. Whereas, when BKT was correlated with CD:H scores calculated by a psychologist, a negligible but significant positive correlation was revealed. This could be because the children with a higher IQ are more curious and aware of their surroundings, which causes them to reason with the behavior management techniques the dentist is using to calm them down. Even though they tend to cope with stressful situations such as dental treatment, they might have higher anxiety than lower-IQ children. Studies have already shown that children with higher IQs are more susceptible to mental disorders such as anxiety and depression.[23]

On the contrary, Hodges and Plow[24] showed that children with anxiety had a lesser level of IQ than children without anxiety based on an examination of the Full Scale IQ from the WISC-R. This suggests that anxiety limits intellectual performance since an anxious child will have to struggle to encode and process relevant and necessary information. It has been proposed that IQ largely reflects a broad neuropsychological function known as "executive functioning," which comprises sustaining attention and concentration, reasoning abstractly, forming goals, anticipating and planning, initiating purposeful behavior, and self-monitoring. Executive control deficits inhibit the person's ability to monitor and control their behavior.[25]

There are certain issues with offering correlations between age and dental anxiety and behavior,[26] as it could only designate a decrease with age in the tendency to admit to being afraid or an increase in self-control but not a decrease in anxiety.[27] Toledano et al[28] showed that there was a significant correlation between IQ and dental anxiety if other features such as socioeconomic status and age variations were considered.

The present study has considered the fact that both dental anxiety and IQ are multifactorial entities. Environmental factors such as socioeconomic status, parent's education, genetic factors such as disorders, parent's IQ, nutrition factors such as vitamins and minerals, and cognitive factors such as personality and logical reasoning, may have an influence on the IQ of the child.[29]

The present study has considered the fact that both dental anxiety and IQ are multifactorial entities. Environmental factors like socioeconomic status, parent's education; genetic factors like disorders, parent's IQ; nutrition factors like vitamins and minerals; and cognitive factors like personality and logical reasoning, may have an influence on the IQ of the child.[30] Few studies have found that high levels of emotional intelli-

gence have the ability to decrease the level of anxiety of an individual.[31] Another limitation that has been observed from the current study is that it is difficult to separate dental anxiety from the general anxiety of the person as it is a subjective score.[32] The CD:H scale has a limitation in that pre-anxiety cannot be calculated using this scale, as the children refused to draw about the treatment before the dental experience.[33]

Conclusion

Dental anxiety, when correlated with the IQ levels calculated by the CD:H by the psychologist, showed a negligible statistically significant positive correlation, which implies that as the IQ increased, there was an increase in dental anxiety. CD:H scale is an inexpensive and accurate scale to measure dental anxiety. It can be derived from a simple entity, like a child's drawing. Based on the current study, it can be postulated that there might be a correlation between dental anxiety and IQ; hence, further research can be done considering both IQ and emotional quotient.

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Conflict of Interest: None declared.

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