

Association between Intelligence Quotient Dental Anxiety and Oral Health-related Quality of Life in Children: A Cross-sectional Study

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ABSTRACT

Background: Determining the intelligence quotient (IQ) grades of children help in managing dental anxiety (DA) and maintaining the good oral health-related quality of life (OHRQoL).

Aim: To assess the association between IQ, DA, and OHRQoL in children aged 10–11 years.

Design: This cross-sectional study was carried out among 202 children aged 10–11 years in the Southern part of Tamil Nadu, India. The IQ level, DA, and OHRQoL were measured using Raven's Coloured Progressive Matrices (RCPM), Children's Fear Survey Schedule-Dental Subscale (CFSS-DS), and Child Oral Health Impact Profile Short Form (COHIP-SF) 19, respectively. Chi-squared test and Spearman rank order correlation test were used for analysis.

Results: The results revealed a significant negative correlation ($p < 0.05$; $r = -0.239$) between IQ and OHRQoL. DA was negatively correlated with IQ ($r = -0.093$) and OHRQoL ($r = -0.065$), but it was not statistically significant. The gender-based comparison revealed no significant difference in the distribution of girls and boys within different grades of IQ levels ($p = 0.74$), DA ($p = 0.29$), and OHRQoL ($p = 0.85$).

Conclusion: Children with higher IQ showed low OHRQoL scores. DA was negatively correlated with IQ and OHRQoL.

Keywords: Behavior, Cognitive ability, Dental anxiety, Intelligence quotient, Oral health-related quality of life.

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INTRODUCTION

Intellectual developments are the changes that take place in each and every individual. Cognitive ability, commonly referred to as general intelligence, is necessary for the survival of the human in his/her environment.¹ Cognitive functions are an intellectual process through which an individual or a person becomes aware of the surrounding situations and has the ability to cope with them.² It is the capacity of an individual to reason out, plan, and solve various problems which arise around them, making decisions in a better way by thinking abstractly and making the situations favorable for them.³ The intellectual level of an individual depends not only on his/her genetic ability but also on the knowledge acquired from experiences.⁴

Intelligence is one such trait, which is the ability of a person to use knowledge to make decisions, solve problems, understand complex ideas, handle abstract thoughts, learn quickly, and adapt to environmental challenges. It is the overall capacity to think rationally and act out in a more effective manner.⁵ IQ is "the relative intelligence measured in terms of raw scores using various conventional standardized tests, and it varies throughout the life of an individual."⁶ Analytical, creative, and practical intelligence altogether form the core of the intellectual capacity of an individual.⁷

Dental anxiety (DA) is one of the major problems encountered among common individuals, and it poses a major challenge to dentists, especially pediatric dentists.⁸ Anxiety could be an impediment to the cognitive functioning of an individual.⁹ Generally, people differ not only in their levels of anxiety but also in their ability to cope with various threats or fear of dental treatment.¹⁰

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Oral health is one of the basic and significant determinants of quality of life. OHRQoL is a multifactorial complex that reflects on people's sophistication when eating, sleeping, and engaging with societal talks; their self-esteem, and their fulfillment with respect to their oral health.¹¹

Intelligence level can be expected to have a significant impact on the behavior of children in the dental environment because of their varying levels of anxiety, as a result of which the oral health condition of the individual may be affected.¹² There are few studies correlating IQ with factors like DA, dental caries, and gingivitis.^{6,13} Shetty *et al.* showed less anxiety among children with special health care needs than normal children.¹³ Navit *et al.* studied the association of dental caries and gingivitis with IQ and found a

significant correlation between IQ and moderate gingivitis but not with caries.⁶ Literature search found a dearth of studies correlating OHRQoL with IQ and DA in children. Hence, this study was planned to evaluate the correlation between IQ, DA, and OHRQoL among children 10–11 years of age.

MATERIALS AND METHODS

The present cross-sectional study was planned by the Department of Pediatric and Preventive Dentistry, KSR Institute of Dental Science and Research (KSRIIDSR), Tiruchengode, Tamil Nadu, India. The study protocol was analyzed and approved by the Institutional Review Board and Institutional Ethics Committee of KSRIIDSR. The study was carried out from October 2020 to January 2021 following the Strengthening the Reporting of Observational Studies in Epidemiology guidelines.

Sample Size Calculation

The sample size was estimated based on the study by Navit et al., who studied the correlation of IQ with caries and gingivitis using G*Power version 3.1.9.2 software with the significance level set at 5%, the power of the test as 80%. The estimated sample size was 134.

Study Population

A total of 202 children (75 girls and 127 boys) in the age range of 10–11 years participated in the study. The study children were selected from five private English medium schools in Karur district, Tamil Nadu. Recognized approval was obtained from school authorities. Due to the coronavirus disease of 2019 (COVID-19) pandemic, recruitment of children directly from schools was not possible. Phone numbers of the children were obtained from school authorities. The procedures to be carried out were explained to the parents through phone calls, and verbal consent was obtained. All those parents who gave consent for the participation of their children were included. Prior appointments were fixed, and the children were approached personally at their houses. Strict safety precautions were followed due to the pandemic. Convenience sampling was done. Written informed consent in the native language was also obtained from the parents of the children prior to the initiation of the study when they were visited in person.

Inclusion Criteria

- Children aged 10–11 years.
- Children who were medically fit, healthy, and free of any systemic diseases.
- Children selected from the same geographical distribution.
- No history of any unpleasant experiences with dental or medical treatments.

Exclusion Criteria

- Children who were not willing to participate in the study.
- Children with any special health care needs.

Calibration of the Investigator

Prior to the study, the principal investigator was trained by a psychiatrist and a clinical psychologist to use RCPM and estimates the IQ of children. The training session included slide presentations and theoretical discussions. A pilot trial was done among 25 children of age 10–11 years. Reexamination of the 25 children for their IQ

scores was done after a 1-week interval by the same investigator to determine the accuracy of IQ measurement. Test/retest reliability and intraexaminer reliability were determined using K-values. A K-value of 0.98 was obtained, showing a high degree of agreement. The results of the pilot study were not included in the main study.

Questionnaires

RCPM

Raven's Coloured Progressive Matrices (RCPM) is the most commonly used self-reported nonverbal test of intelligence for children aged 6–11 years. The matrix consisted of 36 problems, which were divided into three sets (A, AB, and B) with 12 problems in each. The problems contain a matrix of geometrical patterns, with a part removed. Each child was asked to select the missing cell from six given alternative options to complete the pattern in each item. Instructions regarding the questionnaire were given prior to the start of the study. The score for each individual was categorized under the percentile scores as per the guidelines.¹⁴ The test was carried out by the principal investigator under the guidance of the psychiatrist or the clinical psychologist.

Scores were Classified Accordingly

- Grade I: Intellectually superior if a score lies at or above the 95th percentile for people of that age group.
- Grade II: Definitely above the average in intellectual capacity if a score lies at or above the 75th percentile.
- Grade III: Intellectually average if a score lies between the 25th and 75th percentiles.
- Grade IV: Definitely below average in intellectual capacity if a score lies at or below the 25th percentile.
- Grade V: Intellectually impaired if a score lies at or below the 5th percentile for that age group.

Children's Fear Survey Schedule-Dental Subscale (CFSS-DS)

Children's Fear Survey Schedule-Dental Subscale (CFSS-DS), initially developed by Cuthbert and Melamed in 1982 to assess DA in children aged 6–12 years, was used in this study. It consisted of 15 items related to different aspects of dental treatment and was scored as follows: 1, not afraid; 2, a little afraid; 3, fairly afraid; 4, quite afraid; and 5, very afraid. The total score ranged from 15 to 75, with the highest score indicating maximal fear. Children with CFSS-DS ≥ 38 were defined as dentally anxious.¹⁵

Child Oral Health Impact Profile (COHIP-SF)

The OHRQoL was assessed using the COHIP-SF, developed by Hillary L. Broder in 2007. It assesses the subjective experience of an individual regarding the disease or well-being.¹⁶ It has 19 items categorized under five domains: oral health (five items), functional well-being (four items), socioemotional well-being (six items), school environment (two items), and self-image (two items). It consisted of 17 negative and two positive aspects of oral health. A five-point Likert scale (0, never; 1, almost never; 2, sometimes; 3, fairly often; and 4, almost all of the time) was used to collect responses for all items. The median value found in this study was 56. Children with lesser scores than 56 were categorized under poor OHRQoL, and those with scores greater than or equal to 56 were categorized under good OHRQoL.

Raven's Coloured Progressive Matrices (RCPM) consisted of a booklet with questions in a colorful nonverbal picture format. CFSS-DS and COHIP-SF questionnaires were presented in both

English and the native language (Tamil). Linguistic validation was done by translating the English version to the native language and back translation to English by two different translators. Prior to the distribution of the questionnaires to the children, common instructions were given regarding the questionnaires. They were asked to answer all the questions, and in case of any unanswered question, it was marked incorrect. A total time limit of 1 hour was given to complete all three questionnaires. The questionnaire was administered to the children and filled by them in the presence of their parents under the supervision of the principal investigator.

Statistical Methods

The data obtained were statistically analyzed using Statistical Package for the Social Sciences (SPSS) software (SPSS® for Windows, version 17.0, New York, United States of America: IBM Corp.) with the significance value set at $p < 0.05$. Chi-squared test was used to determine the difference between boys and girls with regard to their IQ, DA, and OHRQoL, and the Spearman rank order correlation test was used to find the association between IQ, DA, and OHRQoL.

RESULTS

A total of 202 children (75 girls and 127 boys) fulfilling the inclusion criteria were enrolled in the study. The overall frequency distribution of children based on their IQ, DA, and OHRQoL is shown in Table 1. Grade III level of IQ was found to be the maximum (43.06%) among 10–11-year-old children. In this study, 55.44% of

Table 1: Frequency distribution of children based on their IQ, DA, and OHRQoL

Grades of IQ based on Raven's classification	Frequency (N) and percentage (%)
I	9 (4.45%)
II	40 (19.8%)
III	87 (43.06%)
IV	57 (28.21%)
V	9 (4.45%)
Dental anxiety	
Anxious	90 (44.55%)
Non-anxious	112 (55.44%)
OHRQoL	
High	104 (51.48%)
Low	98 (48.51%)

children were found to be under the non-anxious category of DA, and 44.55% of children were under the anxious category. Higher OHRQoL was found in 51.48% of study children, and lower OHRQoL was found in 48.51% of children, as shown in (Table 1).

The gender-wise comparison showed no statistically significant difference in the distribution of girls and boys within different grades of IQ levels ($p = 0.74$), DA ($p = 0.29$), and OHRQoL ($p = 0.85$) (Table 2).

Based on different IQ grades, there was no significant difference ($p = 0.27$) in the distribution based on their DA. More percentage of children were not anxious when their IQ increased. There was a significant difference ($p = 0.009$) in the distribution of children based on their OHRQoL scores with regard to different grades of IQ. More percentage of children had lower OHRQoL as IQ increased (Table 3).

Based on DA, there was a significant difference in the distribution of children ($p = 0.009$) among high and low OHRQoL scores (Table 4).

On assessing the correlation between the three parameters: IQ, DA, and OHRQoL, there was a statistically significant ($p = 0.001$) negative correlation found between IQ grades and OHRQoL scores among the study children. There was no significant correlation observed between IQ grades and DA levels (Table 5).

Table 2: Gender based comparison of IQ grades, DA levels, and OHRQoL

	Gender	
	Girls (n = 75)	Boys (n = 127)
Grades of IQ based on Raven's classification		
I	4 (44.44%)	5 (55.55%)
II	14 (35%)	26 (65%)
III	28 (32.18%)	59 (67.81%)
IV	26 (45.61%)	31 (54.38%)
V	3 (33.33%)	6 (66.66%)
p-value	0.74 ^a	
DA levels		
Anxious	37 (33.03%)	53 (47.32%)
Not anxious	38 (42.22%)	74 (82.22%)
p-value	0.29 ^a	
OHRQoL scores		
High	38 (36.53%)	66 (63.46%)
Low	37 (37.75%)	61 (62.24%)
P-value	0.85 ^a	

^aChi-squared test

Table 3: Distribution of children based on their IQ grades with respect to DA levels and OHRQoL scores

Grades of IQ based on Raven's classification	DA levels		OHRQoL scores	
	Anxious (n = 90)	Not anxious (n = 112)	High (n = 104)	Low (n = 98)
I (n = 9)	3 (33.33%)	6 (66.66%)	5 (55.55%)	4 (44.44%)
II (n = 40)	16 (40%)	24 (60%)	18 (45%)	22 (55%)
III (n = 87)	37 (42.52%)	50 (57.47%)	36 (41.37%)	51 (58.62%)
IV (n = 57)	27 (47.36%)	30 (52.63%)	37 (64.91%)	20 (35.08%)
V (n = 9)	7 (77.77%)	2 (22.22%)	8 (88.88%)	1 (11.11%)
p-value	0.27 ^a		0.009 ^{a,*}	

^aChi-square test; * $p < 0.05$ statistically significant

Table 4: Distribution of children based on their DA levels and OHRQoL

Dental anxiety levels	High (n = 104)	Low (n = 98)
Anxious (n = 90)	46 (51.11%)	44 (48.88%)
Not anxious (n = 112)	58 (55.78%)	54 (48.21%)
p-value	0.009 ^{a,*}	

^aChi-squared test; *p < 0.05 statistically significant

Table 5: Correlation between IQ, DA, and OHRQoL scores among the children

Parameters assessed		IQ	Dental anxiety	OHRQoL
IQ	ρ-value	1.000	-0.093 ^a	-0.239 ^a
	p-value	-	0.190	0.001*
Dental anxiety	ρ-value	-0.239 ^a	1.000	-0.065 ^a
	p-value	0.190	-	0.356
OHRQoL	ρ-value	-0.239 ^a	-0.065 ^a	1.000
	p-value	0.001*	0.356	-

^aSpearman rank order correlation test; *p < 0.05 statistically significant

DISCUSSION

Cognitive control involves the ability of an individual to assiduously form a picture of the environmental situation and uses logical reasoning to face them.¹⁷ The intelligence level determines the behavior and attitude of children based upon their level of cognition to understand.¹⁸ The cognitive skills of the children help them in complying with better oral health status. This might help in maintaining good OHRQoL and thereby encompassing general well-being.¹⁹ IQ generally involves two major factors: fluid intelligence and crystallized intelligence. Fluid intelligence commonly measures the ability of an individual to use logic and reasoning skills to solve problems through nonverbal questions. Crystallized intelligence involves the assessment of the ability to use intelligence from experiences through verbal questions.³ Verbal assessment has the disadvantage of being influenced by cultural and other societal factors.²⁰ Hence, in the present study, the RCPM test is preferred over verbal IQ tests. RCPM had colored matrices, which appear to be visually attractive and is also independent of reading and language skills, simplicity in their use, and interpretation.¹⁴ In the present study, CFSS-DS and COHIP-SF were used to test DA and OHRQoL, respectively. These scales were chosen as they were self-reported measures and helped in portraying the feelings, attitudes, and fear of children from their own point of view. Self-evaluation, or a subjective way of assessment, generally provides a better critical evaluation of oneself and proves to be more reliable than the proxy measures involving parents or dentists.²¹

Most of the studies correlated the relationship between IQ and DA.^{6,10,13,22} However, the association of OHRQoL with IQ and DA has not been extensively studied. OHRQoL of a person serves as a primary outcome for the assessment of the overall health and well-being of an individual.¹⁹ Association of IQ and DA with OHRQoL would give a clear picture of the impact of IQ and DA on the oral health of the children. Hence, the present study is the first of its kind to explicitly show whether a relationship exists between the above three factors.

The majority of children in this study were intellectually average, which is in accordance with a study by Navit et al. The higher distribution of children with the average level of IQ may

be attributed to various factors like socioeconomic status and education level of the parents, all of whom were selected from rural areas.⁶

In the current study, there was no significant difference in the DA levels of children with respect to their IQ grades. However, children with superior IQ grades were less anxious than those with inferior IQ grades. This was in accordance with the study by Blomqvist et al. and Toledano et al., which reported that there was a significant negative correlation between IQ and dental fear and anxiety. IQ deals mainly with reasoning ability, which helps in understanding dental treatment needs, thereby reducing the levels of anxiety.^{10,22}

In the present study, there was a significant negative correlation found between IQ and OHRQoL. Children with a higher level of intelligence might be capable of critically evaluating themselves, leading to lower OHRQoL scores.¹³ But Watten et al. contradicted that intelligence was not correlated with the quality of life of an individual. Self-perception could vary from one individual to another, which could mark as the sole reason for the differences in opinion of each child.¹²

In the present study, there was a negative correlation found between DA and OHRQoL. This was in accordance with the result of the study by Kumar et al., which showed a significant negative correlation between DA and OHRQoL. The higher the level of DA, the lower their OHRQoL.²³ Those people who were dentally anxious ignore the maintenance of their good oral health; thereby, the individual is deprived of better OHRQoL.²⁴ Also, dentally anxious children tend to avoid regular dental checkups leading to poor oral health, thereby resulting in low OHRQoL.²⁵

In this study, there was no statistically significant difference found between girls and boys concerning their IQ grades. However, girls exhibited lower IQ. Similar results were shown by Navit et al., which stated that the boys exhibited significantly higher IQs than girls.⁶ This higher grade of IQ among boys can be attributed to the fact that girls are more conservative in their attitude, and boys tend to show more outwardly acting behavior.²⁶

The results of the study revealed no significant difference in anxiety levels between boys and girls. However, girls were more anxious than boys. This was in accordance with the studies by Toledano et al., where a higher level of anxiety was found among girls than boys.²² Boys, who are more exposed to the outside world, tend to be more emotionally stable than girls. Also, boys tend to react to external influences or stresses at times, whereas girls are governed by internal factors.²²

In the present study, the gender-based comparison revealed no significant difference in relation to OHRQoL scores. Self-assessment on OHRQoL was similar among boys and girls. However, Sun et al. showed better OHRQoL among boys than girls.²⁷ But, Thiruvenkadam et al. and Kumar et al. showed contradicting results with girls depicting better OHRQoL.^{23,28} As the clinical examination was not carried out in the present study, the OHRQoL assessment solely depended on the self-reported questionnaire and the individual's own perception. This might be attributed to the difference in results and contributed to perceive oral health alike.²⁹

LIMITATIONS

The limitation of our cross-sectional study was no cause-and-effect relationship could be established, and results could not be generalized. Clinical examination along with OHRQoL would have

given us a better insight into the oral health status of the children. However, it was not possible as the study was carried out during COVID-19 pandemic. Both subjective and objective measurements for the three parameters would have provided a more appropriate assessment.

CONCLUSION

Children with higher IQ grades had lower OHRQoL. DA was negatively correlated with IQ and OHRQoL. There was no difference in IQ, DA, and OHRQoL among boys and girls. Assessing the IQ levels and DA can help us frame an effective treatment plan and provide better oral health care to the children.

Why is this Paper Important to Pediatric Dentists?

- In pediatric dentistry, the major problems encountered by dentists are anxiety and fear among children. Anxiety depends on the cognitive ability and coping capacity of the children.
- The level of anxiety varies among children with varying grades of IQ. Both these contribute to the maintenance of a better OHRQoL.

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