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A Cross-Sectional Study on the Impact of Children's Intelligence Quotient on Their Behavior and Anxiety in a Dental Setting

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Aim: This study examined the relationship between children's intelligence quotient (IQ) and their levels of dental fear and anxiety (DFA) during their first dental visit. It also evaluated the influence of parental general anxiety on children's anxiety during this visit.

Materials and methods: Eighty-eight children, aged 6–12 years, who had never visited a dentist before were conveniently recruited. Recruited children were subjected to the Wechsler Intelligence Scale for Children III (WISC III) and the Children's Fear Survey Schedule-Dental Subscale (CFSS-DS) to examine their IQ and dental fear and anxiety, respectively. Concerning parental general anxiety, General Anxiety Disorder-7 (GAD-7) was utilized. Children's behavior at their first dental visit was assessed utilizing Frankl's behavior rating scale. The Arabic-validated versions of WISC III, CFSS-DS, and GAD-7 were used. The correlations were examined using Spearman's rank-order correlation coefficient ($P<0.05$).

Results: There was a negative correlation between children's IQ score and their DFA levels. There was a positive association between children's DFA and their parent's general anxiety levels. There was a favorable positive correlation between the degree of cooperation and the children's IQ scores during their first dental visit.

Conclusion: This study reveals the common occurrence of fear and anxiety in children during dental visits between the ages of 6 and 12. The findings highlight the complex interplay between cognitive abilities, parental influence, and dental experiences in children. It emphasizes the importance of addressing both child and parental anxiety to promote positive dental visits.

Keywords: Child's IQ, Dental Fear and Anxiety, Parental general anxiety, Child's behavior.

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Introduction

A person's intelligence quotient (IQ) has an impact on their capacity to express distress and conduct themselves in dental situations effectively.[1] IQ level can be expected to impact children's behavior in the dental environment significantly. As a result, the individual's oral health condition may be affected. [2] It has been shown that children with intellectual impairments need a longer time to accept dental treatment because of the association between dental fear and overall cognitive impairment.[3] A correlation between a high intelligence quotient (IQ) and a reduced level of dental anxiety was found by Aminabadi et al.[4] With a prevalence of 9% in pediatric dentistry, dental fear and anxiety (DFA) poses a major challenge for any physician who encounters patients of that age. [5] Dental fear and anxiety affect 6–20% of European children and 20–50% of Asian children between the ages of 4 and 18, according to estimates. [6–9] Behavior avoidance and noncompliance are outcomes of DFA, which are correlated with increased caries complications and the necessity for oral rehabilitation. [9] Additionally, DFA can identify the formation of detrimental cycles that result in subsequent postponement or nonattendance at the dentist, ultimately leading to a decline in oral health [10]. Thus, there is an urgent need for further research, estimating the DFA prevalence and revealing it's contributing factors. [8,9]

Parents can foster the psychosocial development of their children, which can influence their behavior. They can transmit anxiety and terror to their children [11]. Numerous children are likely to internalize their parents' values and attitudes through modeling, and parents with DFA may transmit their anxiety to their children, negatively affecting their cooperation. [12] Research has revealed that parents who experience anxiety tend to attribute apprehension to their children's actions, leading to an overestimation of the severity of their children's dental anxiety. [13] This parental influence may be stronger among children with no dental experience and diminishes or disappears as they gain dental experience. [14] A child's reaction in a dental environment can be impacted by many factors, including cognitive capabilities, the child's capacity to employ diverse coping mechanisms to alleviate apprehensive emotions, and social adaptive abilities, which children utilize to react to routine or everyday occurrences. [15]

According to the available literature, there is insufficient data about the relation between a child's IQ score, dental anxiety, parental general anxiety, and their influence on the child's behavior and cooperation during dental visits. [16]

Furthermore, parental apprehension, perceptions of children's behavior in the dental operatory room, and past dental experiences have been reported to play a significant role in the child's behavior in the dental operatory. Anxious parents tend to interpret their children's behavior as apprehensive, thereby overestimating their dental anxiety. [13] This parental influence may be stronger among children with no dental experience and diminishes or disappears as they gain dental experience. [14]

Accordingly, it is crucial to illustrate the significant role of parents in influencing their children's behavior and cooperation in dental settings. Doing so can clarify the extent to which children's IQs influence anxiety during dental visits and the relationship between this and parents' anxiety levels, children's behavior, and cooperation.

The present study aimed to evaluate the correlation between the child's intelligence quotient and dental fear and anxiety, the parental general anxiety and the child's dental fear and anxiety, and the child's intelligence quotient and cooperation during dental settings at their first visit.

Materials and methods

Participants:

This cross-sectional research was conducted in the Pediatric Dentistry and Dental Public Health Department, Faculty of Dentistry, Ain Shams University. The ethical committee authorized the assessment and publication on January 9th, 2019, under the reference FDASU-RecIM011936. Before the study was conducted, the children's parents or guardians provided a signed informed consent. The children also gave oral assent.

Sample size and study group:

To test the null hypothesis that there is no correlation between a child's intelligence quotient and dental fear, a power analysis was performed for a two-sided statistical test. The sample size (n) required for the study was 88, based on the calculation by Blomqvist, My et al. [17] The statistical analysis used an alpha (α) level of 0.05 (5%), a beta (β) level of 0.20 (20%), power of 80%, and effect size (r) of 0.03. The sample size was computed using the software G*Power 3.1.9.22 (51). Children aged 6-12 years of both genders having their first dental visit, classified as Class I in the American Society of Anesthesiology Physical Status, were recruited. Children were planned for restorative or vital pulp therapy under local anesthesia on the same day of assessment. On the other hand, children with special healthcare needs and those whose parents/carers failed to provide consent for the dental procedure were excluded.

WISC III Arabic:

The Arabic version of the Wechsler Intelligence Scale for Children (WISC III) was used to measure the intelligence quotient (IQ) of children. A qualified psychologist [18] administered the test. The IQ test consisted of 10 subtests, divided into five verbal subtests and five performance subtests. The verbal subtests measured i) vocabulary, ii) similarities, iii) arithmetic, iv) information, and v) comprehension. The performance subtests assessed i) object assembly, ii) coding, iii) block design, iv) image layout, and v) picture completion.

The test took place in a conference room with excellent ventilation, sufficient lighting, complete silence, and suitable table height. The chief investigator supervised the test. After completing the Wechsler test, each subtest was scored, and the total test score was calculated on a scale of 160. Children who did not complete the verbal, performance, and full-scale IQ scores or who did less than three subtests were excluded from the study. For the verbal/performance scales, the missing fifth subtest was replaced by the average of the four completed subtests. This is a common method for using WISC III.[19]

Dental Fear and Anxiety (DFA):

The principal investigator evaluated the level of dental anxiety in every participant child prior to each dental visit using the Arabic-validated version of the Children's Fear Survey Schedule Dental Subscale (CFSS-DS). [20–22] Each query response received a numerical value ranging from 1 (representing no fear) to 5 (representing extreme dread); the cumulative score for each child varied from 15 to 75. Pediatric individuals who achieved a CFSS-DS score of 38 or above were categorized as having dental anxiety. [23]

Parental anxiety:

The principal investigator utilized the Arabic-validated version of the Generalized Anxiety Disorder Scale (GAD-7) [24,25] to evaluate the general anxiety of the parents. The scores on a scale of zero to three were assigned to each response, with "nearly every day" to "not at all" representing anxiety symptoms. The accumulated ratings were displayed on a scale of 0 to 21. The cut-off

values for mild, moderate, and severe anxiety were denoted as scores of 5, 10, and 15, respectively. [24]

Frankl's behavior rating scale:

The principal investigator conducted a thorough evaluation of the child's behavior using Frankl's behavior rating scale. [25] To ensure a comfortable experience for the participants, both topical and local anesthetics were provided. During a single visit, restorative or vital pulp therapy procedures were performed. The child's behavior was closely monitored during the administration of local anesthesia and dental treatment procedures. [26]

Out of the 67 children, only those who demonstrated cooperation completed treatment under local anesthesia. To ensure the comfort of children who were classified as "definitely uncooperative," therapy under general anesthesia was suggested. As a result, 21 children received this therapy.

Statistics

The data was presented in two formats: frequencies and percentages for categorical and ordinal variables, and mean, standard deviation, minimum, and maximum values for numerical data. The normality of the data was determined using the Shapiro-Wilk test. The age data had a Gaussian distribution, while the remaining data followed a non-parametric distribution. To establish correlations, Spearman's rank-order correlation coefficient was computed, with a significance level of $p<0.05$. The statistical analysis was performed using R version 4.3.1 software on the Windows operating system.

Results

Demographic data:

The investigation was conducted on 88 Egyptian school children aged from 6 to 12 years old with mean ages of 8.82±1.14 years. Forty-six were boys, and 42 were girls. The children included in the study were in good mental health and did not have any difficulties with speech or hearing. The included children showed different mental disabilities: most of the cases (53.4%) showed average intelligence, 21.6% showed low average intelligence, 10.2% showed borderline mental disability, and an equal number showed mild mental disability and excellent intelligence. On the other hand, only one child showed very high intelligence (Table 1).

Table 1: Summary statistics for mental ability according to the Wechsler Intelligence Scale for Children (WISC III)

IQ	n (%)
Mild mental disability (< 79)	3 (3.4%)
Borderline mental disability (79-80)	9 (10.2%)
Low average intelligence (80-89)	19 (21.6%)
Average intelligence (90-109)	47 (53.4%)
High average intelligence (110-119)	6 (6.8%)
Very high intelligence (120-129)	1 (1.1%)
Excellent intelligence (130 and more)	3 (3.4%)
Total	88 (100.0%)

Full-Scale IQ assessment

The following table shows the IQ scores for different cognitive abilities. The verbal comprehension index has a mean score of 97.41±13.45, with the lowest score being 66.00 and the highest 134.00. The perceptual reasoning index has a mean score of 98.34±13.76, with the lowest score being 67.00 and the highest 131.00. The working memory index has a mean score of 87.64±18.75, with the lowest score being 50.00 and the highest 136.00. The processing speed index has a mean score of 88.65±14.65, with the lowest score being 50.00 and the highest 111.00. The overall score is the full-scale IQ, which has a mean score of 93.20±14.01, with the lowest score being 57.00 and the highest 124.00.

Table 2: Mean and Standard deviation of the WISC III

Parameter	Mean ± S.D.	Min	Max
Verbal comprehension Index	97.41±13.45	66.00	134.00
Perceptual Reasoning Index	98.34±13.76	67.00	131.00
Working Memory Index	87.64±18.75	50.00	136.00
Processing Speed Index	88.65±14.65	50.00	111.00
Full-Scale IQ	93.20±14.01	57.00	124.00

Child's dental fear and anxiety (DFA)

According to the Children's Fear Survey Schedule Dental Subscale (CFSS-DS), the participants were categorized into three categories depending on the obtained scores: non-apprehensive, moderately fearful, and fearful (Table 3). Most participants showed themselves to be non-apprehensive (61.36%), while 34.09% scored to be fearful, and 4.55% scored to be moderately fearful. The findings revealed that children exhibited a moderate level of dread, as evidenced by the mean dental fear and anxiety score of 34.43±20.90 (minimum: maximum = 15.00; maximum = 75.00).

Table 3: Summary statistics of the Children's Fear Survey Schedule Dental Subscale (CFSS-DS) scores

CFSS-DS category	n (%)
Non-apprehensive	54 (61.36%)
Moderately fearful	4 (4.55%)
Fearful	30 (34.09%)
Total	88 100.0%)

Parental General Anxiety GAD-7

The parental general anxiety disorder scale categories according to the GAD-7 questionnaire data are presented in Table 4. Most of the parents showed mild and moderate general anxiety disorder (43.18 and 38.64%, respectively), while the minority of them showed severe anxiety (18.18%). The mean parental general anxiety score was 9.76±4.79, showing that the participating parents showed mild general anxiety disorder, ranging from 2.00 as a minimum value to 21.00 as a maximum score.

Table 4: Summary statistics of the Generalized Anxiety Disorder categories

GAD-7 category	n (%)
Mild anxiety	38 (43.18%)
Moderate anxiety	34 (38.64%)
Severe anxiety	16 (18.18%)
Total	88 (100.0%)

Evaluation of the child's dental behavior and cooperation:

Table 5 shows the categories of Frankl's Behavior Rating Scale at the first visit of all participants. Most of the participants showed themselves to be cooperative and definitely cooperative (38.63 and 37.50%, respectively), while 10.23% showed themselves to be definitely uncooperative, and 13.64% showed themselves to be uncooperative. According to the Frankl behavior score (first visit), the mean cooperation score was 3.03±0.96, ranging from 1 to 4.

Table 5: Summary statistics for Frankl's Behavior Rating Scale categories during the first visit

Frankl's Behavior Rating Scale category	n (%)
Uncooperative (-)	12 (13.64%)
Definitely uncooperative (--)	9 (10.23%)
Cooperative (+)	34 (38.63%)
Definitely cooperative (++)	33 (37.50%)
Total	88 (100.0%)

Correlation between intelligence quotient (IQ) and child's dental anxiety:

The relationship between a child's IQ score and their level of dental anxiety was analyzed using Spearman's rank order correlation coefficient. The results are presented in Table 6, where it can be observed that all the parameters assessed were statistically nonsignificant (P > 0.05). However, it was found that the verbal comprehension index, perceptual reasoning index, and working memory index were negatively correlated with dental anxiety (with correlation coefficients of -0.085, -0.162, and -0.048, respectively). On the other hand, the processing speed index was positively correlated with dental anxiety (with a correlation coefficient of 0.037). Additionally, the full-scale IQ was negatively correlated with dental anxiety (with a correlation coefficient of -0.075).

Table 6: Correlation between child's IQ score and child's dental anxiety correlation

Parameter	r_s (95%CI)	p-value
Verbal comprehension Index	-0.085 (-0.290:0.126)	0.429^{ns}
Perceptual Reasoning Index	-0.162 (-0.359:0.050)	0.133^{ns}
Working Memory Index	-0.048 (-0.255:0.163)	0.654^{ns}
Processing Speed Index	0.037 (-0.174:0.244)	0.735^{ns}
Full-Scale IQ	-0.075 (-0.280:0.137)	0.489^{ns}

ns; non-significant (p>0.05)

Correlation between the child's dental anxiety and parental general anxiety:

The association between children's and their parents' anxiety was assessed using Spearman's rank-order correlation coefficient. A positive association between children and parental anxiety was shown. However, it was not statistically significant (rs= 0.086, ranging from -0.126 to 0.290; P= 0.425).

Correlation between the child's Intelligence Quotient (IQ) score and cooperation in the first dental visit:

The relationship between the child's IQ score and their cooperation during their first dental appointment was assessed using Spearman's rank order correlation coefficient (Table 7). All the parameters that were analyzed did not show any statistical significance (P >0.05). The verbal comprehension index, perceptual reasoning index, and working memory index showed positive correlations with the child's cooperation on the first visit to the dentistry clinic (rs= 0.129, 0.107, and 0.062, respectively). Conversely, the processing speed index exhibited a negative correlation with the child's cooperation on the first visit (rs= -0.038). The child's level of cooperation on their first visit to the clinic showed a favorable correlation with their full-scale IQ test (rs= 0.074).

Table 7: Correlation between child's IQ score and cooperation in the first dental visit

Visit	Parameter	r_s (95%CI)	p-value
First	**Verbal comprehension Index**	0.129 (-0.082:0.330)	0.230ns
	Perceptual Reasoning Index	0.107 (-0.105:0.310)	0.320ns
	Working Memory Index	0.062 (-0.149:0.268)	0.566ns
	Processing Speed Index	-0.038 (-0.246:0.173)	0.725ns
	Full-Scale IQ	0.074 (-0.138:0.279)	0.494ns

***; significant (p<0.05) ns; non-significant (p>0.05)**

Discussion

Children's cognitive abilities and coping mechanisms have a role in their anxiety levels. The child's IQ can also affect behavior during dental settings. [27] According to the available literature, there is insufficient data about the relation between a child's IQ score, dental anxiety, parental general

anxiety, and their impact on the child's attitude and cooperation during dental visits. In addition, there was an apparent lack of evidence about the correlation between children's dental fear and anxiety and the child's manner during dental procedures. [16]

The children recruited in the study were aged from 6 to 12 years. This age range is considered as the middle childhood period. At this age range, the child is known to develop its first attitudes toward dental care.[28] Many social, emotional, and cognitive changes during the period of middle childhood occur that transform children's minds and result in increasing their self-control and responsibility. [29,30] Previous investigations have reported that dental anxiety is prevalent in youngsters aged 6-12 years. [31–33]

The children included in the study were having their first visit, as children's past dental experience can strongly affect their reaction, anxiety, and cooperation in their following dental visits, which can affect the study's results. [34]

The IQ assessment results showed that the mean full-scale IQ was 93.20±14.01. This full-scale IQ score is in the average range.[35] This is because the children included in the study were at the beginning of the early school developmental stage. Thus, the findings of the study may be more relevant to children who are just starting early school age rather than children who are already further along in this stage. [36]

Results revealed that the child's mean dental fear and anxiety score was 34.43±20.90 according to the CFSS-DS test. This score means that dental fear and anxiety for all participants is in the moderate range from 32 to 39, which means that the sample is representative of the population.[7,23] Therefore, given the correct help, the children in the study showed promise in overcoming their fears and anxieties associated with dental appointments. [37] The obtained results were consistent with results obtained by Alharbi et al. [20], who found that Saudi children aged 8-15 years showed moderate CFSS-DS scores, proving the reliability of the Arabic translation of CFSS-DS to evaluate the child's dental fear and anxiety. The results also agreed with Kvesić et al. [38], who found that children aged 8-13 years have moderate CFSS-DS scores in Croatian children who suffered traumatic dental injury. However, Dahlander et al. [33] found that all included children have high CFSS-DS scores at age 9. This can be due to the narrow age range of the included children.

In addition, results showed that the mean parental general anxiety score was 9.76±4.79, showing that the participating parents showed mild general anxiety, ranging from 2.00 as a minimum value to 21.00 as a maximum score according to the GAD-7 assessment. [24,39,40] Given that the mean score falls within the mild anxiety range, it suggests that while some parents experienced anxiety, it was not severe. Further assessment and consideration of individual distress and impairment are essential for a comprehensive understanding of anxiety levels.

Furthermore, according to the Frankl behavior rating scale, the mean cooperation score was 3.03±0.96, ranging from 1 to 4. This means that the children included in the study were generally cooperative during their first dental visit. However, there was a range of scores, with some children being more cooperative than others.

The full-scale IQ score was positively correlated to the child's cooperation on the first visit to the clinic but was statistically insignificant. This means that children with higher IQ scores tended to be more cooperative during the first clinic visit. The difference in cooperation based on IQ scores wasn't strong enough to be definitively considered a real effect. This may be due to the relationship between the two variables being mediated by other factors, such as the

child's temperament, personality, or past medical experiences. [32] These results were contrary to Khosrozadeh et al. [41], who found a significant correlation between the child's IQ level and cooperation during the dental visit; children with high IQs were more cooperative than those with low IQs. In addition, the children's cooperation during their dental visits varied due to the child's age or the child's growing environment. [42]

Results also showed that the child's full-scale IQ was negatively correlated to their level of dental fear and anxiety. This indicates that there is an inverse relationship between a child's full-scale IQ and their level of dental fear and anxiety. This finding suggests that children with higher cognitive abilities may experience less dental fear and anxiety, while those with lower cognitive abilities may be more prone to dental-related apprehension. Understanding this relationship can help inform strategies for managing dental anxiety in pediatric patients.

Furthermore, results showed a positive, statistically insignificant correlation between child and parental anxiety. These results were consistent with those obtained by Vasiliki et al. [43], who found no correlation between parents and their children's dental anxiety, psychological functioning, and behavior. These results came in contrast with Assunção et al. [44], who found that trait anxiety and dental anxiety scores were correlated among parents and their children. A study by Kanwal et al.[45] found that children's dental fear and anxiety and their behavior during dental settings correlated with the level of parental anxiety.

The present study contributes to the improvement of the quality of life of the included children. Parents of children with weak cognitive ability were unaware of the problem. These parents were educated and guided to institutions that can help them understand and improve their children's abilities. The study is unique in studying the effect of IQ on the behavior of the child in the dental office, which may influence the behavior control approaches used in the management of children with different intellectual abilities.

Limitations of the study

- The absence of a temporal link prevents us from establishing a cause-and-effect connection, and our data merely indicate possible correlations.
- Some children needed help reading while answering the questionnaire questions, which could have influenced their answers.

Conclusion

Within the limitations of this study, it can be concluded that:

- Children between the ages of 6 and 12 often experience dental anxiety and fear.
- The study revealed a negative correlation between children's IQ scores and their DFA levels. In other words, as children's DFA levels increased, their IQ scores tended to decrease.
- Interestingly, there was a positive association between children's DFA and their parent's general anxiety levels. When parents experienced higher anxiety, their children tended to exhibit more dental fear and anxiety.
- During their first dental visit, a favorable positive correlation was observed between the degree of cooperation exhibited by children and their IQ scores. Children who cooperated well tended to have higher IQ scores.

These findings highlight the intricate interplay between intelligence, anxiety, and behavior in the dental setting. Further research could explore strategies to mitigate dental fear and enhance cooperation, considering both child and parental factors.

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