Impact of Intelligence Quotient on the Oral Health Needs of Diabetic Children in Tumkur City

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Abstract: **Background: Selective neuropsychological deficits have been observed in both adult and pediatric patients with type 1 diabetes and are likely to be associated with parameters of metabolic control. There is evidence that both serious hypoglycemia and chronic hyperglycemia alter central nervous system (CNS) causing excessive release of excitatory neurons leading to their death. Important factors governing the Intelligence is Nutrition and health care. Dental health is an integral part of the overall health of a person and a growing child encounters issues like dental caries, gingival diseases. The aim of this study was to determine and compare the Impact of Intelligence quotient on the oral health assessment in diabetic (type-1) and non-diabetic children of age 6-14 years.**

Materials & Methodology: A total of 60 children (30 in each group) were evaluated for general Intelligence using the Seguin form board test (SFBT) and oral health assessment was done using the WHO oral health assessment form for children 2013.The anxiety and behaviour were recorded using the Venham's picture test and Venham's behaviour rating scale respectively.

Result & Observations: A statistically significant differences was seen with the Intelligence quotient (p =0.04) in the control group (Non-diabetic children) was (100.84±14.12) and in diabetic children was (92.57±17.97), anxiety score (p=0.04) in control group (3.03±1.07) and diabetic group (2.56±1.02) and the oral needs (p=0.0007) in control group (3.55±2.07) and diabetic group (5.42±1.98).

Conclusion: In this study diabetic children reported lower IQ compared to the other children and showed an increase in their overall dental treatment needs.

Key words: **Intelligence tests; dental care for children; Diabetes Mellitus (Type -1),Dental treatment needs.**

INTRODUCTION

Intelligence, a multifaceted cognitive capacity encompassing various interconnected capabilities such as rational thinking, problem-solving, and linguistic proficiency, plays a pivotal role in shaping an individual's overall well-being. Intelligence quotient (IQ), a standardized measure of cognitive ability, serves as a comparative indicator of intellectual aptitude, with factors such as nutrition and access to healthcare services influencing its development. However, despite its significance, the impact of Intelligence on pediatric oral health remains a relatively understudied area.[1,2]

Dental health, an integral component of overall well-being, is often compromised in the pediatric population due to prevalent oral health issues such as dental caries, periodontal conditions, and dental misalignments. The interventions required to address these conditions may involve discomforting experiences, potentially leading to dental phobia and behavioral management challenges, particularly in children. Understanding the differential responses of children towards stress-inducing dental procedures is crucial for developing effective strategies to manage pediatric patients and promote positive oral health outcomes.[3,4]

Diabetic ketoacidosis (DKA), a severe complication of type -1 diabetes, poses significant health risks to youth with diabetes and can have acute structural effects on the brain. Parents of children with diabetes have reported subtle learning and emotional problems, indicating potential cognitive implications associated with the condition. Moreover, children with diabetes are often found to have poor oral health, highlighting the need for further investigation into the relationship between intelligence, diabetes, and oral health outcomes in pediatric patients.[5]

Therefore, the aim of this study is to assess the Impact of Intelligence quotient on the overall oral health of diabetic children aged 6-14 years. By examining the relationship between Intelligence, diabetes, and oral health outcomes, this research seeks to elucidate the complex interplay of factors influencing pediatric oral health and inform the development of targeted interventions to improve oral health outcomes in diabetic children. Through a comprehensive understanding of these relationships, we can work towards enhancing the quality of care and promoting optimal oral health in pediatric patients with diabetes.

MATERIALS AND METHODS

Study Design& Duration: A convenience sampling method was employed to recruit children aged 6 to 14 years who reported to the outpatient department of Sri Siddhartha Dental College, Tumkur, over a period of 18 months from April 2022 to July 2023. Additionally, oral examinations for diabetic children were conducted at weekly diabetic camps held in Tumkur city. The study protocol was approved by the college's ethical committee. (SSDCIEC/2022/12)

Methodology: A total of 60 children were included in the study, divided into two groups: Group A (30 children) comprised non-diabetic individuals (Dental OPD), and Group B (30 children) consisted of diabetic patients (Diabetic camps). Inclusion criteria encompassed healthy children visiting the outpatient department, children attending weekly diabetic camps, and those aged between 6 and 14 years. Children who are visiting the dentist for the first time. Exclusion criteria involved children with systemic illnesses other than type-1 diabetes, emergency treatment cases such as trauma or acute infections, and those who had previously visited a dentist.

For every child a thorough oral examination was done and data was recorded using the WHO oral health needs form for children 2013, followed by the assessment of Intelligence quotient using the Seguin -Form board test. The pretreatment anxiety and behaviour were also recorded using the Venham's picture test and Venham's behaviour rating scale respectively.

Recording the Intelligence Quotient [6-18]:

The Intelligence quotient (IQ) of participants was assessed using the Seguin Form Board Test[6] a performance-based measure of General Intelligence by a single trained investigator. This test involves 10 shapes categorized into primary, secondary, and tertiary groups. The Seguin Form Board Test assesses spatial reasoning, visual-motor coordination, and attention to detail, making it suitable for children aged 6 to 14 years. The test is administered in a controlled environment, and the examiner records the time taken for completion and accuracy of responses.SK Goel norm [11]was used to standardize the lowest time recorded and arrive at the child's mental age.

Once the mental age was calculated, Intelligence quotient was calculated using the formula:

Intelligence quotient =Mental age /Chronological age *100

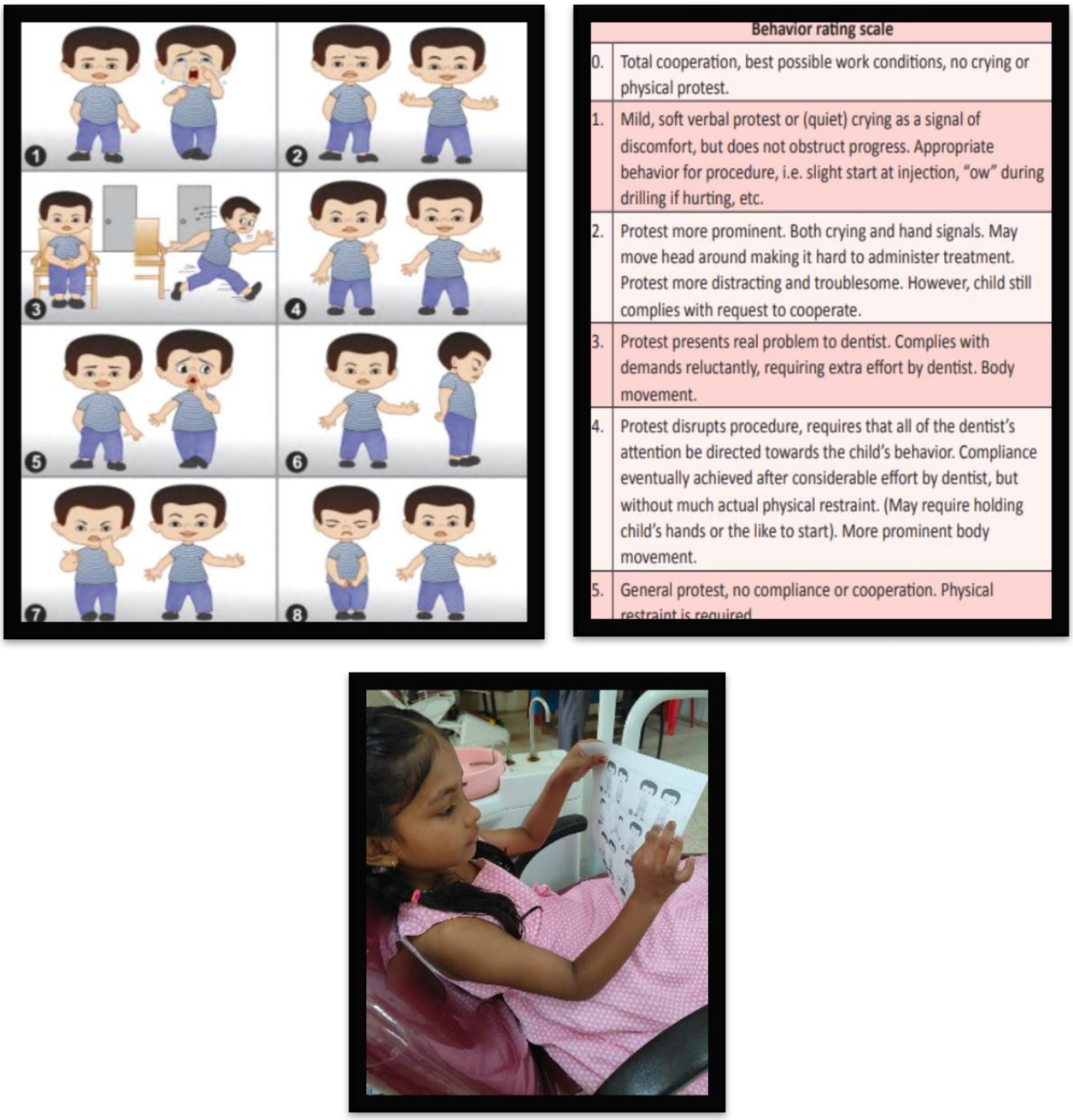
Then the children were categorized into different Intelligence groups according to the Standford-Binet test scale.[18]

(Figure 3,4,5)

Assessment of Anxiety and Behaviour [19,20]: Pre-treatment Anxiety levels and behaviour were evaluated when the patient visited the OPD of the department using the Venham picture scale [9] and Venham's Behaviour rating scale respectively. Children were shown the picture test which comprises of 8 images and were asked to select the image that was the closest to how they felt. Each image is given a score. Highest score (8) means the child was highly anxious and lowest score (0) means the child was calm. Highest score (5) for behaviour rating scale means child showed no cooperation and score zero meant child was totally co-operative.

Assessment of the oral health [21]: This examination occurred on a dental chair using a mouth mirror and a World Health Organization (WHO) probe were utilized for the examination. The WHO Oral Health Assessment Form 2013 for children [10] was employed to systematically record and document any treatment needs identified during the oral examination.

Figure 1: Oral health needs assessment



Behavior rating scale	
0.	Total cooperation, best possible work conditions, no crying or physical protest.
1.	Mild, soft verbal protest or (quiet) crying as a signal of discomfort, but does not obstruct progress. Appropriate behavior for procedure, i.e. slight start at injection, "ow" during drilling if hurting, etc.
2.	Protest more prominent. Both crying and hand signals. May move head around making it hard to administer treatment. Protest more distracting and troublesome. However, child still complies with request to cooperate.
3.	Protest presents real problem to dentist. Complies with demands reluctantly, requiring extra effort by dentist. Body movement.
4.	Protest disrupts procedure, requires that all of the dentist's attention be directed towards the child's behavior. Compliance eventually achieved after considerable effort by dentist, but without much actual physical restraint. (May require holding child's hands or the like to start). More prominent body movement.
5.	General protest, no compliance or cooperation. Physical restraint is required

Figure 2: Venham's picture scale (Pretreatment anxiety assessment)

Figure 3: Assessment of Intelligence Quotient using the Seguin Form Board test

NORMS FOR SFB

MENTAL AGE	3.5	4	4.5	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10	10.5	11
Shortest of three trials (in seconds)	56	46	40	35	31	27	25	23	21.5	20	19	18.5	17.5	16.5	16	15
Total of Three Trials (in Seconds)	216	161	133	125	114	105	98	90	83	77	72	68	64	61	59	55
MENTAL AGE	11.5	12	12.5	13	13.5	14	14.5	15	16	17	18	19	20			
Shortest of three trials (in seconds)	14.5	14	13.5	13	12.5	12.5	12	12	11.5	11	10.5	10.5	10			
Total of Three Trials (in Seconds)	52	49	46	43	41	39	37	36	35	35	34	34	34			

Stanford–Binet Fifth Edition (SB5) classification[4]

IQ Range ("deviation IQ")	IQ Classification
145–160	Very gifted or highly advanced
130–144	Gifted or very advanced
120–129	Superior
110–119	High average
90–109	Average
80–89	Low average
70–79	Borderline impaired or delayed
55–69	Mildly impaired or delayed
40–54	Moderately impaired or delayed

Figure 4&5: SK Goel norm for the assessment of the mental age and Stanford Binet test for classification of the IQ.

Documentation and Analysis: Data collected from the Seguin Form Board Test, Venham Scale assessments, and oral examinations were compiled and analysed using appropriate statistical methods. Data was analyzed using the statistical package SPSS 26.0 (SPSS Inc., Chicago, IL) and level of significance was set at $p<0.05$. Descriptive statistics was performed to assess the mean and standard deviation of the respective groups. Normality of the data was assessed using Shapiro Wilkinson test. Inferential statistics to find out the difference between the groups was done using Mann Whitney U, Chi square test was used for checking frequency in gender.

Spearman rank correlation test was used for correlation analysis.

Results: A statistically significant differences was seen with the Intelligence quotient (p =0.04) in the control group was (100.84±14.12) and in diabetic children was (92.57±17.97) , anxiety score (p=0.04) in control group (3.03±1.07) and diabetic group (2.56±1.02) And the oral needs (p=0.0007) in control group (3.55±2.07) and diabetic group (5.42±1.98) Statistically insignificant results observed with behaviour rating scores(p=0.43) in control group (0.8±0.74) and diabetic group (0.96±0.83)

Table 1 - Mean age

		CONTROL	DIABETIC	Z VALUE (MANN WHITNEY U TEST)	P VALUE
AGE	MEAN	9.36	9.16	0.25	0.69
	SD	2.51	2.28		

*P<0.05 is statistically significant (Shapiro Wilkinson test, p<0.05)

Mann Whitney U test did not report statistically significant difference in mean age between the groups (p>0.05).

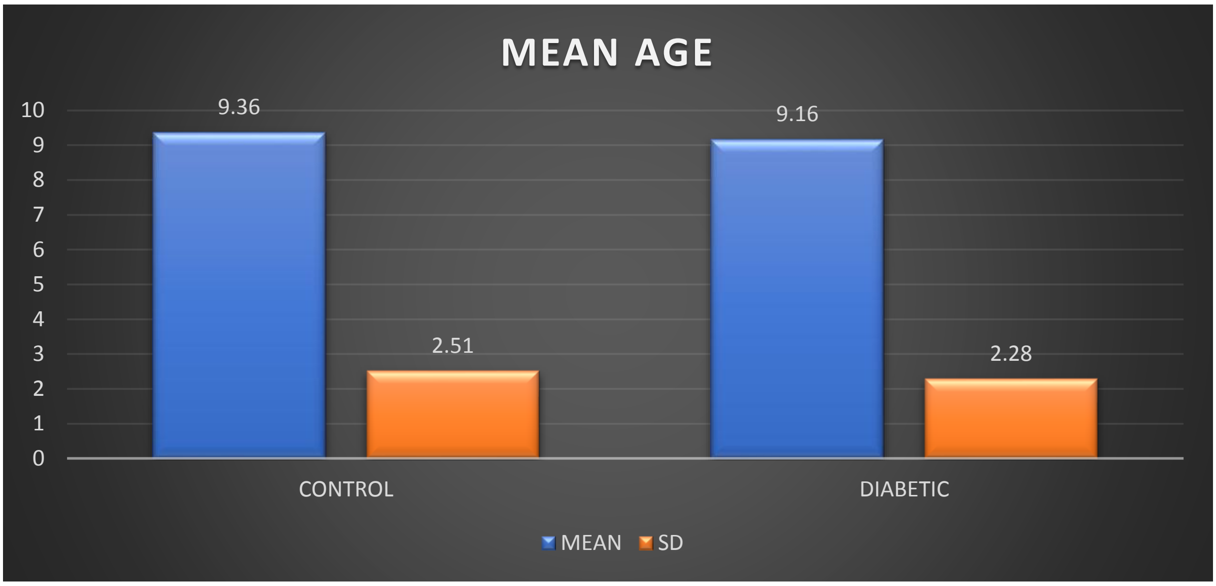


Table 2- Gender

		CONTROL	DIABETIC	X^2VALUE	P VALUE
GENDER	MALE	15(50%)	15(50%)	0	1
	FEMALE	15(50%)	15(50%)		

*P<0.05 is statistically significant

Chi square test did not report statistically significant difference in frequency in gender between the groups(p>0.05)

Table 3- Comparison – Behaviour score, IQ & anxiety score

	CONTROL	DIABETIC	Z VALUE (MANN WHITNEY U TEST)	P VALUE
BEHAVIOUR SCORE	0.8±0.74	0.96±0.83	0.78	0.43
IQ	100.84±14.12	92.57±17.97	1.98	0.04*
ANXIETY SCORE	3.03±1.07	2.56±1.02	1.84	0.04*

*P<0.05 is statistically significant (Shapiro Wilkinson test, p<0.05)

Table 4- Comparison – carious tooth & missing tooth

	CONTROL	DIABETIC	Z VALUE (MANN WHITNEY U TEST)	P VALUE

CARIOUS TEETH	3.55±2.07	5.42±1.98	3.57	0.0007*
MISSING TEETH	6±0(n=1)	0	1.98	Not analysed#

*P<0.05 is statistically significant (Shapiro Wilkinson test, p<0.05)#(single observation in control group)

Significant difference observed in carious status between the groups.

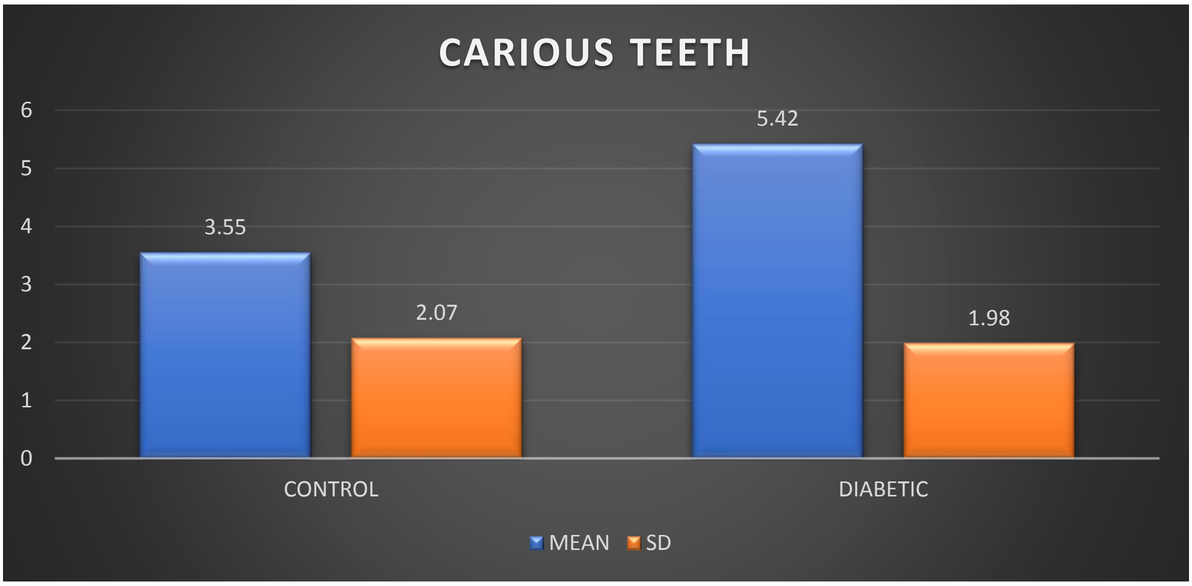


Table 5 -Correlation analysis (IQ&other variables)
(Spearman rank corelation-control
*P<0.05 is statistically significant (Shapiro Wilkinson test, p<0.05)

Correlations-control group

			IQ	BEHAVIOUR SCORE	ANXIETY SCORE	CARIOUS TEETH
Spearman's rho	IQ	Correlation Coefficient	1.000	.072	.224	.375*
		Sig. (2-tailed)	.	.696	.219	.035
		N	32	32	32	32
	BEHAVIOUR SCORE	Correlation Coefficient	.072	1.000	.362*	.208
		Sig. (2-tailed)	.696	.	.042	.254
		N	32	32	32	32
	ANXIETY SCORE	Correlation Coefficient	.224	.362*	1.000	.098
		Sig. (2-tailed)	.219	.042	.	.594
		N	32	32	32	32
	CARIOUS TEETH	Correlation Coefficient	.375*	.208	.098	1.000
		Sig. (2-tailed)	.035	.254	.594	.
		N	32	32	32	32

*. Correlation is significant at the 0.05 level (2-tailed).

Table 5 -correlation analysis (IQ &other variables)
(Spearman rank corelation-diabetic

Correlations

			IQ	BEHAVIOUR SCORE	ANXIETY SCORE	CARIOUS TEETH	FILLED
Spearman's rho	IQ	Correlation Coefficient	1.000	-.166	-.169	.024	-.866
		Sig. (2-tailed)	.	.364	.354	.896	.333
		N	32	32	32	32	3
	BEHAVIOUR SCORE	Correlation Coefficient	-.166	1.000	.744**	.202	.000
		Sig. (2-tailed)	.364	.	.000	.268	1.000
		N	32	32	32	32	3
	ANXIETY SCORE	Correlation Coefficient	-.169	.744**	1.000	.022	-.866
		Sig. (2-tailed)	.354	.000	.	.904	.333
		N	32	32	32	32	3
	CARIOUS TEETH	Correlation Coefficient	.024	.202	.022	1.000	-.866
		Sig. (2-tailed)	.896	.268	.904	.	.333
		N	32	32	32	32	3
	FILLED	Correlation Coefficient	-.866	.000	-.866	-.866	1.000
		Sig. (2-tailed)	.333	1.000	.333	.333	.
		N	3	3	3	3	3

**. Correlation is significant at the 0.01 level (2-tailed).

DISCUSSION

Diabetes, a chronic metabolic disorder characterized by abnormal glucose metabolism, poses multifaceted challenges for pediatric patients, extending beyond its immediate physiological effects to impact various aspects of health and well-being. One significant area of concern is the potential impact of diabetes on cognitive function in children. Studies have suggested that diabetes, particularly type- 1 diabetes, may have implications for cognitive development and performance, potentially leading to lower cognitive abilities in affected individuals. [22] The chronic fluctuations in blood glucose levels characteristic of diabetes can disrupt neuronal function and impair brain metabolism, particularly in regions crucial for learning, memory, and executive function. Consequently, children with diabetes may exhibit deficits in attention, processing speed, and problem-solving skills, which can influence various domains of functioning, including academic achievement and adaptive behaviour.[22,23]

Assessment of Intelligence quotient in this study was done using Seguin -Form Board test. It is one of the most widely used tests of General Intelligence for young children in India (Srinivasan Venakatesan)[6,7] due to its simplicity, quickness and ease of administration, portability, facility to arouse interest and sustain interest. It is a non-verbal test which is much easier to administer even in specially abled children. SFBT continues to remain a valid and reliable speed test of Intelligence at lower age levels with minimal influence of extraneous or organismic variables, such as, sex or education levels .[9-17]

Poor cognitive abilities may impact a child's ability to comprehend and adhere to oral hygiene practices, leading to inadequate plaque removal and increased susceptibility to dental caries and periodontal disease. Additionally, lower cognitive abilities may affect a child's understanding of the importance of dental care and their ability to cooperate during dental visits, potentially resulting in suboptimal treatment outcomes.[23] Furthermore, children with diabetes may experience delays in cognitive development due to the metabolic disturbances associated with the condition, further exacerbating their susceptibility to oral health problems. The underlying mechanisms linking diabetes and poor oral health are multifactorial and include compromised immune function, impaired wound healing, and alterations in salivary composition—all of which contribute to an elevated risk of oral diseases.[5,24-28]

Moreover, the psychological impact on children can be understood by assessing anxiety and behaviour of the children. The daily management demands, hypoglycemic episodes, and concerns about long-term health outcomes can contribute to consistent anxiety levels in diabetic children, which may reduce dental anxiety and impact their willingness to engage in dental care. Anxiety has been linked to avoidance of dental visits, poor oral hygiene practices, and increased risk of dental phobia, all of which can further compound the oral health challenges faced by children. Statistically significant results were observed when comparing anxiety levels and intelligence quotient (IQ) scores between the diabetic group and non-diabetic group.

In this study the analysis revealed that individuals within the diabetic group exhibited lower levels of anxiety compared to those in the non-diabetic group. Furthermore, in terms of IQ scores, the diabetic group demonstrated lower average scores than the non-diabetic group, with statistical significance established through inferential testing. These findings suggest a potential association between diabetes status, as well as a correlation with diminished cognitive abilities (Stanisławska-Kubiak M)[23]. This could be explained due to the high HbA1c levels.

According to Navit s et al [3]children with borderline Intelligence had the highest prevalence of caries. Low cognitive skills in individuals with borderline intellectual levels may lead to non-compliance with oral hygiene and abnormal dietary habits. Attention problems and dental anxiety have been associated with low IQ in children. [27,29,30,31]

The results indicate that diabetic children may face unique challenges related to oral health maintenance and potential cognitive impairments. Poor oral health outcomes observed in diabetic children highlight the importance of comprehensive dental care strategies tailored to address their specific needs, including regular dental examinations, preventive interventions, and behavioral management techniques.[30,31] The limitation of this study would be the small sample size. Intelligence Quotient is affected due to many reasons like socioeconomic status, nutrition and diet, cultures [2] etc, which were not taken into consideration in this study. Blinding of the investigator was not possible as the sample collection was from two different locations.

CONCLUSION

In conclusion, diabetes in children represents a complex and multifaceted condition with far-reaching implications for cognitive function, oral health, and psychological well-being. Lower cognitive abilities associated with diabetes may contribute to increased susceptibility to oral health problems and challenges by the metabolic disturbances inherent in diabetes Continued research into the intricate interplay between diabetes, cognitive function, and oral health is essential for developing tailored interventions that address the unique needs of diabetic children and improve their overall quality of life. Maintaining good oral health is crucial for diabetic kids because poor oral hygiene can exacerbate blood sugar control issues and increase the risk of infections. Regular dental care helps prevent gum disease and other oral health problems, which can, in turn, contribute to better overall diabetes management and improved quality of life.

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