Caries Experience and Oral Hygiene Status of Children Suffering from Attention Deficit Hyperactivity Disorder

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Objective: *The study was conducted to determine the caries experience and oral hygiene status of children suffering from attention deficit hyperactivity disorder (ADHD) and was compared with that of non-ADHD children.* ***Study design:*** *A total of 80 children, including 40 ADHD and 40 non-ADHD children were included in the study. A visual dental examination for dental caries was performed and oral hygiene status of these children was determined. The parent/ guardian completed a questionnaire concerning the child's behavior followed by questionnaire to the child regarding oral hygiene practices and food habits.* ***Results:*** *Student-t test and chi-square test showed that children with ADHD had significantly higher defs score, mean plaque score in compared to that of non-ADHD children. Statistical significant differences were also found out in relation with frequency of tooth brushing and consumption of sugary food among the children suffering from ADHD.* ***Conclusion:*** *Caries prevalence in the primary dentition is increased in the children suffering from ADHD due to poor oral hygiene and increased consumption of sugary foods..*

Keywords: *ADHD, dental caries, defs, plaque score.*
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INTRODUCTION

Attention-deficit/hyperactivity disorder (ADHD) is the most common neurobehavioral disorder of childhood. ADHD is also among the most prevalent chronic health conditions affecting school-aged children. ADHD refers to a family of related chronic neurobiological disorders that interfere with an individual's capacity to regulate activity level (hyperactivity), inhibit behavior (impulsivity), and attend to tasks (inattention) in developmentally appropriate ways.[1]

Children with ADHD may experience significant functional problems, such as school difficulties, academic underachievement, troublesome interpersonal relationships with family members and peers, and low self-esteem.[2,3] Children with ADHD present their symptoms in childhood that may continue as they enter adolescence and adult life.[4] Early recognition, assessment, and management of this condition can redirect the educational and psychosocial development of most children with ADHD.[5] ADHD is frequently associated with other conditions such as dyslexia, developmental coordination disorder, Tourette syndrome, oppositional defiant disorder, conduct disorder, and anxiety disorder.[6,8]

Recorded prevalence rates for ADHD vary substantially, partly because of changing diagnostic criteria over time and partly because of variations in ascertainment in different settings and the frequent use of referred samples to estimate rates. In the general population, 9.2% (5.8% –13.6%) of males and 2.9% (1.9% – 4.5%) of females are found to have behaviors consistent with ADHD.[9-17]

Our pediatric dental community is concerned with the oral health of children with ADHD because of the associated inattentiveness and/or hyperactivity. Due to features of inattentiveness and hyperactivity they are unable to perform regular routine activity like tooth brushing in an effective manner, which may lead to improper oral hygiene practices. Additionally, the diet and appetite of an ADHD child may be altered by medications that could contribute to an increased dental caries risk. The children with these disorders have behavioral management problem (BMP) in dental settings that is connected with fear and anxiety.[18] ADHD is also associated with high risk of traumatic dental injuries (TDI).[19]

Hence, the present study was undertaken to evaluate the caries experience and oral hygiene status in children suffering from ADHD and to compare with those of non-ADHD children in Bangalore city, India.

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MATERIALS AND METHODS

The study group in the present study consisted of 40 ADHD and 40 non-ADHD children in the age group of 6-14 years. The experimental and control group were age, sex and socioeconomic status matched. 32 males and 8 females were included in the study with the mean age group of 8.88 ±1.828 years. (Table 1, Table 2)

Table 1. Gender distribution

Sex	Group		
	ADHD	Non-ADHD	Total
Male	32	32	64
	80.0%	80.0%	80.0%
Female	8	8	16
	20.0%	20.0%	20.0%
Total	40	40	80
	100.0%	100.0%	100.0%

Table 2: Age distribution

	N	Mean + SD	't' value	'p' value
ADHD	40	8.88 + 1.828	0.035	0.853
Non-ADHD	40	8.88 + 1.828		
Total	80	8.88 + 1.828		

Table 3. Distribution of DMFS and defs score among the study group

		Number of children (N)	Mean + SD	't' value	'p' value
DMFS	ADHD	40	1.05 + 1.239	2.179	0.144 (NS)
	Non-ADHD	40	0.68 + 1.023		
Defs	ADHD	40	8.90 + 4.866	46.776	0.002 (S)
	Non-ADHD	40	2.85 + 2.760		

Table 4. Frequency of tooth brushing among the study group

Group	Number of times Brushing			
	Once a day	Twice a day	Not everyday	Total
Non-ADHD	21	19	0	40
	52.5%	47.5%	0%	100.0%
ADHD	27	7	6	40
	67.5%	17.5%	15.0%	100.0%
Total	48	26	6	80
	60.0%	32.5%	7.5%	100.0%

This study involved eighty children out of which forty children suffering from ADHD were taken from the outpatient department of Child and Adolescent Psychiatry, National Institute of Mental Health and Neuro Sciences (NIMHANS), Bangalore, India while the non-ADHD (control group) consisting of forty non-ADHD children were taken from various schools of Bangalore city.

Both male and female children were included. Medicated and non-medicated children were also included in the study. Children with mentally retardation and associated with other syndromes were excluded in this study. Children with systemic diseases such as asthma, diabetes, chronic renal failure etc were also excluded from the study.

Before the start of the study, ethical clearance was obtained from the Department of Child and Adolescent Psychiatry, NIMHANS as well as the Institutional Ethics committee of MS Ramaiah Dental College. Permission was also obtained from the school authorities prior to the study. Detail information regarding the purpose of the study was given to the parents or guardian and informed consent was obtained from the same prior to the examination procedure.

The study group consisted of children suffering from ADHD selected according to the inclusion and exclusion criteria attending the Outpatient department of Child and Adolescent Psychiatry, NIMHANS, Bangalore for a period of eight months. The children were examined by the Resident of Pedodontics department who was trained for assessment of both caries as well as oral hygiene status with the use of defs/DMFS index and O'Leary index. The examiner was calibrated for intra-examiner reliability at the department of Pedodontics, M S Ramaiah Dental College and Hospital, Bangalore with examination of children attending the department for routine treatment till the κ value of 1 was obtained. The consultant child psychiatrist in NIMHANS, Bangalore, did the diagnosis of ADHD. Assessment of child behavior was done with the help of Conner's 10-item questionnaire containing 10 items, rated on a four-point scale where 0 indicated no abnormality and 3 indicated abnormality, with a possible range of total scores from 0 to 30 pertaining to the child's attentional functions, hyperactivity, and behavior.[20]

Clinical data for the detection of dental caries were collected based on the protocol developed by World Health Organization (WHO)[21] on the child's first visit only. The decayed, missing, filled surface index (DMFS) was obtained

Table 5. Frequency of consumption of sticky carbohydrate foods among the study group

Group	consume chocolate, candy bars, chips, pastries or other similar foods between meals 3 days/week		
	No	Yes	Total
Non-ADHD	28	12	40
	70.0%	30.0%	100.0%
ADHD	17	23	40
	42.5%	57.5%	100.0%
Total	45	35	80
	56.2%	43.8%	100.0%

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Abbreviated Parent-Teacher Questionnaire

Responses Observations	Not at all Score = 0	Just a little Score = 1	Pretty much Score = 2	Very much Score = 3
Restless and overactive				
Excitable and impulsive				
Disturb other children				
Fails to finish things he/she starts- short attention span				
Constantly fidgeting				
Inattentive, easily distracted				
Demands must be met immediately – easily frustrated				
Cries easily and often				
Moods changes quickly and drastically				
Temper outbursts, explosive and unpredictable behavior				

J. Abnormal Child Psychology; 25(6):425-451,1997.

for the permanent teeth and decayed, indicated for extraction and filled tooth (defs) was obtained for the primary teeth.

Oral hygiene status was determined by recording the Plaque index (O'Leary *et al*, 1972).[22] Disclosing solution (Plaksee®) was diluted with water and swished all over the tooth surface. Examination was done for each stained surface at the dento-gingival junction. All the teeth present in the oral cavity were examined and scored. After all the teeth were examined and scored, the index was calculated by dividing the number of plaque containing surfaces by the total number of available surfaces.

Questionnaire regarding the oral hygiene practices, dietary habits, socioeconomic status, any relevant medical history of the child were asked to the parent. The oral hygiene practices involve frequency of brushing, use of any other aids to brush the teeth, gingival bleeding during brushing. The frequency of brushing was asked like brushing once a day, twice a day or not every day. The use of any other oral hygiene aids and gingival bleeding during brushing was expressed as "Yes" or "No". The dietary habits questionnaire comprised of two question on the frequency of food and beverages intake and frequency of fermentable carbohydrate snacking. Each question consisted of the response alternatives "Yes" or "No". The questions included in the dietary behaviors were most predictive of dental caries risk.

Statistical analysis

The Excel and SPSS (SPSS Inc, Chicago) software packages were used for data entry and analysis. The results were averaged (mean ± standard deviation) for each parameter. The student *t* test was used to determine whether there was a statistical difference between the groups in the parameters measured. The proportions were compared using Chi-square test of significance.

RESULTS

The result showed that there was a statistical significant difference (p= 0.002) in the mean defs score between ADHD and non-ADHD children but no such statistical differences was observed in DMFS score (Figure 1). A statistical significant difference (p=0.02) was observed in the mean plaque score between ADHD and non-ADHD children.

When frequency of brushing was considered, in non-ADHD group 21 (52.5%) children brushed their teeth once daily, 19 (47.5%) children brushed twice daily. In ADHD group 27 (67.5%) children brushed their teeth once daily, 7 (17.5%) children brushed their teeth twice daily and 6 (15%) do not brush their teeth every day. Chi-square test was applied on the data and a value of 12.321 and the corresponding p value of 0.002 was obtained. Hence, there was a statistical significant difference in frequency of brushing between ADHD and non-ADHD children (Figure 2).

When frequency of consumption of cariogenic carbohydrate foods among ADHD and non-ADHD children was taken into consideration, 12 (30%) children in non-ADHD group and 23 (57.5%) children in ADHD agreed to the consumption of food like chocolate, candy bars, chips, pastries or other similar foods between meals more than 3days/week. 28 (70%) children in non-ADHD group and 17 (42.5%) children in ADHD group did not consume these foods. Chi-square test was applied on the data and a value of 6.146 and

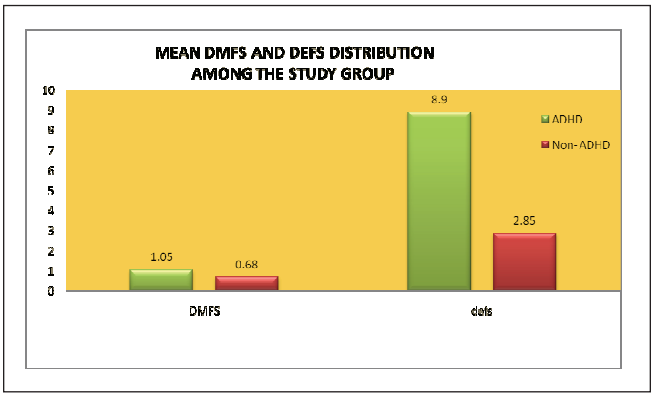

Figure 1.

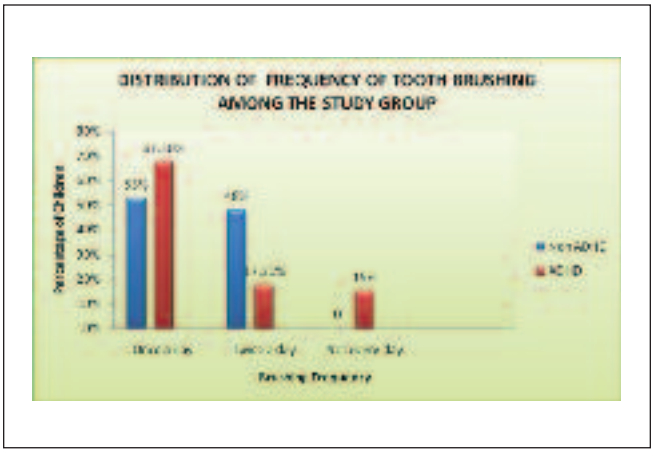

Figure 2.

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the corresponding p value of 0.013 was obtained. Hence a statistical significant difference was found between consumption of carbohydrate foods between ADHD and non-ADHD children. The odds ratio for consumption of food like chocolate, candy bars, chips, pastries or other similar foods between meals more than 3days/week in ADHD children was 3.157 (95% CI:1.2.55- 7.938) when compared with that of non-ADHD children.

DISCUSSION

The present study showed that children with ADHD exhibit more caries experience in the primary dentition with higher defs score compared to that of non-ADHD children. One of the possible reasons for a statistically significant finding in increased caries prevalence in young ADHD patients could be that by the time parents realize that the child is suffering from ADHD, neglect of proper oral hygiene measures by both the parent as well by the child has led to significant damage to the dentition This finding was not in agreement with the previous findings of Grooms *et al*.[23] There was a statistical significant difference in defs score (p = 0.002) between ADHD and non-ADHD children in the present study. Literature about the caries experience in the primary dentition for children with ADHD is sparse and more studies are needed in this regard. But there was no such statistical significant difference (p = 0.144) in the DMFS score between ADHD and non-ADHD children in the permanent dentition. However, Broadbent JM et al in a case control study found that the children with ADHD had nearly 12 times the odds of having a higher DMFT score than children who did not have ADHD.[24] While Blomqvist *et al* [18] reported significantly higher DMFS score in the ADHD group as compared to non-ADHD in the age group of 11 years while in another study done by him[25] on children of 13 years of age a non-significant difference was found in the DMFS score.

The present study was formulated to examine the oral health status of children with ADHD. Due to features like inattentivity and hyperactivity, these children may not be able to perform oral hygiene practices properly. Hence, improper oral hygiene may lead to more accumulation of plaque, which in turn may pose as one of the risk indicators for dental caries. The present study showed that there was a statistically significantly differences in the plaque score between ADHD and non-ADHD children, which was not in agreement with the study done by Bimstein *et al* (2008*)*.[26]

Studies had shown that long term consumption of drugs like methylphenidate, methamphetamine etc for treatment of ADHD behaviors causes xerostomia.[27] The reduced salivary flow can be one of the causes for dental caries risk. It has also been reported that children with ADHD have idiosyncratic reactions to the sedative agent midazolam hydrochloride and that medications used for the treatment of ADHD produce xerostomia, which may facilitate the development of dental caries.[28]

Children with ADHD have deficits in their executive functioning, leading to difficulties in planning and organization, distractibility and problem starting activities that are not stimulating or motivating. This means that a 13 year old child with ADHD performs executive functions at a level comparable to that of an 8 year old child. Keeping this thing in mind, the present study was performed to assess the oral hygiene practices in these children with the help of a questionnaire to the child in presence of the parents. When the frequency of brushing was compared between the two groups it was found that 6 (15.9%) ADHD subjects do not brush their teeth everyday compared to non-ADHD who brushes their tooth every day. This finding was in agreement with the study done by Blomqvist M et al.[25] In this context parents or caregivers of these children (ADHD) should be motivated and care should be directed towards regular oral hygiene practices. Thus, children with ADHD need more support from parents in maintaining daily activities, including coping with their oral health measures.

The odds of eating sticky carbohydrate foods like chocolate, candies, pastries etc between meals for more than 3 days/week were higher in the group of children with ADHD when compared with the control group. There are few studies that seem to be controversial regarding sugar consumption and behavioral alterations such as hyperactivity. Recent report published by Fraser stated that there is a proven link between sugary soda consumption and mental disorder like hyperactivity and distress.[29] The present study also tried to establish a relationship between frequencies of sugar consumption in ADHD subjects since the consumption of sugary food was more in ADHD children when compared with that of non-ADHD. There exist a statistical significant difference (p=0.012) in consumption of sugary foods between these two groups. But till date, there is no such supporting evidence that explains the fact that whether sugar consumption is responsible for hyperactivity or hyperactivity leads to high consumption of sugar. But as far as the relationship between dental caries and sugary food, there are numerous studies which has shown that carious lesions increase significantly with increasing number of carbohydrate food intake.[30] A systematic review of scientific articles examining the relationship between sugar and caries risk classed sugar consumption as a risk factor for caries in most people.[31] But in this study, there was no statistical significant difference between consumption of sugar and both DMFS and defs score. The present study does not show any correlation between oral hygiene, frequency of consumption of cariogenic carbohydrate foods and caries prevalence. A statistically non-significant result was obtained when this correlation was established. A study done by Kimberly A et al[32] found that methamphetamine users were more likely to snack without eating defined meals, consume carbonated beverages regularly, never brush their teeth and smoke more frequently than the nonusers.

Previous investigations and the present study indicated that the oral health status of these ADHD children may be impaired due to various reasons. Though there is little compelling evidence at this time regarding the oral health status in ADHD children especially in India, dental professionals and parents should be aware of the possibility of increased

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susceptibility to oral diseases. However, additional studies with better methodologies are still required to clarify previous findings.

CONCLUSION

The clinical implications of this study were that children with ADHD need more support from their parents regarding oral hygiene and dietary habits. They should be followed up with shorter intervals for dental examinations to prevent caries progression till their adolescence as a result of their oral health behavior. Considering the nature of these disorders (ADHD) and their influence on oral health, suggestion has to be laid down for the development and implementation of specific strategies for the prevention and treatment of their oral diseases. Longitudinal studies with larger sample size are needed to investigate the caries experience and oral health status in children with ADHD.

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