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Salivary Dopamine Among Primary School Students with Attention Deficit Hyperactivity Disorder in Relation to Caries Status

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ABSTRACT

Background: Attention Deficit Hyperactivity Disorder (ADHD) is a neurodevelopmental disorder. Evidence from brain imaging studies have shown that brain dopamine neurotransmission is disrupted among them that may had some effect on caries experience.

Aims: This study was carried out to investigate the association of dental caries status and salivary dopamine level among students with Attention Deficit Hyperactivity Disorder in comparison to control group.

Materials and Methods: Total sample composed of 500students selected from schools in Baghdad city/ Iraq. All were subjected to NICHQ-Vanderbilt-Assessment-Scales index for diagnosis of ADHD. The study group include students that were selected from type combined (attentive and deficit) ADHD to make comparisons between salivary dopamine level and dental health status. Official permission was obtained from the Iraqi Ministry of Education to examine the students without obligation and to ensure support from schools' authority. Dental caries measured by following the criteria of WHO in 2013 by using dmfs, dmft index for primary teeth and DMFs and DMFT for permanent teeth

Result: From the total sample examined only (17.2%) were found with attention deficit hyperactivity disorder from which 44 type combined were pooled from them according to specific formula and they have dmfs mean which is more than the control group, but the difference is not significant. The same result found concerning permanent teeth, but the difference was statically significant correlation coefficient of dental caries represented by dmfs to the level of salivary dopamine in primary dentition is go on positive direction for ADHD and control group, while for permanent teeth represented by DMFs to be in negative direction in the ADHD group and it is on positive direction in the control group for however the result is not significant in both groups.

Conclusion: in this study ADHD children appear to have more caries that seemed to be not associated with salivary dopamine.

Key words: Dental caries, Dopamine, ADHD

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INTRODUCTION

Attention-deficit/hyperactivity disorder (ADHD) is one of the most common mental disorders affecting children. Symptoms of ADHD include inattention (not being able to keep focus), hyperactivity (excess movement that is not fitting to the setting) and impulsivity (hasty acts that occur in the moment without thought) [1]. Strong genetic contributions have been reported for ADHD [2-4]. Attention Deficit Hyperactivity disorder likely arises from multiple changes in biological, psychological, and social domains from which many etiologies of small effect, both environmental and genetic, interact and result in symptoms [5].

Studies in model systems also suggest that genetic variations may cause dysregulation of dopamine signaling and paucity of dopamine release in response to stimuli result in hyperactivity and forgetfulness [6]. Dopamine is an organic chemical of the catecholamine

and phenethylamine families. It functions as a neurotransmitter in the brain. It helps in focus and attention. Vision helps a dopamine response in the brain and this in turn helps one to focus and direct their attention. Dopamine may be responsible for determining what stays in the short-term memory based on an imagined response to certain information. Reduced dopamine concentrations in the prefrontal cortex are thought to contribute to attention deficit disorder [7] there is previous evidence from brain image show that dopamine is deficient in ADHD and this may be contributed to the inattention and impulsivity seen in ADHD [8]. There is also increased awareness that patients with ADHD may have reward and motivation deficits [9-11]. The ADHD adversely influences an individual's ability or motivation to maintain a good standard of oral hygiene, or that parents of a child with ADHD are more likely to reward that child with cariogenic treats. On the other hand, evidence has suggested that the dietary intake of food additives, artificial colors and artificial flavorings may be linked to the behavioral disturbances seen in ADHD, and that perhaps the best method of treating itis to restrict intake of these substances [12,13], thereby reducing the child's intake of cariogenic foods. Few studies on the oral health of children with ADHD have been published. Grooms et al. [14] conducted cross sectional study on children aged 6-10 years and found no differences between ADHD and control group while Broadbent et al. [15] suggested that ADHD is a risk factor for high dental caries experience among 11–13-yr-old children. It was concluded that children with ADHD had high DMFT score than children who did not [16]. In previous studies, there were a higher caries prevalence in a cohort of 11-years old children with ADHD compared with a control group. [17,18] which show that the mean decayed, missed, or filled surfaces (DMFS) value in children diagnosed with ADHD was 2.8 ± 4.0 compared with 2.2 ± 3.2 in the control group, with non-significant difference.

However as far there is no previous Iraqi studies concerning the salivary dopamine in relation to caries status among ADHD patient this study was conducted in order to estimate the salivary dopamine level and found its relationship with dentition status among ADHD school students.

SUBJECT AND METHODS

A cross sectional study was carried out during the period from mid-October 2019 until the end of March 2020. The sample involved primary school students' males and females aged between 9-11 years. The age of sample was calculated according to last birthday according to World Health Organization, 1997. The size of sample composed of 500 students who are randomly selected from 10 schools in the AL-Adamiya sector; the total number of schools were (76) and the number of students were (20214) in the Al-Adamyia Sector.

steven K. thopmson formula was used to calculate the sample size [19]. The sub-sample of students with attention deficit hyperactivity disorder (ADHD)was pooled after examining representative sample (500) for the presence and absence of ADHD and the type of ADHD they have from primary school, their age ranging from 9-11 years for both gender that do not taken any medication, The children were classified, according to the criteria of the DSM-IV [20], into combined, inattentive, or hyperactive-impulsive type and only those with combined type of ADHD were selected (study group) and compared with non-Attention Deficit Hyperactivity Disorder students(control group). the sub- sample was chosen Using G power 3.1.9.7 (Program written by Franz-Faul, Universitatit Kiel, Germany) and using Pilot study of dental caries of primary teeth (dmfs) for both study and control group about 25 subjects for each giving that the mean ± SD is 10.2 ± 3.2 and 8.2 ± 2.1 for both study and control groups respectively makes the effect size is 0.739 and with error of probability is 0.05 and the power of study is 85%, with all these conditions the minimum required sample size for each group less than 44 subjects for each. An approval was obtained from the student's parent that were given an information sheet and consent form which provide simple description about the present study and its importance to insure voluntary precipitation.

A NICHQ-Vanderbilt-Assessment-Scales index [21] was used for diagnosis the ADHD patients. The directions in this index include that each rating should be considered in the context of what is appropriate for the age of child. The index includes symptoms that may appear on child and the teachers choose scale ranging from

never (0) to very often (3).

The first version was consists of (50) items, 32 items has been deleted after presentation to a group of experts, (18) items choose that related only to ADHD symptom as the original index used for number of psychological disorders and ADHD is one of them, the index is given to the child teacher only as the parents may not give the true result due to cultural consideration.

Unstimulated saliva sample collected according to Navazes et al. [22] and salivary dopamine measured by using special kit ELISA technique. Examination of dental caries carried out under standardized condition and the following the criteria of WHO in 2013 by using dmfs, dmft index for primary teeth and DMFs and DMFT for permanent teeth. An approval was obtained from the student's parent that were given an information sheet and consent form which provide simple description about the present study and its importance to insure voluntary precipitation. Clinical examination was performed by using plane mouth mirror and dental probe. Data were collected and analyzed using SPSS version 21 (statistical package for social sciences). Differences between 2 groups were examined by Two independent sample T test, p≤0.05 was considered as statistically significant, relation of variable were conducted using sperman correlation coefficient.

RESULTS

After examining 500 students only 44 students (8.78%) were pooled from ADHD type combined that considered the study group and 44 students free from disorder were selected matched in age and gender with the study group considered as a control group. Dental caries experience is shown in table 1 that illustrates dental caries in primary teeth represented by dmfs was recorded to be more among ADHD group with mean value (9.13 ± 6.941) than control group (6.13 ± 4.317), the difference is not statically significant. Concerning each component, the result of present study illustrates that the mean values of ds ms were not significantly higher in ADHD group than control group, but the mean value of fs was higher in control group and differences were statically significant.

While table 2 shows caries experience of primary teeth represented by mean percentage dmfs (0.34 ± 0.24) to be more than the control group (0.18 ± 0.14) and the difference was statically significant and its components were not significantly more in study group than control while the mean of fs component more in control group than the study group and the difference was significant statically.

Table 3 shows that dental caries in permanent teeth represented by DMFs was recorded to be more among ADHD group with mean value (3.30 ± 4.53) than control group (1.64 ± 1.53), the difference was statistically significant. The same result found concerning each component of DMFs as shown that the mean values of Ds,Ms were more in ADHD group than control group asthe difference was statistically significant for Ds and not significant for Ms component but the mean value of FS was more in control group and the difference was not significant. However, table 4 illustrates that the caries experience of permanent teeth represented by mean percentage DMFs in ADHD group (0.04 ± 0.04) more than control group (0.03 ± 0.07) but

Table 1: Caries experience of primary teeth represented by dmfs and its component among study and control group.

	Study		Control		Statistic	
	Mean	SD	Mean	SD	t test	P value
ds	6.09	6.99	3.42	3.322	1.732	0.089
ms	2.61	3.758	1.08	1.932	1.815	0.075
fs	0.28	0.813	1.75	2.27	-3.391*	0.001
dmfs	9.13	6.941	6.13	4.317	1.862	0.068
dmft	3.81	2.879	3.83	2.681	-.028-	0.978

*Significant P ≤ 0.05

Table 2: Caries experience of primary teeth represented by mean percentage dmfs and its component among study and control group.

	Study		Control		Statistic	
	Mean	SD	Mean	SD	t test	P value
ds	0.2	0.24	0.11	0.09	1.739	0.088
ms	0.12	0.25	0.06	0.13	1.2	0.235
fs	0.01	0.02	0.06	0.11	-2.445*	0.018
dmfs	0.34	0.28	0.18	0.14	2.55*	0.014
dmft	0.55	0.35	0.4	0.25	1.747	0.086

*Significant P ≤ 0.05

Table 3: Caries experience of permanent teeth represented by DMFS and its component among study and control group.

	Study		Control		Statistic	
	Mean	SD	Mean	SD	t test	P value
ds	2.48	2.48	1.25	1.2	2.951	0.004*
ms	0.68	3.34	0.11	0.75	1.101	0.274
fs	0.14	0.46	0.25	0.61	-0.980-	0.33
dmfs	3.3	4.53	1.64	1.53	2.301	0.024*
dmft	1.98	1.81	1.41	1.02	1.814	0.073

*Significant P ≤ 0.05

Table 4: Caries experience of permanent teeth represented by mean percentage DMFS and its component among study and control group.

	Study		Control		Statistic	
	Mean	SD	Mean	SD	t test	P value
ds	0.04	0.06	0.02	0.02	2.225	0.029*
ms	0.01	0.03	0	0.01	1.131	0.261
fs	0	0.01	0	0.01	-0.564	0.574
dmfs	0.04	0.04	0.03	0.07	0.383	0.703
dmft	0.1	0.09	0.1	0.17	0.056	0.956

*Significant P ≤ 0.05

it statically not significant, Ds, Ms component show a mean percentage more in ADHD group which statically not significant while the mean percentage of Fs component was equal in both groups.

Table 5 demonstrates that correlation coefficient of dental caries represented by dmfs and its components to the level of salivary dopamine in primary dentition is go on positive direction for ADHD and control group except for ms component in ADHD group and fs component in control group.

Table 6 shows that the correlation of dental caries to the level of salivary dopamine in permanent teeth represented by DMFs and its components to be in negative direction in the ADHD group except for Fs component which go on positive direction while it's on positive direction in the control group for DMFs and its components except for Fs component which go on positive direction, but the result is not significant in both groups. Table 7 show the mean of salivary dopamine level to be lower in the ADHD group (13.85±4.81) than the control group (14.22 ± 5.35), but the difference is not significant.

Table 5: Correlation between salivary dopamine and caries in primary teeth.

	Study		Control	
	r	p	r	p
dmfs	0.129	0.481	0.198	0.354
ds	0.139	0.447	0.282	0.183
ms	-0.025	0.889	0.296	0.16
fs	0.067	0.714	-0.37	0.075

Table 6: The correlation of dental caries to the level of salivary dopamine in permanent teeth.

	Study		Control	
	r	p	r	p
dmfs	-0.213	0.165	0.142	0.359
ds	-0.094	0.544	0.179	0.245
ms	-0.223	0.146	0.233	0.127
fs	0.026	0.867	-0.244	0.11

Table 7: Mean of salivary dopamine level.

	Study		Control		Statistics	
	Mean	SD	Mean	SD	T test	P Value
Dopamine	13.85	4.81	14.22	5.35	0. 35	0. 731

DISCUSSION

This comparative study suggests that ADHD is a risk factor for high dental caries experience among 9-11-years-old children in Al-Adamiya sector. Before considering the implications of this finding, it is appropriate to consider the methodological weaknesses and strengths of the study. As number of children in the primary School of Al-Adamiya sector is high, the cases and controls were identified from what is essentially a census sample of 9-11-year-old children. A population-based study is more likely to be representative, and therefore more generalizable. As a teacher-report questionnaire was used to collect data on putative risk factors, bias is a possible with the large number of students they had in classroom; however, this is better than asking the child parents as they tend to give their children a better rating than their truth especially considering their academic performance and with keeping the questionnaire as short and simple as possible this effect should have been minimized.

Confounding by age, gender and ethnicity has been eliminated using matching and random selection of children in each group.

While the dental caries showed to be higher in children having ADHD, and the finding was statistically significant. Future confirmatory studies should use a larger sample size than was used in this study.

The data of present study showed that dental caries was found to be higher in ADHD group than control group in both primary and permanent dentition represented by dmfs, dmft and DMFs, DMFT respectively , but Fs, fs were more in control group than ADHD group this may be due to the behavior problem associated with ADHD as in children with ADHD, cognitive and executive functions may be impaired, leading to significant behavioral problems that affect everyday life and their parents are more concerned with the child behavior than dental health [23].

So health promotion interventions directed at children with ADHD (and their parents) should

promote awareness of the possibility that the condition will increase their dental caries risk, and suggest preventive measures (such as tooth-brushing, fluoride supplementation, and dietary improvement) that may be effective in minimizing this effect. A low sugar diet should be suggested although its effect is minimum in reducing ADHD only 1-2% but its carry more dental benefits for this high-risk group of children. Because ADHD may increase a child's dental caries risk, these children should be targeted for shorter dental recall periods and increased preventive measures such as topical fluoride, parental monitoring of oral hygiene practices, and encouragement to modify diet where it is a problem. this finding agrees with the finding of Broadbent*et al*. [15] and My Blomqvist study [24] But disagree with the finding of Groom s*et al* [14], HIDAS A [25], Carlsson [26].

howeverthis study concluded that salivary dopamine is lower in ADHD group than control group, but the result is not significant may be due to the small sample size used in the study, there is Evidence from brain imaging studies have shown that brain dopamine neurotransmission is disrupted in ADHD and that these deficits may underlie core symptoms of inattention and impulsivity. [8] The result of present study found no relation between salivary dopamine and increase dental caries in primary and permanent dentition this result agrees with Vanderas et al. [27] although the study correlate dopamine with other excretion fluid (urine).

More studies with a larger sample size are needed to have more evidence on the relationship of salivary dopamine with the dental health status of children with ADHD as there is previous thought that ADHD associated with deficit dopamine which is important for motivation and motor movement that may affect the oral hygiene and sugar consumption which in turn increase dental caries.

CONCLUSION

With the available evidence, based on quality assessment and evidence level of selected articles, two studies had low risk of bias and one study had moderate risk of bias. Out of the three studies, the salivary F concentrations after placing fluoride devices were found to be statistically significant, also caries reduction were observed in the clinical trials where DMFT/S, dmft/s status were assessed. Therefore, it can be concluded that slow release intra oral fluorides are effective in decreasing caries occurrence and altering the salivary fluoride concentrations. But a greater number of clinical trials should be done in order to establish generalis ability of the device among the population.

REFERENCES

1. Anielson ML. Prevalence of parent-Reported ADHD diagnosis and associated treatment among U.S. children and adolescents 2016. J Clini Child Adol Psychol 2018; 47:199-212.
2. Faraone SV, Sergeant J, Gillberg C, et al. The worldwide prevalence of ADHD: Is it an American condition? World Psychiatry 2003; 2:104–113.
3. Ginsberg Y, Quintero J, Anand E, et al. Underdiagnosis of attention-deficit/hyperactivity disorder in adult patients: A review of the literature. Prim Care Companion CNS Disord 2014; 16.
4. Berger I. Diagnosis of attention deficit hyperactivity disorder: Much ado about something. Isr Med Assoc J 2011; 13:571–574.
5. Atkinson M, Hollis C. NICE guideline: Attention deficit hyperactivity disorder. Arch Dis Child EducPract Ed 2010; 95:24-27.
6. Russell VA. Dopamine hypofunction possibly results from a defect in glutamate-stimulated release of dopamine in the nucleus accumbens shell of a rat model for attention deficit hyperactivity disorder–The spontaneously hypertensive rat. Neurosci Biobehav Rev 2003; 27:671–682.
7. https://www.news-medical.net/health/Dopamine-Functions.aspx
8. Rosa Neto P, Lou H, Cumming P, et al. Methylphenidate-evoked potentiation of extracellular dopamine in the brain of adolescents with premature birth. Ann N Y Acad Sci 2002; 965:434-439.
9. Luman M, Oosterlaan J, Sergeant JA, et al. The impact of reinforcement contingencies on AD/HD. Clin Psychol Rev 2005; 25:183-213.
10. Johansen EB, Killeen PR, Russell VA, et al. Origins of altered reinforcement effects in ADHD. Behav Brain Funct 2009; 5:719226460.
11. Haenlein M, Caul WF. Attention deficit disorder with hyperactivity. J Am Acad Child Adolesc Psychiatry 1987; 26:356-362.
12. Feingold BF. Hyperkinesis and learning disabilities linked to artificial food flavors and colors. Am J Nurs 1975; 75:797–803.
13. Feingold BF. Behavioral disturbances linked to the ingestion of food additives. Del Med J 1977; 49: 89–94.
14. Grooms MT, Keels MA, Roberts MW, et al. Caries

experience associated with attention-deficit/ hyperactivity disorder. J Clin Pediatr Dent 2005; 30: 3–7.

15. Broadbent JM, Ayers KM, Thomson WM, et al. Is attention deficit hyperactivity disorder a risk factor for dental caries? A case-control study. Caries Res 2004; 38:29–33.
16. Blomqvist M, Augustsson M, Bertlin C, et al. How do children with attention deficit hyperactivity disorder interact in a clinical dental examination? A video analysis. Eur J Oral Sci 2005; 113:203–209.
17. Blomqvist M, Holmberg K, Fernell E, et al. Oral health, dental anxiety, and behavior management problems in children with attention deficit hyperactivity disorder. Eur J Oral Sci 2006; 114:385–390.
18. Wolraich M, Lambert W, Doffing M, et al. Psychometric properties of the vanderbilt ADHD diagnostic parent rating scale in a referred population. J Pediat Psych 2003; 28:559-568.
19. Thompson SK. Sampling, 2nd Edn Jhon Wily and Son. New Jersey 2012.
20. Diagnostic and statistical manual of mental disorders, 4th Edn. Washington D.C. American Psychiatric Association, 1994.
21. Navazesh M, Kumar SK. Measuring salivary flow: Challenges and opportunities. J Am Dent Assoc 2008; 139:35S-40S.
22. Odgers CL, Caspi A, Broadbent JM, et al. Prediction of differential health burden by conduct problem subtypes in males. Arch Gen Psychiatry 2007; 64:476–484.
23. Staberg M, Norén JG, Johnson M, et al. Parental attitudes and experiences of dental care in children and adolescents with ADHD-A questionnaire study. Swed Dent J 2014; 38:93-100.
24. Blomqvist M, Holmberg K, Fernell E, et al. Oral health, dental anxiety, and behavior management problems in children with attention deficit hyperactivity disorder. Eur J Oral Sci 2006; 114:385–390.
25. Hidas A, Noy AF, Birman N, et al. Oral health status, salivary flow rate and salivary quality in children, adolescents, and young adults with ADHD. Arch Oral Biol 2011; 56:1137–1141.
26. Carlsson V, Hakeberg M, Blomkvist K, et al. Attention deficit hyperactivity disorder and dental anxiety in adults: relationship with oral health. Eur J Oral Sci 2013; 121:258-263.
27. Vanderas AP, Manetas C, Papagiannoulis L. Urinary catecholamine levels in children with and without dental caries. J Dent Res 1995; 74:1671-1678.