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Duangruethai Khobkham

*Faculty of Public Health, Chiang Mai University, 50202 Chiang Mai Province, Thailand,
duangruethai_khob@hotmail.com*

Kanyarat Korwanich

Department of Family and Community Dentistry, Faculty of Dentistry, Chiang Mai University, 50202 Chiang Mai Province, Thailand, ped005@hotmail.com

Narumanas Korwanich

Department of Family and Community Dentistry, Faculty of Dentistry, Chiang Mai University, 50202 Chiang Mai Province, Thailand, e2809025@yahoo.com

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ORIGINAL ARTICLE

Oral Health and Related Behavior of Children Aged 9–12 with Attention Deficit Hyperactivity Disorder in Tron District, Thailand

Duangruethai Khobkham¹, Kanyarat Korwanich², Narumanas Korwanich²

¹*Faculty of Public Health, Chiang Mai University, 50202 Chiang Mai Province, Thailand,*

²*Department of Family and Community Dentistry, Faculty of Dentistry, Chiang Mai University, 50202 Chiang Mai Province, Thailand*

Correspondence e-mail to: duangruethai_khob@hotmail.com

ABSTRACT

Attention deficit hyperactivity disorder (ADHD) is a common biobehavioral childhood disorder that leads to significant behavioral problems that affect everyday life. **Objective:** This study aimed to compare oral health and oral health behaviors among children with and without ADHD. **Methods:** The study included 105 children aged 9–12 years with ADHD and 105 age-, gender-, and family income-matched children without ADHD. Clinical data as caries, periodontal health, and traumatic dental injuries were recorded by calibrated examiners. All parents of the children completed questionnaires about the oral health behaviors of their children by a single interview. Data were compared using Chi-square test, McNemar test, and Paired t-test at the significance level of 0.05. **Results:** The children with ADHD had significantly lower tooth brushing frequency and shorter tooth brushing duration compared with the children without ADHD. The two groups had equivalent dental trauma prevalence (1.9%). Compared with the children without ADHD, the children with ADHD had significantly more decayed, missing, and filled teeth (3.24 ± 2.14 vs. 2.25 ± 2.23). Therefore, 11.4% of the children in the ADHD group were caries free compared with the 30.5% in the non-ADHD group. The children with ADHD had 3.9 times the odds of prevalence dental caries than the children without ADHD. The children with ADHD had significantly higher Simplified Debris Index and Simplified Calculus Index values than the children without ADHD. **Conclusion:** Children with ADHD exhibited a higher prevalence of caries and periodontal problems than children without ADHD.

Key words: ADHD children, oral health, oral health behavior

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INTRODUCTION

Attention deficit hyperactivity disorder (ADHD) is a neurobehavioral developmental disorder characterized by inattention, hyperactivity, and impulsivity that is associated with significant functional impairment.¹ ADHD is a common biobehavioral childhood disorder with a worldwide prevalence of approximately 5.29%. In Thailand, the reported prevalence of ADHD is 8.1% in primary school children, and boys are more likely to be affected than girls.²

However, the dental implications of ADHD remain unclear. Grooms et al. found more initial carious lesions in children with ADHD compared with a

control group.³ Similarly, Kohlboeck et al. revealed that children with ADHD exhibit more non-cavitated lesions on tooth surfaces than children without ADHD.⁴ When the children have grown up, the prevalence of new caries and gingivitis increases in adolescents with ADHD than in those without ADHD.⁵ In addition, children with ADHD demonstrate a higher plaque index than those without ADHD.⁶

Children with ADHD have difficulties with communication, overactivity, impulsivity, and staying focused. These behaviors can make oral health practices such as tooth brushing difficult and dental examination challenging, leading to improper oral hygiene.^{7,8} Medications used to treat ADHD have side

effects, including xerostomia, and are often associated with increased drinking frequency and dental caries.⁸ Previous studies exhibited that children with ADHD are likely to experience accidental injuries because of their high levels of motor activity.^{7,9-11} While some studies have shown higher dental caries, dental injuries, and gingivitis among children with ADHD, others have demonstrated no significant differences. Thus, whether or not ADHD or associated factors, such as medication and poor oral hygiene, are risk factors for gingivitis and dental caries remains unclear.¹²⁻¹⁴

To the best of our knowledge, no previous studies have investigated the oral health and oral-health behaviors of children with ADHD in Thailand. Accordingly, this study aimed to compare the oral health and oral-health behaviors among children with and without ADHD.

METHODS

The study protocol was approved by the Committee of Research Ethics, Faculty of Public Health, Chiang Mai University, Thailand. Informed consent was obtained from all parents or legal guardians of participating children and children.

Study samples

The study was an observational, cross-sectional comparative study conducted in Tron District, Uttaradit Province, Thailand. This study consisted of 210 children aged 9–12 years. The 105 children with ADHD were diagnosed by Child and Adolescent Psychiatry doctors of Uttaradit Hospital in accordance with the criteria of the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition. The non-ADHD group comprised 105 children matched for gender, age, and family income to the ADHD group. The children without ADHD were medically healthy and have never been diagnosed of any psychiatric conditions. The children with and without ADHD lived in Tron District from January to December 2018 and had at least one permanent tooth. Children were excluded if they did not cooperate in dental examinations or had other medical or dental conditions, including heart disease, diabetes, anemia, cancer, Down's Syndrome, dentinogenesis imperfecta, amelogenesis imperfecta, handicapped, or under active orthodontic treatment.

Oral examination

Clinical examinations included visual and digital assessment by two calibrated dentists. Intra-examiner reliability was carried out in 10 children with 137 teeth. Kappa values of 0.93 and 0.92 for each examiner were calculated on a tooth-by-tooth basis. The inter-examiner agreement between the two examinations was 0.85 as calculated by the Kappa score. Oral examinations of all children were performed at their school or home, with mobile unit and electrical lighting, a mouth mirror, a periodontal probe developed by the

World Health Organization, and 6% erythrosine solution to detect caries, calculus, and debris.

Questionnaires

The questionnaires have been adapted from previous study on casual factors of tooth decay in Thai primary school students⁽¹⁵⁾. The adapted questions were validated by three experts of different fields, including a Uttaradit Hospital child and adolescent psychiatric doctor, a pediatric dentist, and a public health dentist. The questionnaire scored 0.94 in the Index of Item-Objective Congruence. Then, the questionnaires were used on 30 children aged 9–12 years with ADHD and on 30 age-, gender-, and family income-matched children without ADHD in Pichai District. The Cronbrach's alpha was 0.814 in the non-ADHD group and 0.816 in the ADHD group. All parents or legal guardians of the participating children completed questionnaires by a single interview. The questionnaires comprised three parts: (1) dental hygiene and dietary habits, (2) general information of parents and children, and (3) oral health behavior.

Statistical analysis

The Dependent t-test or Wilcoxon sign rank test was used to determine the significant differences between continuous variables. Categorical data were compared using the chi-square test and McNemar test. If the expected frequency was below five in one cell, Fisher's exact test was used. Statistical significance levels for all tests were set at $P < 0.05$.

RESULTS

The ADHD group consisted of 105 patients (81 male, 24 female) aged 9–12 years. The children in the ADHD group were age-, gender-, and family income-matched to 105 medically healthy children (Table 1). No significant differences in education, age, and sex of parents were found between the two groups.

Table 2 presents a summary of the data on the oral-health and dietary behavior of the study population. Significantly more children in the non-ADHD group had consumed yogurt and soy milk than those in the ADHD group. Tooth brushing was significantly more frequent in the non-ADHD group than in the ADHD group ($P < 0.05$). Compared with the ADHD group, the non-ADHD group exhibited a significantly higher frequency of tooth brushing after lunchtime and longer tooth brushing duration ($P < 0.05$). No significant differences in tooth brushing in the morning and bedtime were found between the two groups.

Table 3 shows a summary of data on the oral health of the study population. No differences in the prevalence of dental trauma were found between the ADHD and non-ADHD groups. The ADHD group exhibited a significantly higher prevalence of dental caries than

Table 1. Sociodemographic characteristics according to group

Characteristic	Non-ADHD (n = 105)	ADHD (n = 105)	Test	P
Age (years)				
9	20 (19.0)	20 (19.0)		
10	26 (24.8)	26 (24.8)		
11	18 (17.1)	18 (17.1)		
12	41 (39.0)	41 (39.0)		
Family income (per month)				
≤ 5,000 baht	17 (16.2)	17 (16.2)		
5,001 – 10,000 baht	53 (50.5)	53 (50.5)		
≥ 10,001 baht	35 (33.3)	35 (33.3)		
Sex of parents				
Male	9 (8.6)	19 (18.1)	McNemar	0.076
Female	96 (91.4)	86 (81.9)		
Education of parents				
Primary school	66 (62.9)	76 (72.4)	Chi Square	0.337
Secondary school	27 (25.7)	20 (19.0)		
Post- secondary school	12 (11.4)	9 (8.6)		
Age of parents (years)				
≤ 40	29 (27.6)	28 (26.7)	Chi Square	0.144
41 – 50	30 (28.6)	19 (18.1)		
≥ 51	46 (43.8)	58 (55.2)		

Variables are given as n (%)

Table 2. Oral-health and dietary behavior according to group

Variable	Non-ADHD (n = 105)	ADHD (n = 105)	Test	P
Consumption of candy frequency per week				
0–3 days	96 (91.4)	96 (91.4)	McNemar	1.000
4–7 days	9 (8.6)	9 (8.6)		
Consumption of yogurt milk frequency per week				
0–3 days	85 (81.0)	99 (94.3)	McNemar	0.007*
4–7 days	20 (19.0)	6 (5.7)		
Consumption of soy milk frequency per week				
0–3 days	94 (89.5)	103 (98.1)	McNemar	0.022*
4–7 days	11 (10.5)	2 (1.9)		
Tooth brushing frequency per day				
< 2 times	35 (33.3)	52 (49.5)	McNemar	0.033*
≥ 2 times	70 (66.7)	53 (50.5)		
Tooth brushing in the morning				
No	16 (15.2)	24 (22.9)	McNemar	0.256
Yes	89 (84.8)	81 (77.1)		
Tooth brushing after had lunch				
No	44 (41.9)	59 (56.2)	McNemar	0.049*
Yes	61 (58.1)	46 (43.8)		
Tooth brushing in bedtime				
No	63 (60.0)	71 (67.6)	McNemar	0.312
Yes	42 (40.0)	34 (32.4)		
Fluoride in toothpaste				
No	12 (11.4)	4 (3.8)	McNemar	0.057
Yes	93 (88.6)	101 (96.2)		
Tooth brushing time (seconds)	98.76 ± 33.93	92.52 ± 40.74	Paired t-test	< 0.001*
Tooth brushing time				
< 2 min	72 (68.6)	80 (76.2)	McNemar	0.268
≥ 2 min	33 (31.4)	25 (23.9)		

Variables are given as n (%) or mean ± SD.

Table 3. Oral health status according to group

Variable	Non-ADHD (n = 105)	ADHD (n = 105)	Test	P
Prevalence				
Trauma	2 (1.9)	2 (1.9)	Fisher's Exact	0.498
Dental caries	73 (69.5)	93 (88.6)	McNemar	0.001*
DMFT	2.25 ± 2.23	3.24 ± 2.14	Paired t-test	0.042*
OHI-S	0.87 ± 0.93	1.03 ± 1.11	Paired t-test	0.232
DI-S				
1	13 (12.4)	6 (5.7)		
2	62 (59.0)	47 (44.8)	Chi Square	0.005*
3	30 (28.6)	52 (49.5)		
CI-S				
0	103 (98.1)	84 (80.0)	McNemar	< 0.001*
1	2 (1.9)	21 (20.0)		

Variables are given as n (%) or mean ± SD.

Table 4. Adjusted odds ratio of dental caries prevalence among children with and without ADHD

Factor*	Adjusted Odds Ratio	95%CI	p-value
ADHD diagnosis (yes)	3.90	1.64–7.1	0.001*
Consumption of yogurt milk (4–7 days)	1.45	0.41–5.16	0.566
Consumption of soy milk (4–7 days)	2.05	0.33–12.50	0.438
Tooth brushing frequency (< 2 times)	1.70	0.64–4.56	0.284
Tooth brushing after lunch (No)	1.07	0.55–2.08	0.844

*reference group: children without ADHD

the non-ADHD group. The mean DMFT value in the ADHD group was 3.24 ± 2.14, whereas that in the non-ADHD group was 2.25 ± 2.23, showing a significant difference (P < 0.05). The ADHD group did not show a significantly higher mean value of the Simplified Oral Hygiene Index (OHI-S) but had significantly higher DI-S and CI-S than the non-ADHD group (P < 0.05).

Table 4 shows adjusted odds ratio of variables related to a prevalence of dental caries, such as ADHD diagnosis, toothbrushing after lunch, and fluoride toothpaste. Children with ADHD had likely 3.9 times prevalence of dental caries than those who did not have ADHD.

DISCUSSION

This study revealed that 9–12-year-old children with ADHD have a significantly higher DMFT, dental caries prevalence, and DI-S and CI-S values compared with an age-, gender-, and family income-matched non-ADHD (control) group. The higher prevalence of dental caries in the ADHD group compared with the non-ADHD group agreed with the results of a previous study. Broadbent et al. demonstrated that children with ADHD present 11.98 times higher DMFT than those without ADHD.¹⁶ Similarly, reported by Bloomqvist et al. revealed that 17 years old children with ADHD

have significantly higher dental caries prevalence and incidence compared with an age-matched control group. Only 6% of children with ADHD are caries free compared with 29% in children without ADHD.⁵ Studies on dental caries among children with and without ADHD found a predominant prevalence of dental caries in the diseased groups.^{3-5,16}

In the present study, the children in the non-ADHD group consumed higher yogurt and soy milk than those in the ADHD group but did not present higher dental caries despite the high content of sugar in yogurt and soy milk. This result may be due to the fact that the consumption of sugar significantly increases the prevalence of caries when children have poor oral hygiene.^{17,18} Previous studies have shown a higher dental caries risk in subjects who consume large amounts of foods high in sugar without brushing their teeth adequately.¹⁹ A review of articles showed that constant exposure to fluoride could compromise the risk of dental caries in children with high sugar consumption.²⁰ In consideration that the exposure of children with ADHD to fluorides from toothpaste was not as frequent as that of children without ADHD, the tooth brushing frequency report showed that the caries index among the children without ADHD was lower than among those with ADHD.

In the present study, the children with ADHD did not reveal significantly higher mean OHI-S but DI-S and CI-S values than those without ADHD. The poorer oral hygiene in the children with ADHD possibly developed because they usually brushed their teeth only once a day in the morning and spend lesser time for tooth brushing than those in the control group. Several authors agreed that infrequent or irregular tooth brushing could lead poor oral hygiene in children with ADHD. Hida et al. reported that children with ADHD demonstrate a significantly higher plaque index.¹³ Blomqvist et al. exhibited that children with ADHD have a higher percentage of gingival sites; in specific, 48% in the ADHD group brushed their teeth every evening compared with the 82% in the non-ADHD group, and 48% in the ADHD group brush their teeth every morning compared with the 75% in non-ADHD group.⁵ McGrath found that children with ADHD have a significantly higher prevalence of gingival bleeding and longer tooth brushing duration < 1 min than those without ADHD.¹⁴ Given their symptoms of impulsivity, hyperactivity, and inattention, children with ADHD may be ineffective in completing regular routine activities in daily life, such as tooth brushing, leading to improper oral hygiene practices.⁴ In addition, children with ADHD perform executive functions at an age level that is about 30% reduced.²¹

The present study found no differences in dental trauma between children with and without ADHD. Similarly, Altun et al. revealed that the prevalence of traumatic dental injury is higher in children with ADHD, but the distinction is not significant. A significant relationship has been reported between the prevalence of traumatic dental injury and the overjet of teeth in excess of 3 mm.²² Previous studies have found that children with ADHD have statistically higher histories of oral trauma prevalence.^{7,9,10,23} The cross-sectional design of this study possibly limited the enrollment of dental trauma data. This study recorded dental trauma only on visible crown defects, and no history was taken.

In conclusion, children with ADHD exhibited a higher prevalence of dental caries than children without ADHD. Therefore, children with ADHD need more advocates concerning oral hygiene and dietary habits. They should be recalled more frequent than those without ADHD for dental examinations and other procedures in caries preventions.

CONFLICT OF INTERESTS

All authors declared no conflict of interest in the study.

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