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Original research

DENTAL CARIES, GINGIVITIS, AND ORAL HEALTH PRACTICES IN 6-12-YEAR-OLD CHILDREN WITH AUTISM SPECTRUM DISORDER: PREVALENCE AND RISK FACTORS

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ABSTRACT

Background: *Autism spectrum disorder (ASD) is a neurodevelopmental condition affecting communication and behavior. The prevalence and risk factors for oral diseases in Vietnamese children with ASD remain unclear. The study aimed to assess the prevalence and risk factors associated with dental caries, gingivitis and oral care practices among 6-12-year-old children with mild-to-moderate ASD.*

Methods: *A cross-sectional study was conducted on 218 schoolchildren with ASD, diagnosed per DSM-5, in Hue, Vietnam. Oral health was evaluated using the dental caries index (DMFT), gingivitis index (GI), calculus index (CI), and plaque index (PI). A pre-designed questionnaire assessed children's oral care practices via parent/caregiver interviews. Logistic regression identified risk factors for dental caries and gingivitis.*

Results: *Caries prevalence was 80.3%, with 70.2% in permanent and 77.1% in deciduous teeth. The mean (standard deviation) dmft and DMFT were 6.1 (4.3) and 3.1 (3.2), respectively. Gingivitis was present in 79.4% of participants, with 62.9% classified as mild and 16.5% as severe.*

Children with gingivitis and poor oral care practice, including lack of flossing, absence of fluoride mouthwash at school, frequently sugary food consumption, food-grinding habit, self-brushing, had significantly higher odds of developing dental caries. Males with plaque and gingivitis, combined with poor oral care practices (not using dental floss, frequently consuming sugary foods, having a food-grinding habit, and practicing self-brushing) had significantly higher odds of developing gingivitis.

Conclusions: *The prevalence of dental caries and gingivitis was high in the study population. Risk factors included current gingivitis and inadequate oral care practices.*

Keywords: *Autism, cross-sectional study, school, oral health status, risk indicators.*

I. BACKGROUND

In recent years, there has been an observable global and Vietnamese trend of increasing prevalence of Autism Spectrum Disorder (ASD) among children [1-5]. A comprehensive analysis of global data from 1994 to 2019 reveals an approximate prevalence rate of 0.72% for ASD [3]. Additionally, a separate meta-analysis covering 2008 to 2021 reports a slightly lower prevalence of ASD at 0.6% [3]. Notably, there are regional disparities in the ASD prevalence rates, with corresponding figures in Asia, the Americas, Europe, Africa, and Australia being 0.4%, 1.0%, 0.5%, 1.0%, and 1.7%, respectively [1]. In Vietnam, a cross-sectional population-based study conducted from 2017 to 2018 in six provinces reported an ASD prevalence rate among children aged 18 - 30 months at

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0.758% [6]. The consequences of ASD result in severe psychological, social, and economic impairments. Most children with ASD encounter significant challenges in independent living, employment, and social relationships. Communication difficulties, particularly in language use during social activities, pose significant obstacles for children with ASD compared to typically developing children. Early examination, timely detection of dental issues such as cavities, gingivitis, as well as guidance on oral hygiene and early treatment of oral diseases are crucial for these children.

In the context of global research, children with ASD are at an increased risk of cavities, alterations in periodontal conditions, changes in oral microbiota, and an elevated likelihood of experiencing injuries [7]. Numerous studies indicated that children with ASD exhibit higher rates of oral health issues compared to their control counterparts [8]. The survey by Herrera-Moncada in 2019 revealed a significantly higher prevalence of cavities, tooth loss, and dental fillings (77%) in the ASD group compared to the control group (46%) [9].

In Vietnam, current studies on the cavities and gingivitis status of children with ASD remain relatively limited, with insufficient attention given to understanding factors associated with the prevalence of cavities, gingivitis, and the need for preventive measures and treatment. Therefore, we conducted this study to determine the prevalence of cavities and gingivitis among children aged 6-12 with mild-to-moderate ASD in a city in Vietnam, as well as to explore risk indicators.

II. PATIENTS AND METHODS

2.1. Study population

This cross-sectional study was conducted in Hue City among 218 children aged 6-12 years with mild-to-moderate ASD whose parents consented to their study participation. These children were integrating into normal public school classrooms. The data was collected through a school survey conducted from February 2023 to May 2023.

Ethical approval for this study was obtained from the Ethics and Research Committee of the Hue University of Medicine and Pharmacy (H2022/136). Parental consent was obtained from the parents of children who participated in the study.

2.2. Data collection

Step 1: Conduct a classification examination of children with ASD by Pediatric Neurologists. ASD children are categorized based on the criteria outlined in The Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition, Text Revision (DSM-5-TR) published by the American Psychiatric Association, and the Childhood Autism Rating Scale (CARS) [7, 10]. CARS at 30 - 37 indicate mild to moderate ASD, while scores higher than 37 are characterized as severe ASD. Only children with mild-to-moderate ASD were enrolled in this study.

Step 2: The dental examination for children was performed by 3 maxillofacial dentists with experience in the field of odonto-stomatology. The clinicians were trained in using the data collection tools and the ethical conduct of research.

The clinicians sequentially examined all teeth, from region 1 to region 4 (permanent teeth) and from region 5 to region 8 (deciduous teeth). The examination was conducted under natural light with additional illumination, following the appropriate research methods. Examination of cavities, gingivitis, dental plaque, and dental tartar was performed visually and using dental explorers based on standardized assessment criteria.

Step 3: Interview with the child and their parent/primary caregiver, conducted by a researcher and two maxillofacial dentists. ASD child interview: A familiarization session was conducted before the interview. Subsequently, the child's knowledge and practices concerning preventing cavities and gingivitis were assessed. Parent or primary caregiver interview: Gathering information about the child's health, habits, and behaviors related to oral health and seeking dental care information.

Data were collected including: (1) Characteristics of ASD children: gender, age, grade, ASD severity level, and their practice of oral care. (2) Medical history features of children: malnutrition, rickets, bleeding gums, tooth loss, or cavities. (3) Habits of children: food grinding, consumption of cold water, and self-tooth brushing. (4) Oral care behaviors for children. (6) Cavities status: overall prevalence, permanent cavities rate, deciduous cavities rate, the Decayed, Missing, and Filled Teeth (DMFT) index

in the permanent and deciduous teeth. (7) Prevalence of gingivitis, dental plaque, and dental tartar. (7) Oral hygiene habits by extracting information from parents or primary caregivers. (8) Behaviors related to oral care practices

2.3. Data analysis

After data collection, the gathered information was synthesized, cleaned, and entered into SPSS 20.0 software. Frequencies and percentages were used for categorical variables, and mean value with standard deviation (SD) was used for quantitative variables. Multivariate logistic regression analysis explored factors associated with cavities and gingivitis. The dependent variables in the multivariate logistic regression model were cavities and gingivitis. The independent variables included factors related to cavities and gingivitis, such as characteristics of ASD children, and practices of oral hygiene of the children, their behaviors and habits. To select independent variables for the multivariate regression model, we conducted statistical analysis following this sequence: factors in the univariate analysis with a significance level of $p \leq 0.05$ were chosen to be included in the multivariate regression model.

III. RESULTS

Table 1 presents the characteristics of children with ASD. The ratio of males to females among children with ASD was approximately 3:1. The age group with the highest proportion was 9 years old, constituting 28.9%, while the lowest proportion was observed in the 12-year-old group, accounting for 6.0%. Children in grade 1 had the lowest proportion (8.3%). A significant percentage of ASD children exhibited poor oral care practices, accounting for 71.6% and 69.7%, respectively. The overall prevalence of dental caries in this study was 80.3%, with 70.2% being permanent dentition and 77.1% being deciduous dentition. The prevalence of gingivitis was 79.4%, including 62.9% with mild gingivitis and 16.5% with severe gingivitis.

The DMFT index for deciduous teeth was 6.1, and the DMFT index for permanent teeth was 3.1. The average values for tooth loss and fillings were low (0.1 and 0.3 for permanent teeth; 0.9 and 0.7 for deciduous teeth) (Table 2).

Table 1: Characteristics of ASD children

Characteristics		**Quantity (n)**	**Percentage (%)**
Gender	Male	167	76.6
	Female	51	23.4
Age	6	16	7.3
	7	31	14.2
	8	46	21.1
	9	63	28.9
	10	29	13.3
	11	20	9.2
	12	13	6.0
Caries	Overall	175	80.3
	Permanent teeth	153	70.2
	Deciduous teeth	168	77.1
Gingivitis	Overall	173	79.4
	Mild gingivitis	137	62.9
	Severe gingivitis.	36	16.5
Total		218	100.0

Table 2: The Decayed, Missing, and Filled Teeth (DMFT) index in the permanent and deciduous teeth

DMFT	Deciduous teeth				Permanent teeth			
	Decayed Teeth	Missing Teeth	Filled Teeth	DMFT index	Decayed Teeth	Missing Teeth	Filled Teeth	DMFT index
the number of teeth in the study sample (N=218)	982	154	211	1347	592	19	66	677
the number of teeth in the population (1)	4.5±3.3	0.7±1.1	0.9±1.3	6.1±4.3	2.7±2.8	0.1±0.4	0.3±0.6	3.1±3.2

Using dental floss, receiving fluoride mouthwash at school from teachers, frequently consuming sugary foods, habits of food grinding, children's tooth brushing techniques, and gingivitis were related to the cavities rate in children with ASD (Table 3). Gender, using dental floss, frequently consuming sugary foods, habits of food grinding, children's tooth brushing techniques, and dental plaque were associated with the gingivitis rate in ASD children (Table 4).

Table 3: Multivariate logistic regression analysis of factors associated with dental caries (n=218)

Factors		OR	CI 95%	p
Using dental floss	No	1		
	Yes	31.53	3.53 - 281.45	0.002
Receiving fluoride mouthwash at school from teachers	Yes	1		
	No	7.34	1.65 - 32.71	0.009
Frequently consuming sugary foods	Infrequent	1		
	Regular	7.18	1.38 - 37.29	0.019
Habits of food grinding	No	1		
	Yes	11.35	1.60 - 80.45	0.015
Children's tooth brushing techniques	Supervised with assistance	1		
	Self-brushing	11.52	2.22 - 59.71	0.004
Gingivitis	No	1		
	Yes	7.62	1.37 - 42.40	0.002

Table 4: Multivariate logistic regression analysis of factors associated with gingivitis

Factors		OR	CI 95%	p
Gender	Female	1		
	Male	6.28	1.70 - 23.17	0.006
Using dental floss	No	1		
	Yes	11.38	2.24 - 57.83	0.003

Factors		OR	CI 95%	p
Frequently consuming sugary foods	Infrequent	1		
	Regular	3.54	1.13 - 11.11	0.031
Habits of food grinding	No	1		
	Yes	6.22	1.46 - 26.49	0.013
Children's tooth brushing techniques	Supervised with assistance	1		
	Self-brushing	8.01	2.17 - 29.58	0.002
Dental plaque	No	1		
	Yes	3.90	1.14 - 13.30	0.030

IV. DISCUSSION

4.1. Prevalence of dental cavities

According to the World Health Organization (WHO) classification of the severity of cavities, a prevalence rate of over 80% is considered high, between 50% and 80% is moderate, and below 50% is low. Our study results indicated an overall cavities prevalence rate of 80.3% in ASD children, with 70.2% being permanent cavities and 77.1% deciduous cavities. Therefore, the cavities rate in ASD children in our study is high. Silva et al. conducted a systematic review and meta-analysis in 2017 on the oral health status of children with ASD and identified 928 relevant articles, with seven included in the review. All studies revealed a general cavities prevalence rate of 60.6% (95% CI: 44.0 - 75.1) [11]. In 2019, Herrera-Moncada et al. studied 61 ASD children aged 6 to 16 and found that 77% of these children had cavities, tooth loss, or fillings (77%) [9].

The research results showed that the DMFT index for deciduous teeth was 6.1, and the DMFT index for permanent teeth was 3.1. The mean values for tooth loss and fillings were low (0.1 and 0.3 for permanent teeth; 0.9 and 0.7 for deciduous teeth). Although the DMFT index for deciduous teeth and the DMFT index for permanent teeth are high, the low mean for teeth fillings indicates a significant need for cavity treatment in ASD children. This low filling status may be explained by parents' lack of concern for their children's teeth, assuming that deciduous teeth are not important and permanent teeth are still erupting, posing a lower risk of cavities. It is crucial to explain and provide more information to parents and schoolteachers about the current status of cavities and the potential risks and complications if timely treatment and prevention are not undertaken.

The prevalence of dental cavities in our study was higher than in some studies with the same subjects. In 2017, Kalyoncu et al. reported the mean DMFT index for permanent teeth and the mean DMFT index for deciduous teeth for ASD children as 2 ± 2.26 and 1.65 ± 2.52, respectively [12]. In 2018, Onol et al. assessed oral health status and influencing factors in ASD children, noting that the mean DMFT index for permanent teeth for ASD children was 3.59 ± 3.60, while the mean DMFT index for deciduous teeth was 4.58 ± 4.22 [13]. In 2022, Piraneh et al. studied the cavities and oral health status of ASD children aged 7 - 15 in Tehran, Iran, revealing mean DMFT for permanent teeth in ASD children aged 7 - 11 as 1.96 ± 1.72 and in children aged 12 - 15 as 2.79 ± 2.85 [14].

4.2. The current status of gingivitis

The results showed that the prevalence of gingivitis was 79.4%, with 62.9% categorized as mild and 16.5% as severe. Worldwide studies indicated a higher prevalence of gingivitis in ASD children compared to their non - ASD counterparts. In 2020, Ferrazzano et al., in a comprehensive review of 46 selected articles on ASD and oral health, found that ASD children were at a higher risk of cavities, altered periodontal conditions, changes in oral microbiota, and an increased risk of trauma [7]. In 2021, Thomas et al. conducted a

meta-analysis on the risk of oral health issues in ASD children. They suggested, from their synthesis of eight eligible studies conducted in Asia (n = 7) and South America (n = 1), that ASD children had a higher prevalence of oral health issues compared to non-ASD children [8].

Therefore, current caries and gingivitis status among ASD children in some primary schools in Hue City exhibit the following characteristics: a high prevalence of deciduous cavities, posing a potential oral-related risk in the community, which may have adverse consequences on permanent teeth later. The prevalence of permanent cavities in ASD children was higher than in other studies. The rate of gingivitis was also high. The oral issues related to cavities were prominent, indicating a low oral hygiene status in school-age children. This emphasizes the urgent need for oral health care, including guidance on oral hygiene practices and addressing high cavity rates in ASD children in primary schools.

4.3. Risk indicators for dental cavities and gingivitis

Through our analysis of oral health issues in ASD children, we observed a remarkably high prevalence of cavities and gingivitis. Therefore, it is imperative to implement health education aimed at modifying oral care behaviors among pupils in schools catering to ASD children. Most of the children in this study exhibited mild to moderate levels of ASD. Thus, we recommend an educational approach that involves the child's efforts combined with support from the schoolteachers and parents/ primary caregivers. The focus should extend to their families, with parents or primary caregivers as subjects for intervention to change detrimental habits and promote positive oral health practices in pupils. For instance, it is essential to alter the child's behaviors by reducing the consumption of sugary foods, shifting towards limited sugar intake, and reinforcing positive habits such as brushing teeth after meals and before bedtime. Additionally, using fluoride toothpaste for cavity prevention, limiting sugary and sweetened foods, reducing snack consumption, and encouraging the consumption of fresh fruits and vegetables for oral cleanliness is crucial. Establishing good oral care habits in children should commence from the eruption of their first tooth. However, the understanding and awareness of each family vary; hence, their consciousness about oral health practices also differs. Regular parental attention and reminders to their children can significantly change detrimental habits and foster positive verbal health behaviors from an early age.

4.4. Limitation

To the best of our knowledge, this is the first study that provides basic information about dental caries and gingivitis of ASD children in primary schools. However, our study still has some limitations. Cross-sectional studies were limited to generating conjectures; they could not clarify the cause-and-effect link between risk variables and oral health. Consequently, the found correlations cannot be regarded as causative; more evidence must be obtained through longitudinal research. The small sample size was another limitation of the study. Therefore, a multicenter study with a large sample size should be conducted to confirm the current findings.

V. CONCLUSION

The prevalence of dental caries and gingivitis was high among children with ASD. The risk factors included gingivitis and poor oral care practices. Because of the neurological deficiency and the difficulties of ASD children in administering dental treatment, it is advised that preventive dental care needs to be provided to these children and their parents.

Competing interests

The authors declare that they have no competing interests.

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