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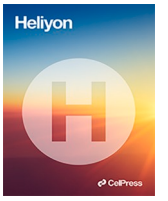

Research article

Oral health status and dental treatment needs in children with autism spectrum disorder

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ABSTRACT

Objective: To evaluate oral health care practices, health status, and dental treatment needs in children with Autism Spectrum Disorder (ASD).
Methods: This cross-sectional study included 96 children diagnosed with ASD per the DSM-V criteria and 96 typically developing healthy children. The WHO form assessed oral health status and dental treatment needs.
Results: Over 50 % of ASD children had mild/moderate autism, 35.4 % had severe autism, and 13.5 % had autistic traits. ASD children experienced more toothbrushing difficulties compared to non-ASD children. Based on Nyvad's criteria and decayed/filled teeth (dft) index, non-ASD children had higher caries prevalence than ASD children, indicating less need for restorative treatments in the ASD group. However, ASD children had poorer plaque scores than non-ASD children. A significantly higher percentage of ASD children exhibited harmful oral behaviors, including mouth breathing, lip biting, bruxism, nail biting, object biting, and self-injury ($p < 0.001$). ASD children also showed increased traumatic dental injuries compared to non-ASD children.
Conclusion: Compared to non-ASD peers, children with ASD have lower dental caries prevalence and less need for restorations, yet poorer plaque control. They also demonstrate more frequent oral self-injuries. ASD status appears related to toothbrushing difficulties. These findings highlight the need for tailored oral health interventions for children with ASD.

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1. Introduction

Children with Autism Spectrum Disorder (ASD) frequently face difficulties in maintaining dental health due to problematic eating patterns, self-harming oral behaviors, and barriers to accessing dental care [1]. Understanding the dental needs and oral health status of those with ASD is vital, as they appear prone to oral health problems [2–5]. Recent systematic reviews have provided nuanced insights into the oral health status of children with ASD. While some studies have reported higher rates of dental caries in ASD children, a comprehensive meta-analysis by Lam et al. [1] found no significant differences in caries prevalence between ASD and neurotypical children. However, children with ASD often exhibit poorer oral hygiene, higher rates of periodontal disease, and more frequent oral trauma, underscoring the complex oral health challenges faced by this population [1,6–8].

Sensory sensitivity in ASD may hinder oral hygiene and care, further impacting dental health [9,10]. Bridging occupational therapy and dentistry has been emphasized as key to addressing oral health disparities affecting children with special needs, including ASD [5]. Concerns exist regarding managing ASD children in dental offices, highlighting the need for tailored behavioral approaches to ensure quality care [11]. Addressing the unique dental needs of children with special needs like ASD is critical, as dental caries remain a prevalent unmet healthcare requirement [12,13]. Inadequacies in procedural dental care for children with special needs signal a need for tailored interventions [13,14].

In light of the complex oral health challenges faced by children with ASD, there is a critical need for comprehensive research that addresses multiple aspects of their oral health status and specific dental treatment needs [15]. Therefore, this study's primary objective was to comprehensively evaluate oral health status, oral care practices, and dental treatment needs in children with autism spectrum disorder, comparing these findings with those of typically developing children. By doing so, we aim to provide a more nuanced understanding of the unique oral health profile of children with ASD, which can inform the development of targeted, multidisciplinary approaches to oral health care for this population.

2. Materials and methods

This cross-sectional analytical study was conducted from August 2022 to June 2023 at Pratheeksha Child Development Center and the Departments of Pediatric and Preventive Dentistry at Pushpagiri Institute of Medical Sciences and Pushpagiri College of Dental Sciences. Approval was obtained from the Institutional Ethics Committee (Ref No: IRB/03/08/2022). The study included 192 children. The study group comprised 96 children diagnosed with ASD per the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-V), who were undergoing therapy with a neurodevelopmental pediatrician. The control group included 96 typically developing healthy children matched for age. These children were recruited from the general pediatric clinics of Pushpagiri Institute of Medical Sciences, ensuring they had no diagnosed developmental disorders or chronic health conditions that might affect oral health. The sample size was calculated based on a previous study's caries prevalence in autistic children [13], with an expected proportion of 0.5, 10 % precision, and 95 % confidence interval [16].

Sample size calculation equation:

$$n = \frac{z^2_{1-a/2} P(1-p)}{d^2}$$

where, P = Expected proportion; D = Absolute precision; $1 - a/2$ = Desired confidence level

Children with ASD comorbidities such as attention-deficit/hyperactivity disorder (ADHD), intellectual disability, or severe anxiety disorders were excluded to focus on the specific oral health challenges associated with ASD. Controls were excluded if they had any medical conditions that could impact oral health or dental treatment. Informed consent was obtained before interviews and oral examinations. The examiner was calibrated with a kappa of 0.82 for intra-examiner reliability. Data collected included demographics, Childhood Autism Rating Scale, Second Edition (CARS-2) scores of ASD children, toothbrushing habits, dietary preferences, abnormal oral habits, and self-injurious behaviors.

Oral examinations were conducted using an approach tailored to each child's needs and comfort level. For children with ASD, examinations took place either in an adjustable dental chair or using a knee-to-knee position, depending on the child's age and cooperativity. Non-ASD children were examined in a standard dental chair. Basic behavior guidance techniques, including tell-show-do, were employed throughout the examinations, and behavioral responses were assessed using the Frankl Scale [17]. The examination used standard dental tools, including a mouth mirror, explorer, periodontal probe, and flashlight. A comprehensive assessment was performed, recording multiple aspects of oral health: the Gingival Index [18] and Plaque Index [19] were used to evaluate oral hygiene and gingival health; caries experience and activity were assessed using the decayed, missing, and filled teeth (dmft/DMFT) indices as per WHO criteria [20] and Nyvad's criteria [21] for active and inactive lesions; occlusal traits including overjet, overbite, and primary molar relationships were noted; the presence of oral habits such as digit sucking, mouth breathing, lip biting, bruxism, nail biting, object biting, and self-injury was recorded; and dental trauma was evaluated using Anderson's criteria [22].

Statistical analysis was conducted using IBM SPSS Statistics for Windows (Version 24.0 IBM Corp.). The significance level was set at $p < 0.05$. Descriptive statistics summarized the quantitative and qualitative study variables, including frequencies, percentages, means, and standard deviations. Chi-square tests compared categorical oral health, dental trauma, oral habit, and behavioral assessment variables between ASD and non-ASD groups.

3. Results

In the study population of children with Autism Spectrum Disorder (ASD), 51 % were diagnosed with mild-to-moderate autism, 35.4 % with severe autism, and 13.5 % exhibited minimal-to-no symptoms of ASD according to the CARS-2. All participants were between 3 and 5 years old. The demographic details are outlined in Table 1.

Behavioral patterns of ASD children, as compared to their non-ASD counterparts, revealed a higher prevalence of adverse behaviors. Regarding dental hygiene, ASD children faced significantly more challenges during tooth brushing. Periodontal health was assessed using the Gingival and Plaque indices (Figs. 1 and 2). ASD children exhibited a higher incidence of moderate to severe gingival inflammation and poorer plaque control compared to non-ASD children.

Caries prevalence, evaluated using the dft and Nyvad criteria, showed interesting contrasts (Table 2). The mean dft score was lower in ASD children, indicating less decay and missing teeth, a finding statistically significant per the Mann-Whitney *U* test. However, using Nyvad's criteria, the prevalence of caries was higher in both groups than indicated by dft scores, with non-ASD children showing a higher prevalence of caries.

Further analysis correlated the caries experience in ASD children with their tooth brushing habits (Table 3). Children who struggled with tooth brushing had more active caries lesions. The study revealed differences in the types of caries management needed between ASD and non-ASD children. For carious lesions manageable by Minimally Invasive Caries Control Methods, 58.3 % of children in the ASD group presented such lesions, compared to 52.1 % in the non-ASD group. Conversely, when examining carious lesions requiring definitive restorative care, we found a lower prevalence in the ASD group. Only 38.5 % of children with ASD needed definitive restorative care, compared to 54.2 % in the non-ASD group.

Finally, the study assessed occlusal characteristics, oral habits, and traumatic dental injuries (Table 4). While overjet and overbite relationships did not differ significantly between the groups, ASD children had a higher prevalence of distal step primary molar relationship and detrimental oral habits such as mouth breathing, lip biting, bruxism, nail biting, object biting, and self-injurious behaviors. Additionally, traumatic dental injuries were more frequent in autistic children than in non-autistic children, but this difference was not statistically significant.

4. Discussion

In our study, a significantly greater number of autistic children were male than female, aligning with known higher diagnosis rates of autism spectrum disorder (ASD) among males globally based on WHO reports [23–25]. This presents opportunities for future investigation - are diagnostic criteria inherently biased, or do legitimate biological differences manifest as higher ASD prevalence in males? Unquestionably, oral sensitivities and anxieties in those with ASD pose barriers concerning proper daily oral hygiene and even receiving dental treatment [16,26]. Tailored behavioral approaches are likely needed alongside technical advances to provide dental

Table 1
Demographic characteristics of the study groups.

Characteristic	Category	ASD N (%)	NON-ASD N (%)	Statistical Significance
Gender				
	Male	68 (58.6)	48 (41.6)	P Value: <0.05*
	Female	28 (36.8)	48 (63.2)	OR: 2.43 (1.3–4.4)
Autism Rating Scale				
	Autistic traits	28 (36.8)	–	–
	Mild-Moderate autism	13 (13.5)	–	–
	Severe autism	49 (51.0)	–	–
Behavior rating				
	Definitely Negative	63 (65.6)	7 (7.3)	P Value: <0.001*
	Negative	28 (29.2)	20 (20.8)	
	Positive	5 (5.2)	33 (34.4)	
	Definitely positive	0 (0.0)	36 (37.5)	
Struggle while tooth brushing				
	Yes	58 (60.4)	20 (20.8)	$\chi2 = 31.179$
	No	38 (39.5)	76 (79.2)	P < 0.001**
Food preference				
	Preference present (Sweet)	71 (74.0)	57 (59.4)	$\chi2 = 4.594$
	Preference to salty, and spicy/No particular preferences	25 (26.0)	39 (40.6)	P = 0.032*
Preference for sweets snacks				
	Yes	69 (71.8)	54 (56.3)	$\chi2 = 5.090$
	No	27 (28.1)	42 (43.8)	P = 0.024*

ASD = Autism Spectrum Disorder, OR= Odds Ratio.
*Significant at $p < 0.05$.
**Significant at $p < 0.001$.

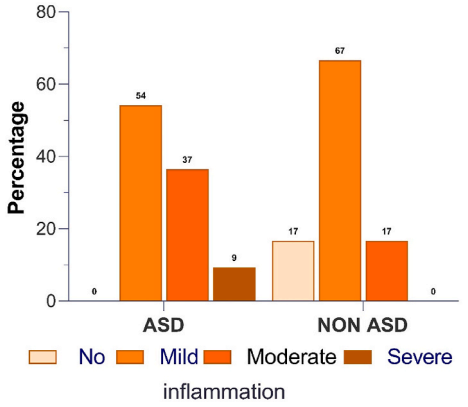

Fig. 1. Gingival index scores comparison between ASD and non-ASD groups.

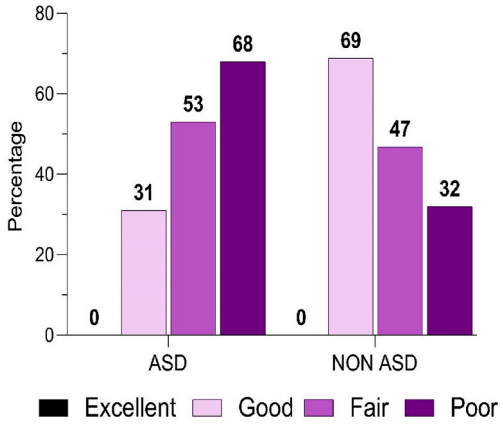

Fig. 2. Plaque index scores comparison between ASD and non-ASD groups.

Table 2
Caries status of the study groups.

A. Mean dft scores				
Group	Mean dft (SD)	Mean difference (SE)	95 % CI of the mean difference	P-value
ASD	2.29 (3.25)	1.67 (0.58)	0.52–2.8	<0.001**
Non-ASD	3.96 (4.65)			
B. Dental caries experience (dft)				
Group	**Caries Free N N N (%)**	**Caries Present N (%)**	**P value**	**OR (95 % CI)**
ASD	48 (50.0)	48 (50.0)	<0.001*	2.00 (1.12–3.58)
Non-ASD	32 (33.3)	64 (66.7)		
C. Dental caries experience (Nyvad's criteria)				
Group	**Caries Free N (%)**	**Caries Present N (%)**	**P value**	**OR (95 % CI)**
ASD	36 (37.5)	60 (62.5)	<0.05*	2.02 (1.07–3.79)
Non-ASD	22 (22.9)	74 (77.1)		

**Mann Whitney *U* Test; *Chi-square test.

care access for this group. Our observations confirm previous findings of poorer plaque control and gingival inflammation in ASD groups compared to non-ASD children [27]. Difficulty complying with toothbrushing instructions is likely a significant factor. Standardizing oral hygiene education for special needs populations could help by using consistent visual aids and reward systems. Caretakers also require more guidance on brushing techniques and establishing positive habits [28].

Interestingly, those with ASD exhibited lower caries rates than the control group, detected using both the WHO's dft criteria and more sensitive Nyvad criteria [29,30]. This finding aligns with recent systematic reviews by Lam et al. [1] and Corridore et al. [6], which found no significant differences or slightly lower caries prevalence in ASD children. Possible reasons include closer diet and

Table 3
Caries experience by tooth brushing and dietary habits in ASD children.

Categories	Subcategories	Nyvad's Scoring		Test statistic & P value
		Active caries n (%) (Score 1)	No caries/Only inactive caries n (%) (Score 0)	
Struggle while tooth brushing				
	Yes	40 (69.0)	18 (31.0)	$\chi2 = 4.478$
	No	18 (47.4)	20 (52.6)	P = 0.034*
Food preference				
	Salty/Spicy	5 (41.7)	7 (58.3)	$\chi2 = 6.269$
	Sweet	33 (55.9)	26 (44.1)	P = 0.044*
	No preference	20 (80.0)	5 (20.0)	
Preference of sweets snacks				
	Yes	46 (66.7)	23 (33.3)	$\chi2 = 4.007$
	No	12 (44.4)	15 (55.6)	P = 0.045*

*Significant.

Table 4
Occlusal characteristics, oral habits, and traumatic dental injuries in children with and without ASD.

Variable	Category	ASD N (%)	Non-ASD N (%)	P value	OR (95 % CI)
Overjet					
	Normal	72 (51.4)	68 (48.6)	0.807	–
	Increased	19 (44.2)	24 (55.8)		
	Decreased	5 (55.6)	4 (44.4)		
Overbite					
	Normal/Deep	84 (48.8)	88 (51.2)	0.345	–
	Open bite	12 (60.0)	8 (40.0)		
Primary molar relationship					
	Flush terminal	28 (37.3)	47 (62.7)	0.001	–
	Mesial step	26 (45.6)	31 (54.4)		
	Distal step	42 (70.0)	18 (30.0)		
Presence of oral habits					
	Digit sucking	9 (9.4)	3 (3.1)	0.074	–
	Mouth breathing	28 (29.2)	6 (6.3)	<0.001	6.17 (2.42–15.75)
	Lip biting	15 (15.6)	1 (1.0)	<0.001	17.59 (2.27–136.08)
	Bruxism	40 (41.7)	8 (8.3)	<0.001	7.87 (3.42–17.86)
	Nail biting	27 (28.1)	3 (3.1)	<0.001	12.13 (3.54–41.61)
	Object biting	20 (20.8)	0 (0.0)	<0.001	2.26 (1.91–2.67)
	-Injury	17 (17.7)	0 (0.0)	<0.001	2.21 (1.88–2.60)
Traumatic dental injuries					
	No	67 (69.8)	77 (80.2)	0.096	–
	Yes	29 (30.2)	19 (19.8)		

*Significant at $p < 0.05$.

hygiene monitoring by caretakers and routine preferences in ASD children. However, the control group here may exhibit selection bias if drawn from pediatric dental clinic visitors actively seeking care. Future matched cohort studies evaluating households under similar socioeconomic conditions could help delineate if legitimate differences exist in cavity rates between ASD and non-ASD children. An interesting finding was increased lesions suitable for minimally invasive caries control methods (silver diamine fluoride, fluoride varnish, atraumatic restorative measures) in the ASD group [31,32]. After consent, we administered such treatment on-site through a knee-to-knee approach tailored to each child's comfort. Minimally invasive methods cause less anxiety and require shorter cooperation time, which is ideal for patients requiring behavioral accommodation [33].

Beyond disease susceptibility, pernicious oral habits can greatly impact the quality of life if left unaddressed. Our findings align with previous observations of higher rates of bruxism, mouth breathing, and other habitual behaviors among autistic patients [34]. Physiological explanations like gastrointestinal issues or repetitive stereotypies associated with autism may contribute to these observations. However, psychosocial factors like dental care access barriers and communication challenges likely enable the progression of existing perioral habits. Similarly, higher occurrence of self-injury and related dental trauma cannot be fully divorced from broader social opportunity gaps [35,36]. Moving forward, a public health agenda prioritizing developmental disability awareness alongside bolstered funding for robust support systems and research on autism spectrum disorder itself will be key to illuminating and properly addressing both physiological and external drivers of poorer oral health among this population.

Concerning limitations, our small sample may have reduced generalizability and introduced selection bias by using a convenience sample. Additionally, we lacked socioeconomic status data between groups that could influence homecare behaviors and disease rates. Prospective cohort studies tracking oral health from early childhood through adolescence in matched ASD and non-ASD groups could

provide richer longitudinal comparisons while assessing the effects of shifting cultural norms regarding both developmental disability awareness and oral healthcare over generations.

5. Conclusion

Our findings reveal a complex interplay of both risks and resilience within the oral health of children across the autism spectrum. This cohort demonstrated lower rates of dental caries than neurotypical peers, even when employing more sensitive diagnostic criteria to detect early non-cavitated lesions. However, significantly higher plaque accumulation among the ASD group highlights deficiencies in consistency in carrying out effective daily brushing, likely stemming from sensory and communication barriers. Predilection towards detrimental oral activities like bruxism and self-injury cannot be ignored in the context of lifelong health for those with developmental disabilities. Any bio-behavioral risks intertwine with psychosocial vulnerabilities conferred by societal inequities in awareness, accommodations, and inclusive health policy. In summary, autistic children have thus far demonstrated less cavitated decay, possibly reflecting caregiver mitigation efforts and patient-specific factors requiring further clarification. Unacceptable barriers regarding adequate daily hygiene and access to compassionate treatment plans for this population's specialty needs remain. Progress begins with the dignity-centered choice to value alleviating suffering and inequality among society's most vulnerable. Policy supporting specialized dentistry and equipment subsidies can provide infrastructure enabling sustainable change. Our challenges demand persistence, while our children deserve nothing less than integrated care systems tailored to their unique needs.

Ethical approval

This study was approved by the Ethics Committee of Pushpagiri Institute of Medical Sciences and Pushpagiri College of Dental Sciences (Ref No: IRB/03/08/2022).

Data availability statement

Data will be made available on request.

CRediT authorship contribution statement

Sherin Sara George: Writing – original draft, Investigation, Funding acquisition, Conceptualization. **Manju George Elenjickal:** Writing – review & editing, Supervision, Software, Methodology, Investigation. **Sachin Naik:** Writing – original draft, Validation, Methodology, Formal analysis, Conceptualization. **Nebu George Thomas:** Writing – original draft, Validation, Investigation, Data curation. **Sajith Vellappally:** Writing – original draft, Supervision, Methodology, Funding acquisition. **Nibu Varghese:** Visualization, Resources, Investigation, Conceptualization. **Aby Mathew:** Writing – original draft, Supervision, Project administration, Methodology. **Vivek Narayan:** Writing – review & editing, Resources, Project administration, Formal analysis. **Rinsy P. Varughese:** Writing – review & editing, Investigation, Data curation. **Sukumaran Anil:** Writing – original draft, Methodology, Investigation, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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