

Dental Health Concerns in Patients with Autism Spectrum Disorder (ASD): A Review

Otizm Spektrum Bozukluğu (OSB) Hastalarında Diş Sağlığı Endişeleri: Bir İnceleme

¹Amina SULTAN, ²Deepali GARG, ¹Akanksha JUNEJA

¹Pediatric & Preventive Dentistry, Faculty of Dentistry, Jamia Millia Islamia, New Delhi 110025, India

²Faculty of Dentistry, Jamia Millia Islamia, New Delhi 110025, India

Amina Sultan: <https://orcid.org/0000-0001-5245-4416>

Deepali Garg: <https://orcid.org/0000-0001-2728-3296>

Akanksha Juneja: <https://orcid.org/0000-0003-4127-1133>

Abstract

Autism Spectrum Disorder (ASD) is a neurodevelopmental condition characterized by impairments in communication, social interaction, and behavior. Sensory sensitivities, dietary habits, medication use, and difficulties with self-care increase the risk of oral health problems and limit access to dental services. This narrative and descriptive review, using a scoping methodology, evaluated oral health conditions among individuals with ASD and identified barriers to dental care. Studies reported poorer oral hygiene, increased dental caries, gingival and periodontal diseases, malocclusion, bruxism, and dental trauma among individuals with ASD. Contributing factors included cariogenic food preferences, impaired motor skills, behavioral challenges, sensory hypersensitivity, self-injurious behaviors, and medication-related oral effects. Major barriers included dental anxiety, inadequate professional training, limited specialized services, financial constraints, long waiting times, and caregiver stress. Improved caregiver education, professional training, behavioral strategies, and inclusive dental environments are essential to enhance oral health outcomes in this population.

Keywords: Autism spectrum disorder, barriers to oral health care, dental caries, dental trauma, oral health

Öz

Otizm Spektrum Bozukluğu (OSB), iletişim, sosyal etkileşim ve davranış bozukluklarıyla karakterize edilen nörogelişimsel bir durumdur. Duyusal hassasiyetler, beslenme alışkanlıkları, ilaç kullanımı ve kendine bakım zorlukları, ağız sağlığı sorunları riskini artırır ve diş hizmetlerine erişimi sınırlar. Bu anlatı ve betimleyici inceleme, kapsam yöntemi kullanılarak OSB'li bireylerin ağız sağlığı durumlarını değerlendirmiş ve diş bakımındaki engelleri belirlemiştir. Çalışmalarda, OSB'li bireylerde daha kötü ağız hijyeni, artan diş çürüğü, diş eti ve periodontal hastalıklar, maloklüzyon, brüksizm ve diş travması bildirilmiştir. Katkıda bulunan faktörler arasında kariojenik yiyecek tercihleri, motor becerilerde bozulma, davranışsal zorluklar, duyuşal aşırı hassasiyet, kendine zarar veren davranışlar ve ilaçların ağız üzerindeki etkileri yer almaktadır. Başlıca engeller arasında diş kaygısı, yetersiz mesleki eğitim, sınırlı uzman hizmetleri, finansal kısıtlamalar, uzun bekleme süreleri ve bakıcı stresi yer alıyordu. Geliştirilmiş bakım veren eğitimi, mesleki eğitim, davranışsal stratejiler ve kapsayıcı diş ortamları, bu popülasyonda ağız sağlığı sonuçlarını artırmak için gereklidir.

Anahtar Kelimeler: Otizm spektrum bozukluğu, ağız sağlığı hizmetlerindeki engeller, diş çürüğü, diş travması, ağız sağlığı

Corresponding Author / Sorumlu Yazar:

Akanksha Juneja
Dept of Pediatric & Preventive Dentistry, Faculty of Dentistry, JMI,
New Delhi 110025, India
E-mail: ajuneja@jmi.ac.in

Article Info / Yayın Bilgisi:

Received / Gönderi Tarihi: 10/07/2026
Accepted / Kabul Tarihi: 09/08/2026
Published / Online Yayın Tarihi: 15/09/2026

Cited / Atıf: Amina Sultan, et al. Dental Health Concerns in Patients with Autism Spectrum Disorder (ASD): A Review. Online Türk Sağlık Bilimleri Dergisi 2026;11(3):347-356. doi: 10.26453/otjhs.1990323



This work is licensed under a [Creative Commons Attribution-Non-Commercial 4.0 International License](https://creativecommons.org/licenses/by-nc/4.0/).

INTRODUCTION

Autism spectrum disorder (ASD) is a neurodevelopmental condition that usually becomes apparent before three years of age and is marked by persistent difficulties in communication, social interaction, and behaviour, all of which are critical to a child's overall development and clinical management.¹ ASD encompasses a broad range of manifestations, including impairments in both verbal and nonverbal communication, restricted patterns of interest, and repetitive or stereotyped behaviors. Children diagnosed with the condition may also experience heightened sensitivity to sensory input, particularly sounds, and often engage in repetitive motor activities such as rocking, hand clapping, or other self-stimulatory actions. In addition, they may exhibit unusual responses to their environment, a strong attachment to specific objects, resistance to changes in routine, and, in some cases, behaviors that are aggressive or self-injurious.²

Epidemiological data on ASD prevalence are inconsistent across regions, with variations in reported figures worldwide. Reliable estimates are particularly limited in low-income settings, generally due to inadequate diagnostic infrastructure and standardized screening methods. Based on the scientific literature, the global prevalence of ASD is approximately 0.77%, and according to reports of the World Health Organization (WHO), roughly 1 in 100 children (about 1%) worldwide has ASD. According to the Centers for Disease Control and Prevention (CDC), 17% of children (or around one in every six) have a developmental disability.³ According to reports from 2020, the highest prevalence was observed in regions such as Hong Kong, South Korea, the United States, Japan, and Ireland, with figures reaching up to 372 per 10,000 children in Hong Kong.³⁻⁶ The population of varied racial, ethnic, and socioeconomic groups has reported the occurrence of ASD; however, Caucasian children are more frequently affected with ASD compared to black or Hispanic children.⁷ Male population is more frequently affected, while a recently published study reported that the male-to-female ratio is closer to 3:1 precisely, than the previously stated 4:1, suggesting that female autism is being misdiagnosed, diagnosed later, or unnoticed.^{8,9}

ASD is broadly classified as syndromic or non-syndromic. The origins of both types are multifactorial, with both hereditary and environmental influences contributing to their development. Syndromic forms are frequently linked with identifiable chromosomal anomalies or single-gene defects, such as Rett syndrome, fragile X syndrome, and MECP2 duplication syndrome.¹⁰ In contrast, the underlying causes of non-syndromic ASD remain less clearly defined because of significant genetic diversity and a combination of de novo mutations together with prenatal and postnatal environmental exposures.¹¹ Several non-genetic risk factors for ASD were identified. These included advanced parental age, maternal health and nutrition, pregnancy-related infections, stress, and exposure to toxins, drugs, or heavy metals. Increased paternal age was associated with a higher incidence of de novo genetic mutations, although some studies have challenged this finding.^{12,13} Maternal nutritional status is also a critical factor, as both deficiencies and excesses of micronutrients such as folic acid, zinc, iron, vitamin D, and omega-3 fatty acids negatively impact brain development. For instance, folate deficiency during pregnancy is associated with elevated ASD risk.¹⁴ Some infections during pregnancy, including congenital rubella, have been long studied in relation to ASD.¹⁵ Similarly, use of certain medications during pregnancy, particularly antiepileptic and antidepressant drugs, is also linked to increased risk. Valproate exposure is consistently implicated in neurodevelopmental alterations, while antidepressant use, especially selective serotonin reuptake inhibitors (SSRIs), has reported mixed evidence.¹⁶ Environmental exposures were also connected to co-occurring conditions in ASD, such as gastrointestinal problems, epilepsy, and obesity.¹⁴ Findings have also suggested that disruptions in oral and gut microbial communities influenced ASD through effects on the gut–brain axis and blood–brain barrier (BBB). Dysbiosis and intestinal inflammation altered gut–brain signalling, while compromised BBB permeability facilitated the passage of microbial products and toxic metabolites into the central nervous system, thereby disturbing neurotransmitter systems.¹⁷

The current diagnostic criteria for ASD was updated from DSM-4 to the Diagnostic and Statistical Manual of Mental Disorders—5th edition (DSM-5) in 2013.³ Diagnosis of ASD is a clinical process, based on structured observation and standardized assessments such as the Autism Diagnostic Observation Schedule (ADOS-2) and the Autism Diagnostic Interview–Revised (ADI-R). No laboratory or imaging tests provide confirmation. Comprehensive evaluation typically involves a multidisciplinary team—including a child neuropsychiatrist, psychologist, and speech therapist—and investigations assess not only autism-related behaviors but also cognition, adaptive functioning, and language abilities.^{18,19} Core diagnostic features are impairments in communication, social reciprocity, and the presence of repetitive or restricted patterns of behaviour. Early signs, often noticeable before the age of three, include reduced eye contact or failure to respond to one's name.²⁰ Many symptoms persist into adulthood, particularly difficulties with social relationships and cognition, although communication skills sometimes improve with age. Cognitive ability and IQ generally do not change, and the quality of life of these individuals can be enhanced with social support systems, interventions, and environmental accommodations.²¹ Many individuals also developed strong, narrow interests, sensory fixations, or strict routines.²² Since there are currently no established ASD biomarkers or diagnostic criteria, the diagnosis is dependent on meeting descriptive criteria.

This review was conducted to explore the oral health concerns and challenges of patients with ASD, as well as the barriers to accessing dental care. We used a narrative and descriptive review approach, along with parts of scoping review methods, to identify, categorize, and bring together findings from many different studies.

MATERIALS AND METHODS

Ethics Committee Approval: This study is an invited review. Ethics committee approval is not required.

Data Sources and Search Strategy: A comprehensive literature search was carried out across multiple electronic databases, including PubMed, Scopus, and Google Scholar. Keywords and Medical Subject Headings (MeSH) terms used in various combinations included: “Autism Spectrum Disorder,” “ASD,” “oral health,” “dental care,” “barriers,” “oral hygiene,” “dental health,” “oral health care,” “Dental complications,” “systemic health issues,” “dental management,” “conscious sedation,” “general anesthesia,” “parental concerns,” “financial concerns,” “dental treatment,” “access to care,” and “behavioral challenges.” Boolean operators (AND, OR) were used to enhance the search strategy.

The search was limited to English-language articles published from 2000 to March 2025 to ensure the inclusion of recent and relevant literature. Additional manual searches of the reference lists of relevant articles were conducted to identify additional studies of interest.

DISCUSSION AND CONCLUSION

Comorbidity Associated with ASD

In most cases, patients with ASD suffer from various psychological and physical illnesses. Psychological comorbidities include attention-deficit hyperactivity disorder (ADHD), obsessive-compulsive disorder (OCD), anxiety, and intellectual disability. ADHD is particularly prevalent, with estimates suggesting that 30–50% of people with ASD also display ADHD traits. This overlap is reflected in the DSM-5, which permits dual diagnoses.^{3,23} Anxiety and depression are also common, often emerging as consequences of social isolation and communication challenges, though they may also have shared underlying biological pathways. Additionally, aggression and self-injurious behaviors are observed in some individuals. Historically, ASD was once mischaracterized as a childhood form of schizophrenia due to overlapping symptoms and risk factors.²³ Among physiological comorbidities, epilepsy, gastrointestinal disorders, and sleep disturbances are the most commonly observed symptoms. The risk of epilepsy is especially high in individuals with both ASD and intellectual disability, and it is believed to arise from shared risk factors such as synaptic dysfunction and adverse prenatal environments.²⁴ Immune dysregulation has also been identified as a relevant comorbidity, with elevated cytokine activity and maternal autoantibody transfer proposed as contributors to atypical neurodevelopment.²⁵⁻²⁷ Secondary manifestations of ASD include hyperactivity, impulsivity, mood instability, and aggression. Importantly, ASD is characterized by significant heterogeneity, with wide variation in clinical presentation and the types of comorbidities observed.¹¹

Prevalence of Different Oral Diseases in ASD

The most common dental ailments reported in ASD patients are periodontal disease (69.4%) and dental caries (60.6%).²⁸⁻³³ This is because ASD generally prefer soft, sweetened foods and often retain food in their mouths. This tendency is attributed to swallowing difficulties linked to poor tongue coordination, which subsequently increased their susceptibility to dental caries.³³⁻⁴⁷ The risk is further heightened because many children with ASD experience difficulties in maintaining basic oral hygiene.²⁹ Traumatic dental injuries (TDI) have also been reported in children with ASD,^{27,30,32-35} with preschool-aged children being particularly affected. The primary maxillary central incisors are the teeth most commonly involved, with enamel fractures reported as the predominant type of trauma. In addition, harmful oral habits such as bruxism, tongue thrusting, lip biting, and gingival picking have been widely observed in this group.³² A study in Saudi Arabia³⁶ examined oral habits in children with ASD and noted bruxism as the most prevalent habit (54.7%), followed by object biting (44.7%) and mouth breathing (26.7%). Children with ASD are also more likely to develop specific types of malocclusion, such as anterior open bite.^{35,48} In a study conducted across five rehabilitation centres in Riyadh, children with ASD exhibited higher rates of Class I malocclusion (40–41%) and lower rates of Class III malocclusion (3–4%) compared with children with Down syndrome. An increased mesial shift of the left primary molars was also observed in children with ASD. Researchers have reported that these children face challenges in toothbrushing due to limited manual dexterity.^{33,38} Parents and caregivers additionally struggle to maintain oral hygiene for children with ASD, mainly due to behavioral and communication difficulties.^{49,50} As a result, many children exhibit poor oral health, with a higher prevalence of gingival and periodontal diseases.^{30,34,50} The side effects of medications prescribed for ASD, such as psychoactive drugs and anticonvulsants, also contribute significantly to oral health problems, particularly gingival

and periodontal disease. Among these medications, antidepressants, stimulants, and antipsychotics were most frequently implicated.^{30,41} Children with ASD frequently exhibit self-injurious behavior, anger outbursts, and irritability, often triggered by stress, heightened sensory stimulation, or environmental influences.⁵¹ Over 60% of affected children engage in harmful behaviors, including severe self-biting, scratching, and self-pinching.^{52,53}

Barriers to Oral Health Care for Autism Spectrum Disorder

Autistic patients face extreme difficulties with oral care, whether at home or at the dental clinic. At home, such patients may not like the taste or flavour of the toothpaste or the feel of the toothbrush bristles.⁵⁴ Patients with ASD often exhibit impaired social interactions, including atypical eye contact, abnormal facial expressions in social contexts, reduced social engagement and receptiveness, difficulties in forming relationships, limited understanding of others' ideas and emotions, deficits in communication skills, challenges in establishing verbal or nonverbal social connections, rigid or unusual behaviors, and restricted activities.⁵⁴⁻⁵⁶ Nearly 50% of kids with ASD don't speak at all.^{56,57} Several of them repeat words, and some make no signals to substitute for vocal communication, and usually take time to process and understand information.^{55,58} Heightened sensory sensitivities often lead to exaggerated negative responses to visual, auditory, and tactile stimuli in the dental setting, negatively impacting the lives of both patients with ASD and their caregivers.^{55,56} Such kinds of sensory sensitivities often result in unpredictable behaviors in the dental clinic, as they may find it difficult to adapt to unfamiliar tastes and unusual smells (from dental materials), people touching them, bright lights overhead, and the unfamiliar sounds of dental equipment.⁵⁴

Most patients are extremely uncooperative and anxious in a dental clinic, and occasionally prevent the dentist from giving the required treatment. A significantly higher number of caregivers of children with ASD reported 'hyperactivity' and 'difficult to explain' sensory reactions. Most of these patients are highly sensitive to the emotional environment and the physical expressions of those around them. Sometimes dentists find it challenging to force patients to sit on the dental chair during treatment.⁵⁹⁻⁶¹ Also, they feel uncomfortable and agitated in the waiting area, while sitting next to unfamiliar people in a different environment and awaiting their treatment.^{61,62} When dental procedures are performed irregularly or by unfamiliar caregivers, such patients often refuse treatment due to their inability to accept change.⁵³ Most of them miss their treatment appointments and fail to report for regular follow-up, as the caregivers dealing with such individuals find it difficult to visit regularly because of their uncooperative behaviour.⁶³

While seeking professional care for such patients, many caregivers have also reported difficulty in finding the right dentist skilled in treating patients with special care needs.⁶⁰ Many caregivers felt a lack of referrals to specialised centres dealing with such patients with ASD. Dental professionals dealing with such patients have also reported several barriers, including the absence of clear guidelines, insufficient reimbursement options, and challenges in managing their behaviour in a routine clinical environment.^{62,64} Alshatrat et al.,⁵¹ in their survey reported a lack of specialised dental staff (28.6%), inadequate resources (34%) and a lack of training in treating patients with disabilities (26.6%).

Management of Children with ASD in a Dental Clinic

Dental management of ASD patients is difficult in a traditional clinical set-up because of their uncooperative behaviours, such as shouting, verbal defiance, refusal to follow instructions, and crying. Clinicians must consider other options in response to these refusals, such as general anaesthesia or physical restraint. They should follow a comprehensive and individualised approach that addresses sensory sensitivities, communication barriers, and behavioural difficulties..⁶⁵⁻⁶⁸ The expertise of dental practitioners, their manner of speech, careful appointment planning, collaboration with other specialists, and implementing clinically effective behavioural guidance techniques such as Tell-Show-Do (TSD), positive reinforcement, distraction methods, and Applied Behaviour Analysis (ABA) have proven effective in improving cooperation and reducing anxiety during dental visits.⁶⁵⁻⁷⁰ Gradual desensitization through stepwise exposure and modelling is also beneficial in building trust and minimizing fear over time. Visual and sensory supports, including social stories, picture exchange communication systems (PECS), and sensory-adapted dental environments (SADE), also play a crucial role in preparing patients and making the clinical experience more tolerable. Parent and caregiver involvement is also helpful; their training and presence during appointments provide comfort and familiarity, which enhance the child's ability to cope.^{57,70,71} In more severe cases, sedation techniques, including nitrous oxide or general anaesthesia, are required to complete treatment.⁷²⁻⁷⁴ However, atypical and inappropriate responses to oral or intravenous sedation are frequently observed; as a result, in about 40% of cases, treatment can only be performed under general anesthesia.⁷⁴ During

such procedures, devices like mouth props are used to facilitate treatment, while restrictive techniques such as hand-over-mouth exercises are discouraged.⁷⁵

Clinicians should be aware of these patients' medical histories. Patients with ASD often receive anticonvulsants such as carbamazepine and valproate, which are associated with side effects including leukopenia, thrombocytopenia, and reduced fibrinogen activity. When combined with NSAIDs or analgesics, these drugs increase the risk of bleeding, necessitating detailed blood investigations before surgery. Methylphenidate, commonly prescribed for hyperactivity, elevates the risk of hypertensive reactions if local anaesthesia is not carefully administered. Furthermore, antibiotics like erythromycin and clarithromycin interfere with carbamazepine metabolism, raising the risk of hepatic toxicity.^{74,75} Clinicians are encouraged to document the management approach during each visit in the patient's record, including the patient's preferences related to flavours, music, communication styles, or comfort objects during treatment, which can be followed during subsequent visits.⁷⁵ And, for better and more effective management, clinicians should collaborate with other specialists such as speech therapists, occupational therapists, and psychologists, and develop a customised treatment strategy for each patient.⁶⁸

Innovative behavioural management strategies continue to evolve to address common barriers to treating patients with ASD in dental settings. For example, virtual reality (VR) devices immerse patients in calming environments, offering both distraction and sensory regulation. Augmented reality (AR) tools simulate dental procedures in interactive formats, allowing patients to become accustomed to clinical processes before appointments. Mobile applications for desensitization and communication, such as personalized visual schedules or behaviour-reward trackers, help patients anticipate treatments and reinforce positive behaviour. Additionally, wearable sensory aids—including vibration therapy devices and weighted lap pads—help modulate sensory input during procedures, thereby reducing overstimulation. The incorporation of these tools into clinical practice improves engagement, lowers anxiety, and ultimately enhances oral health outcomes for individuals on the autism spectrum.⁶⁹

Caregivers should be educated and motivated to adopt preventive measures, including regular toothbrushing with fluoridated toothpaste, mouth rinsing, flossing, and dietary regulation with reduced consumption of sugar-rich foods. In children with ASD, additional preventive interventions such as sealants, topical fluorides, and dental visits every three to six months are recommended. The American Academy of Pediatric Dentistry (AAPD) also supports the use of Silver Diamine Fluoride (SDF) for children with special healthcare needs, mainly those unable to maintain satisfactory oral hygiene.^{70,76,77}

Lastly, the dental problems of the population with ASD are often neglected due to limited access to dental hospitals, financial difficulties, a shortage of trained dental specialists, parental attitudes, and insufficient awareness of oral health. These factors result in substantial unmet dental needs later in life. To ensure that patients with ASD receive proper oral care, it is necessary to expand access to suitable healthcare services, train dentists in specialised techniques, and continually adopt innovative treatment methods.⁶⁵⁻⁶⁷

Collaborative Management: The Role of the Family, Society, and Internet

Dental management for patients with ASD relies heavily on the combined involvement of families, society, and online health-related information. Families act as the central link in care, as they negotiate between the patient and oral health professionals. Lewis⁴⁴ reported that children with special healthcare needs, including those with ASD, often encounter barriers in accessing dental services, and parental participation was decisive in overcoming these challenges. Parents contribute by sharing knowledge about their child's behaviour, sensory triggers, and communication requirements. Family-centred remote support has the potential to significantly improve the overall health of such patients by promoting trust, lowering treatment-related anxiety, and creating a more pleasant experience for both the patient and the dentist.⁷⁸ Their responsibilities extend beyond clinical visits, as they reinforce oral hygiene routines at home, support gradual desensitisation, and ensure regular dental appointments.

Public institutions such as schools, non-governmental organisations (NGOs), and local health services are also key parts of inclusive oral healthcare, as they provide information on special-care dentistry and guidance on easy access. At the same time, dependency on digital knowledge has increased, meaning caregivers often seek information available on social platforms. However, online health resources vary considerably in quality and reliability. Although the internet is user-friendly and encouraging, any error or misinterpretation can spread wrong or misleading healthcare information and often fail to meet acceptable standards, underscoring the value of expert supervision.^{79,80} By encouraging frank communication and strengthening digital awareness, dental professionals can support evidence-based oral health care decisions while avoiding misinformation.

In conclusion, patients with ASD require an inclusive teamwork that extends beyond the dentist's office, for their healthy lives. Successful dental management depends on family involvement, professional collaboration, and structured behavioral interventions. It is desirable to have input from the families of children with ASD and their teachers and other health helpers involved, to fulfil their special needs. Innovative dental tools, such as sensory-adapted environments and virtual reality, help create more tolerable dental experiences. For long-term success, we should encourage regular check-ups and incorporate preventive strategies, such as topical fluoride applications and caregiver-assisted oral hygiene. There should be specialized training, along with clinically proven techniques for dental treatment, to create a strong foundation that will guarantee equitable and superior dental care for patients with ASD.

Ethics Committee Approval: This is an invited review. Ethics committee approval is not required.

Conflict of Interest: No conflict of interest was declared by the authors.

Author Contributions: Concept – AS; Supervision – AS, AJ; Materials – AS, DG; Data Collection and/or Processing – AS, DG; Analysis and/or Interpretation – AS, DG, AJ; Writing – AS, DG, AJ.

Peer-review: Externally peer-reviewed.

REFERENCES

1. Bagattoni S, Lardani L, D'Alessandro G, Piana G. Oral health status of Italian children with autism spectrum disorder. *Eur J Paediatr Dent.* 2021;22(3):243-247.
2. Pagano S, Lombardo G, Coniglio M, et al. Autism spectrum disorder and paediatric dentistry: A narrative overview of intervention strategy and introduction of an innovative technological intervention method. *Eur J Paediatr Dent.* 2022;23(1):54-60. doi:10.23804/ejpd.2022.23.01.10
3. Hodges H, Fealko C, Soares N. Autism spectrum disorder: definition, epidemiology, causes, and clinical evaluation. *Transl Pediatr.* 2020;9(suppl 1):S55-S65. doi:10.21037/tp.2019.09.09
4. Maenner MJ, Shaw KA, Baio J, et al. Prevalence of autism spectrum disorder among children aged 8 years—Autism and Developmental Disabilities Monitoring Network, 11 sites, United States, 2016. *MMWR Surveill Summ.* 2020;69(4):1-12.
5. Chiarotti F, Venerosi A. Epidemiology of autism spectrum disorders: A review of worldwide prevalence estimates since 2014. *Brain Sci.* 2020;10(5):277. doi:10.3390/brainsci10050277
6. Qiu S, Lu Y, Li Y, et al. Prevalence of autism spectrum disorder in Asia: A systematic review and meta-analysis. *Psychiatry Res.* 2020;284:112679. doi:10.1016/j.psychres.2019.112679
7. Baio J, Wiggins L, Christensen DL, et al. Prevalence of autism spectrum disorder among children aged 8 years—Autism and Developmental Disabilities Monitoring Network, 11 sites, United States, 2014. *MMWR Surveill Summ.* 2018;67(6):1-23. doi:10.15585/mmwr.ss6706a1
8. Demily C, Poisson A, Peyroux E, et al. Autism spectrum disorder associated with 49,XXXXY: Case report and review of the literature. *BMC Med Genet.* 2017;18:9. doi:10.1186/s12881-017-0371-7
9. Loomes R, Hull L, Mandy WPL. What is the male-to-female ratio in autism spectrum disorder? A systematic review and meta-analysis. *J Am Acad Child Adolesc Psychiatry.* 2017;56(6):466-474. doi:10.1016/j.jaac.2017.03.013
10. Sztainberg Y, Zoghbi HY. Lessons learned from studying syndromic autism spectrum disorders. *Nat Neurosci.* 2016;19(11):1408-1417. doi:10.1038/nn.4420
11. Sauer AK, Stanton JE, Hans S, et al. Autism spectrum disorders: Etiology and pathology. In: Grabrucker AM, ed. *Autism Spectrum Disorders.* Exon Publications; 2021:chap 1. <https://www.ncbi.nlm.nih.gov/books/NBK573613/>. Accessed July 10, 2026.
12. Wu S, Wu F, Ding Y, Hou J, Bi J, Zhang Z. Advanced parental age and autism risk in children: A systematic review and meta-analysis. *Acta Psychiatr Scand.* 2017;135(1):29-41. doi:10.1111/acps.12666
13. Karimi P, Kamali E, Mousavi SM, Karahmadi M. Environmental factors influencing the risk of autism. *J Res Med Sci.* 2017;22:27. doi:10.4103/1735-1995.200272
14. Emberti Gialloreti L, Mazzone L, Benvenuto A, et al. Risk and protective environmental factors associated with autism spectrum disorder: Evidence-based principles and recommendations. *J Clin Med.* 2019;8(2):217. doi:10.3390/jcm8020217

15. Careaga M, Murai T, Bauman MD. Maternal immune activation and autism spectrum disorder: From rodents to nonhuman and human primates. *Biol Psychiatry*. 2017;81(5):391-401. doi:10.1016/j.biopsych.2016.10.020
16. Modabbernia A, Velthorst E, Reichenberg A. Environmental risk factors for autism: An evidence-based review of systematic reviews and meta-analyses. *Mol Autism*. 2017;8:13. doi:10.1186/s13229-017-0121-4
17. Mussap M, Beretta P, Esposito E, Fanos V. Once upon a time oral microbiota: A Cinderella or a protagonist in autism spectrum disorder? *Metabolites*. 2023;13(12):1183. doi:10.3390/metabo13121183
18. Bhat S, Acharya UR, Adeli H, Bairy GM, Adeli A. Autism: Cause factors, early diagnosis and therapies. *Rev Neurosci*. 2014;25(6):841-850. doi:10.1515/revneuro-2014-0056
19. González MC, Vásquez M, Hernández-Chávez M. Autism spectrum disorder: Clinical diagnosis and ADOS test. *Rev Chil Pediatr*. 2019;90(5):485-491. doi:10.32641/rchped.v90i5.749
20. Masi A, DeMayo MM, Glozier N, Guastella AJ. An overview of autism spectrum disorder, heterogeneity and treatment options. *Neurosci Bull*. 2017;33(2):183-193. doi:10.1007/s12264-017-0100-y
21. Volkmar FR, Wolf JM. When children with autism become adults. *World Psychiatry*. 2013;12(1):79-80. doi:10.1002/wps.20020
22. Kim SH, Lord C. Restricted and repetitive behaviors in toddlers and preschoolers with autism spectrum disorders based on the Autism Diagnostic Observation Schedule (ADOS). *Autism Res*. 2010;3(4):162-173. doi:10.1002/aur.142
23. Leitner Y. The co-occurrence of autism and attention deficit hyperactivity disorder in children—What do we know? *Front Hum Neurosci*. 2014;8:268. doi:10.3389/fnhum.2014.00268
24. Besag FMC. Epilepsy in patients with autism: Links, risks and treatment challenges. *Neuropsychiatr Dis Treat*. 2018;14:1-10. doi:10.2147/NDT.S120509
25. Careaga M, Van de Water J, Ashwood P. Immune dysfunction in autism: A pathway to treatment. *Neurotherapeutics*. 2010;7(3):283-292. doi:10.1016/j.nurt.2010.05.003
26. Boulanger-Bertolus J, Pancaro C, Mashour GA. Increasing role of maternal immune activation in neurodevelopmental disorders. *Front Behav Neurosci*. 2018;12:230. doi:10.3389/fnbeh.2018.00230
27. Friedlander AH, Yagiela JA, Paterno VI, Mahler ME. The neuropathology, medical management, and dental implications of autism. *J Am Dent Assoc*. 2006;137(11):1517-1527. doi:10.14219/jada.archive.2006.0086
28. Como DH, Stein Duker LI, Polido JC, Cermak SA. Oral health and autism spectrum disorders: A unique collaboration between dentistry and occupational therapy. *Int J Environ Res Public Health*. 2021;18(1):135. doi:10.3390/ijerph18010135
29. Bandini LG, Anderson SE, Curtin C, et al. Food selectivity in children with autism spectrum disorders and typically developing children. *J Pediatr*. 2010;157(2):259-264. doi:10.1016/j.jpeds.2010.02.013
30. Ferreira MC, Guare RO, Prokopowitsch I, Santos MT. Prevalence of dental trauma in individuals with special needs. *Dent Traumatol*. 2011;27(2):113-116. doi:10.1111/j.1600-9657.2010.00961.x
31. da Silva SN, Gimenez T, Souza RC, et al. Oral health status of children and young adults with autism spectrum disorders: A systematic review and meta-analysis. *Int J Paediatr Dent*. 2017;27(5):388-398. doi:10.1111/ipd.12274
32. Al-Sehaibany FS. Occurrence of traumatic dental injuries among preschool children with autism spectrum disorder. *Pak J Med Sci*. 2018;34(4):859-863. doi:10.12669/pjms.344.15681
33. Humaid J. Dental experiences related to oral care of children with autism spectrum disorders in Saudi Arabia: A literature review. *Saudi Dent J*. 2022;34(1):1-10. doi:10.1016/j.sdentj.2021.09.023
34. Jaber MA. Dental caries experience, oral health status and treatment needs of dental patients with autism. *J Appl Oral Sci*. 2011;19(3):212-217. doi:10.1590/S1678-77572011000300006
35. Weddell J, Sanders BJ, Jones JE. Dental problems of children with special health care needs. In: McDonald RE, Avery DR, Dean JA, eds. *McDonald and Avery's Dentistry for the Child and Adolescent*. 9th ed. Mosby; 2011:460-486.
36. Alkhadra T. Characteristics of malocclusion among Saudi special needs group children. *J Contemp Dent Pract*. 2017;18(10):959-963. doi:10.5005/jp-journals-10024-2156
37. Bartolomé-Villar B, Mourelle-Martínez MR, Diéguez-Pérez M, de Nova-García MJ. Incidence of oral health in paediatric patients with disabilities: Sensory disorders and autism spectrum disorder. Systematic review II. *J Clin Exp Dent*. 2016;8(3):e344-e351. doi:10.4317/jced.52923

38. Diab HM, Motlaq SS, Alsharare A, Alshammery A, et al. Comparison of gingival health and salivary parameters among autistic and non-autistic school children in Riyadh. *J Clin Diagn Res.* 2016;10(10):ZC110-ZC113. doi:10.7860/JCDR/2016/23373.8692
39. Ferrazzano GF, Salerno C, Bravaccio C, Ingenito A, Sangianantoni G, Cantile T. Autism spectrum disorders and oral health status: Review of the literature. *Eur J Paediatr Dent.* 2020;21(1):9-12. doi:10.23804/ejpd.2020.21.01.02
40. Corridore D, Zumbo G, Corvino I, et al. Prevalence of oral disease and treatment types proposed to children affected by autistic spectrum disorder in pediatric dentistry: A systematic review. *Clin Ter.* 2020;171(3):e275-e282. doi:10.7417/CT.2020.2219
41. Lam PPY, Du R, Peng S, McGrath CPJ, Yiu CKY. Oral health status of children and adolescents with autism spectrum disorder: A systematic review of case-control studies and meta-analysis. *Autism.* 2020;24(5):1047-1066. doi:10.1177/1362361319883767
42. Burgette JM, Rezaie A. Association between autism spectrum disorder and caregiver-reported dental caries in children. *JDR Clin Trans Res.* 2020;5(3):254-261. doi:10.1177/2380084419886448
43. Ningrum V, Bakar A, Shieh TM, Shih YH. The oral health inequities between special needs children and normal children in Asia: A systematic review and meta-analysis. *Healthcare (Basel).* 2021;9(4):410. doi:10.3390/healthcare9040410
44. Lewis CW. Dental care and children with special health care needs: a population-based perspective. *Acad Pediatr.* 2009;9(6):420–6. Doi: 10.1016/j.acap.2009.09.005
45. Tsai SJ, Hsu JW, Huang KL, et al. Autism spectrum disorder and periodontitis risk: A cohort study of 38,203 adolescents. *J Am Dent Assoc.* 2023;154(7):624-632.e1. doi:10.1016/j.adaj.2023.02.020
46. George SS, Elenjickal MG, Naik S, et al. Oral health status and dental treatment needs in children with autism spectrum disorder. *Heliyon.* 2024;10(18):e37728. doi:10.1016/j.heliyon.2024.e37728
47. Motta T, Mota D, Bitencourt F, et al. Dental caries of individuals with autism spectrum disorder (ASD): A systematic review and meta-analysis. *J Autism Dev Disord.* Published online 2025. doi:10.1007/s10803-025-06754-7
48. Mahabala KY, Dutt A, Shenoy R, et al. A scoping review on parental/caregiver challenges in maintaining oral hygiene among children with autism spectrum disorder. *Int J Paediatr Dent.* 2025;35(3):566-576. doi:10.1111/ipd.13268
49. Lord C, Elsabbagh M, Baird G, Veenstra-VanderWeele J. Autism spectrum disorder. *Lancet.* 2018;392(10146):508-520. doi:10.1016/S0140-6736(18)31129-2
50. Udhya J, Varadharaja MM, Parthiban J, Srinivasan I. Autism disorder (AD): An updated review for paediatric dentists. *J Clin Diagn Res.* 2014;8(2):275-277. doi:10.7860/JCDR/2014/7938.4080
51. Alshatrat SM, Al-Bakri IA, Al-Omari WM. Dental service utilization and barriers to dental care for individuals with autism spectrum disorder in Jordan: A case-control study. *Int J Dent.* 2020;2020:3035463. doi:10.1155/2020/3035463
52. Gandhi RP, Klein U. Autism spectrum disorders: An update on oral health management. *J Evid Based Dent Pract.* 2014;14(suppl):115-126. doi:10.1016/j.jebdp.2014.03.002
53. Weil TN, Bagramian RA, Inglehart MR. Treating patients with autism spectrum disorder: Special Care Dentistry Association members' attitudes and behavior. *Spec Care Dentist.* 2011;31(1):8-17. doi:10.1111/j.1754-4505.2010.00173.x
54. Stein LI, Polido JC, Lopez Najera SO, Cermak SA. Oral care experiences and challenges in children with autism spectrum disorders. *Pediatr Dent.* 2012;34(5):387-391.
55. Lai MC, Lombardo MV, Baron-Cohen S. Autism. *Lancet.* 2014;383(9920):896-910. doi:10.1016/S0140-6736(13)61539-1
56. Rose V, Trembath D, Keen D, Paynter J. The proportion of minimally verbal children with autism spectrum disorder in a community-based early intervention programme. *J Intellect Disabil Res.* 2016;60(5):464-477. doi:10.1111/jir.12284
57. Logrieco MGM, Ciuffreda G, Sinjari B, et al. What happens at a dental surgery when the patient is a child with autism spectrum disorder? An Italian study. *J Autism Dev Disord.* 2021;51(1):1-14. doi:10.1007/s10803-020-04684-0
58. Johnson CP, Myers SM; Council on Children With Disabilities. Identification and evaluation of children with autism spectrum disorders. *Pediatrics.* 2007;120(5):1183-1215. doi:10.1542/peds.2007-2361

59. Blomqvist M, Bejerot S, Dahllöf G. A cross-sectional study on oral health and dental care in intellectually able adults with autism spectrum disorder. *BMC Oral Health*. 2015;15:81. doi:10.1186/s12903-015-0065-z
60. Duker LIS, Henwood BF, Bluthenthal RN, Juhlin E, Polido JC, Cermak SA. Parents' perceptions of dental care challenges in male children with autism spectrum disorder: An initial qualitative exploration. *Res Autism Spectr Disord*. 2017;39:63-72. doi:10.1016/j.rasd.2017.03.002
61. Thomas N, Blake S, Morris C, Moles DR. Autism and primary care dentistry: Parents' experiences of taking children with autism or a working diagnosis of autism for dental examinations. *Int J Paediatr Dent*. 2018;28(3):226-236. doi:10.1111/ipd.12345
62. Mansoor D, Al Halabi M, Khamis AH, Kowash M. Oral health challenges facing Dubai children with autism spectrum disorder at home and in accessing oral health care. *Eur J Paediatr Dent*. 2018;19(2):127-133. doi:10.23804/ejpd.2018.19.02.06
63. Bernath B, Kanji Z. Exploring barriers to oral health care experienced by individuals living with autism spectrum disorder. *Can J Dent Hyg*. 2021;55(3):160-166.
64. Taneja N, Litt MD. Caregivers' barriers to dental care for children with autism spectrum disorder. *J Dent Child (Chic)*. 2020;87(2):98-102.
65. American Academy of Pediatric Dentistry. Behavior guidance for the pediatric dental patient. Reference Manual of the American Academy of Pediatric Dentistry. <https://www.aapd.org/research/oral-health-policies--recommendations/behavior-guidance-for-the-pediatric-dental-patient>. Accessed November 23, 2025.
66. Stein Duker LI, Floríndez LI, Como DH, et al. Strategies for success: A qualitative study of caregiver and dentist approaches to improving oral care for children with autism. *Pediatr Dent*. 2019;41(1):4E-12E.
67. Uppal S, Sultan A, Kumar G. Special care dentistry: A challenge to the profession. *OTJHS*. 2024;9(4):379-387. doi:10.26453/otjhs.1532374
68. Nelson TM, Sheller B, Friedman CS, Bernier R. Educational and therapeutic behavioral approaches to providing dental care for patients with autism spectrum disorder. *Spec Care Dentist*. 2015;35(3):105-113. doi:10.1111/scd.12101
69. Son G, Oh S, Lee J, et al. Trends in behavioral management techniques for dental treatment of patients with autism spectrum disorder: A 10-year review. *J Dent Anesth Pain Med*. 2023;23(2):67-79. doi:10.17245/jdapm.2023.23.2.67
70. Chandrashekhar S, Bommangoudar JS. Management of autistic patients in dental office: A clinical update. *Int J Clin Pediatr Dent*. 2018;11(3):219-227. doi:10.5005/jp-journals-10005-1515
71. Kind LS, Aartman IHA, van Gemert-Schriks MCM, et al. Parents' satisfaction with dental care of Dutch children with autism spectrum disorder. *Eur Arch Paediatr Dent*. 2021;22(3):491-496. doi:10.1007/s40368-020-00586-y
72. Hammersmith KJ, Harlan TA, Fenning RM, et al. Correlates of oral health fatalism in caregivers of children with autism spectrum disorder. *Spec Care Dentist*. 2021;41(2):145-153. doi:10.1111/scd.12564
73. Pastore I, Bedin E, Marzari G, Bassi F, Gallo C, Mucignat-Caretta C. Behavioral guidance for improving dental care in autism spectrum disorders. *Front Psychiatry*. 2023;14:1272638. doi:10.3389/fpsy.2023.1272638
74. Delli K, Reichart PA, Bornstein MM, Livas C. Management of children with autism spectrum disorder in the dental setting: Concerns, behavioural approaches and recommendations. *Med Oral Patol Oral Cir Bucal*. 2013;18(6):e862-e868. doi:10.4317/medoral.19084
75. Sultan A, Juneja A, Bhaskar S. Co-morbidity of Down syndrome with autism spectrum disorder: Dental implications. *J Oral Biol Craniofac Res*. 2020;10(2):146-148. doi:10.1016/j.jobcr.2020.03.014
76. Uppal S, Sultan A, Juneja A. Silver diamine fluoride use in children with special health-care needs: Breaking the barriers. *Arch Med Health Sci*. 2024;12(1):10-13. doi:10.4103/amhs.amhs_293_23
77. Angelova S, Konstantinova D, Nenova-Nogalcheva A, Pancheva R. Significance of oral care for children with autism spectrum disorder—A narrative literature review. *Children (Basel)*. 2025;12(6):750. doi:10.3390/children12060750
78. Zhang JJ, Wang EN. Enhancing autism care through remote support: A family-centered approach. *World J Psychiatry*. 2025;15(4):102645. doi:10.5498/wjp.v15.i4.102645
79. Di Pietro NC, Whiteley L, Mizgalewicz A, Illes J. Treatments for neurodevelopmental disorders: Evidence, advocacy, and the Internet. *J Autism Dev Disord*. 2013;43(1):122-133. doi:10.1007/s10803-012-1551-7

80. Livas C, Delli K, Ren Y. Quality evaluation of the available Internet information regarding pain during orthodontic treatment. *Angle Orthod.* 2013;83(3):500-506. doi:10.2319/052512-435