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Oral Assessment of Children with an Autism Spectrum Disorder

R DeMattei, RDH, PhD, A Cuvo, PhD and S Maurizio, RDH, PhD

Ronda DeMattei, RDH, PhD, is an assistant professor in the Department of Dental Hygiene; Anthony Cuvo, PhD, is a professor in the Department of Behavior Analysis and Therapy; and Sandra J. Maurizio, RDH, PhD, is an associate professor in the Department of Dental Hygiene. All three are from Southern Illinois University, Carbondale, Ill.

Purpose. The study assessed the oral health status of children with an autism spectrum disorder (ASD) to help establish the oral health needs of this population.

Methods. Oral assessments were conducted on 39 children with an ASD and 16 children with other developmental disabilities (DD), solicited from 3 different schools. Conditions assessed were bacterial plaque, gingivitis, dental caries, restorations, bruxism, delayed eruption/missing teeth, oral infection, developmental anomalies, injuries, occlusion, salivary flow, and oral defensiveness.

Results. Chi-square and Fisher's exact test of significance were used to compare groups. Young children with an ASD who resided with parents showed significantly more signs of bruxism than the comparison groups. Likewise, older children who lived at the residential school manifested significantly more gingivitis. No other significant differences existed when age and residence were considered for children with an ASD. When comparing children with ASD to those with another DD, the latter group showed significantly more oral injuries, abnormal salivary flow, and developmental anomalies. Children with an ASD displayed the following percentages for clinically visible conditions: plaque (85%), gingivitis (62%), and caries (21%). Approximately half of the children with ASD were orally defensive.

Conclusions. Children with an ASD appear to have oral conditions that might increase the risk of developing dental disease. The extent of risk is unclear and needs further investigation.

Keywords: autism, oral health, access to care, developmental disabilities, oral assessment

Introduction

In 2000, the United States Surgeon General's first report on the oral health status of Americans was released. One major message of this report is that oral health is essential to the general health and well being of all Americans. Although they can achieve it, not all Americans are achieving the same degree of oral health. The Surgeon General's Report emphasized that "a silent epidemic" of oral diseases is affecting our most vulnerable citizens, including those with special needs. At the time the Surgeon General's Report was published, no national studies had been conducted to determine the prevalence of oral and craniofacial diseases among the various subpopulations with disabilities.[1] Very little has been reported in the literature about the oral health needs of individuals with an autism spectrum disorder (ASD); however the oral health status of individuals with mental retardation (MR) and other developmental disabilities (DD) are more readily available. Some local and regional reports show that persons with DD have significantly higher rates of poor oral hygiene and need for

periodontal treatment than the general population. Although there is variability in reports on caries rates, overall, individuals with disabilities appear to have a higher prevalence than individuals without disabilities. Published reports describing the oral health needs and prevalence of oral disease for individuals with an ASD are sparse to nonexistent.

The aim of this study was to investigate the oral health status of children with an ASD. The 4 goals of this research were to (a) investigate the oral health status of all participants in the areas of plaque accumulation, gingival health, caries, restorations, bruxism, malocclusion, delayed eruption and missing teeth, oral infections, developmental anomalies, salivary flow, oral injuries, and oral defensiveness; (b) determine whether there is a significant difference between the oral conditions observed in children with an ASD who reside with their parents/guardians and those children with an ASD who live in the residential school; (c) determine whether there is a significant difference between the oral conditions observed in young children with an ASD and older children with an ASD; and (d) determine whether there is a significant difference between the oral conditions observed in children with an ASD and those children with other DD.

Review of Literature

The term Pervasive Developmental Disorder (PDD) refers to the overarching group of conditions to which autism spectrum disorder (ASD) belongs.[2] PDD is often used synonymously with the term ASD and consists of 5 subtypes. The 5 subtypes are: (1) autism disorder (AD); (2) Asperger's Disorder, also know as Asperger Syndrome (AS); (3) Rett's disorder; (4) childhood disintegrative disorder (CDD); and (5) pervasive developmental disorder-not otherwise specified (PDD-NOS).[3] The most common and best studied form of ASD is AD. Individuals with ASD vary widely in abilities, intelligence, and behaviors. Symptoms may include problems using and understanding language; difficulty relating to people, objects, and events; unusual play with toys and other objects; difficulty with changes in routine or familiar surroundings; and repetitive body movements or behavior patterns.[2]

Limited studies are available that report oral health needs of children with an ASD. The studies that are available show that oral health in children with an ASD was not inferior to that of their healthy comparison group.[4,5,6,7] Unclear is whether the oral health needs of children with an ASD parallel those of children with other DD. There is limited evidence-based research that provides a comparison between the oral health needs of children with an ASD and those with another DD.

Reports concerning dental disease in children with disabilities are contentious, and there are many differences of opinion regarding what extent children with disabilities differ in oral health and disease from children without disabilities.[8] Surveys generally report more missing and fewer filled teeth among individuals with mental disabilities than among the general population, as well as poor oral hygiene, more inflammation or gingivitis, and more periodontal involvement.[9] Other reports of the oral health needs of children with mental retardation (MR) include early childhood caries, prescription medicine-induced dental decay, altered salivary flow, tooth decay, malocclusion, fractured and nonvital teeth, soft tissue complications, bruxism, medicine-induced gingival overgrowth, delayed eruption, oral infections, and developmental defects.[10,11,12] Although there appears to be no known autism-specific oral manifestations, oral problems might arise because of autism-related behaviors such as communication limitations, personal neglect, self-injurious behaviors, dietary habits, effects of medications, resistance to receiving dental care, hyposensitivity to pain, and possible avoidance of social contact.[13] Research is necessary to determine whether behaviors and characteristics inherent in autism predispose those with an ASD to compromised oral health.

Parents consistently report dental care as one of the top needed services for their children with disabilities, regardless of age.[1,14] Often parents and caregivers are unsuccessful in locating dentists who are capable and willing to provide oral care services for their child with special care needs.

Over 13% of US children and adolescents ages [17] and under have a special health care need and are almost twice as likely to have unmet oral health care needs as their typically developing peers across all income levels. Additionally, more than 20% of children and adolescents with a special care need have conditions that create financial problems for their families.[15]

Medicaid serves as a primary source of funding for dental services for a significant proportion of children with DD, yet only 1 in 5 Medicaid-eligible children receive any preventive dental services by age 20.[16]

The reason for inadequate access to oral care for individuals with disabilities is multifactorial. One salient reason is the lack of oral care providers who are willing to serve this population. Waldman and Perlman (2003) discussed reasons why providing dental care to people with MR and other DD is such a low priority.[17] Many of these factors are associated with costs. The dentist's production decreases when extra time is needed for a procedure. Commonly, dentists refuse to accept Medicaid patients into their practice because of low reimbursement rates. Third-party support for the delivery of complex services is often limited.[1] Without third-party support, many parents cannot afford the high costs of dental services. In addition to being time consuming, providing oral care to individuals with DD, mental impairments, and behavioral challenges can be very difficult.[11] Many oral care providers enter their profession ill-prepared to address the oral needs of individuals with disabilities.

Most education programs for dentists and dental hygienists provide either extremely limited or no preparation for the care of individuals with disabilities. Essentially, half of dental hygiene school programs provide minimal didactic training and no clinical experience in the care of patients with special needs.[12] Currently, 50% of dental students report no clinical training in special need patient care and three-fourths report little to no preparation in provision of care for special needs patients. A 2001 study reported only 25% of national general dentists reported having hands-on experience with children with special needs in dental school.[18] Dental hygiene programs fared no better. A 1994 study found that 48% of dental hygiene programs had 10 hours or less of didactic training and 57% reported no clinical experience.[19] More recently, a 2000 study reported 53% of 175 practicing dental hygienists in Idaho had never received training directed toward patients with special needs.[20] In 2004, the Commission on Dental Accreditation adopted a new standard that dental and dental hygiene programs were required to implement beginning January 1, 2006. The new standard states that "Graduates must be competent in assessing the treatment needs of patients with special needs."[21]

Methods

Participants. Participants were solicited by mailing consent forms and cover letters to parents/guardians or direct caregivers of students from 3 different schools: a residential school for children with severe developmental disabilities (DD), including autism spectrum disorder (ASD), a university laboratory preschool for children with an ASD, and a public special education school. Parents/guardians or direct caregivers of all residential students were asked to participate, regardless of age and diagnosis of the children. Diagnosis with an ASD was the selection criterion for soliciting participants from the preschool and the public special education school. Children with other DD were solicited from the residential school to form a comparison group.

Of the 117 consent forms and cover letters mailed, 55 were returned, for a 47% return rate; 41 participants were from the residential school, 11 from the preschool, and 3 from the public school. Children's ages ranged from 2.6 to 21.0 years old. Children were placed into either a younger group (ages 2.6 to 5.0) or an older group (ages 9.0 to 21.0). No children younger than 2.6 years or between the ages of 5.1 and 8.11 years participated in this study. All of the children in the younger age group had a diagnosis of ASD. There were 40 boys and 15 girls. A total of 39 participants (27 boys and 12 girls) had an ASD diagnosis, and the remaining 16 participants (13 boys and 3 girls) had diagnoses of other DD that included mental retardation, Klinefelter's syndrome, seizure disorder, cerebral palsy, Down's syndrome, developmental delay, tuberous sclerosis, and/pr Angelman's syndrome. The diagnoses were reported initially on the survey by parents/guardians or caregivers, and then confirmed or corrected by the diagnosis reported in the child's school file.

The project was evaluated and approved by the Southern Illinois University's Human Subjects Committee as an expedited project, and by the Internal Review Board of the residential school.

Instruments. There were 12 categories (ie, bacterial plaque, gingivitis, caries, restorations, bruxism, malocclusion, delayed eruption/missing teeth, infections, developmental anomalies, salivary flow, injuries, and oral defensiveness) assessed

clinically using the evaluation criteria shown in Appendix A Appendix A part 2. The oral assessments were conducted by 2 registered dental hygiene faculty researchers, each with over 25 years of dental hygiene experience. A clinical observation form was developed to record the findings of the oral assessment. Each finding was expressed as a numerical value and entered into an Excel spreadsheet observation form.

Nine of the 12 oral conditions were scored dichotomously; the dental hygienists measured the presence or absence of an oral condition and assigned a 1 or 0 score, respectively. In addition, when an oral condition was present, the dental hygienists would determine whether it was in urgent need of care (UNC). A condition was considered to be in UNC if dental treatment was needed to avoid or eliminate pain or acute infection. In addition, oral defensiveness was scored using an 8-point ordinal scale that identified the level of cooperation exhibited during the oral assessment. Oral defensiveness was operationalized as the degree to which the participant cooperated with the oral assessment. Cooperativeness was scored according to participants' willingness to open their mouth, allow the researchers to lift the lip, insert the mirror, retract the cheeks, and view the oral conditions. A score of 0 indicated complete cooperation, whereas a score of 7 indicated aggressive refusal. Prior to analyzing group data using chi-square or Fisher's exact test of significance, oral defensiveness data were artificially dichotomized to categorize those children who willingly cooperated with the oral assessment by opening their mouth, allowing for the insertion of the mouth mirror, and lifting of their lips, and those who would not allow these procedures.

The remaining 2 oral conditions, salivary flow and malocclusion, were scored on a 4- and 5-category rating scale, respectively. As shown in Appendex A, the score assigned represented the quality of the oral condition.

The 2 dental hygienist raters scored the first 14 oral assessments independently to establish interrater reliability. The dental hygienists independently scored each of the categories for the 14 children. An agreement occurred when both dental hygienists scored the same category identically (eg, both scored either present or absent). A disagreement occurred when the raters differed on the scoring. Scoring reliability was established for each of the 12 oral categories by dividing the number of scoring agreements by the number of agreements plus disagreements multiplied by 100%. Across the 12 oral conditions, the mean interrater reliability coefficient was 91.1%. The range of interrater agreement across the 12 categories was 79% to 100%. The researchers conducted the remaining oral assessments together and collaborated on the scoring of each category. A total of 55 oral assessments were completed across 3 sites.

Procedure. A cover letter and consent form for the oral assessment were mailed either to the parents/guardians or primary caregivers to solicit participants. Follow-up letters or phone contacts were made by school staff to encourage participation; staff members were provided a phone script for consistency of solicitation. Consent forms were requested to be returned to the schools. Oral assessment data were coded to protect the participants' confidentiality.

Oral assessments were conducted by 2 registered dental hygienists who were dressed in muted colored street clothes. Immediately prior to each oral assessment, direct care staff members were asked to give suggestions for the appropriate stimulus to prompt participants to open their mouth and to identify the behavioral approach most likely to be effective for each participant.

Participants were instructed to sit either in a portable dental chair, a straight-back chair, or on the floor. After a brief greeting, the researchers donned gloves and offered participants a new toothbrush. One of the researchers then stated that she needed to look in the participants' mouths. If participants opened their mouths, the researchers moved within viewing distance and the oral conditions were scored based on those that were visible. Next, the hygienist would show the participants a disposable mouth mirror and state, "I need to see better." The mouth mirror would be inserted for the inspection of the occlusal and lingual surfaces of teeth. Finally, the hygienist would state that she was going to touch participants' face and the lips. If participants were cooperative, the cheeks were retracted for inspection of the facial surfaces of the teeth. If participants were compliant, the entire oral assessment was completed in approximately 3 minutes.

Participants were considered to be uncooperative if they refused to willingly open their mouths and allow the insertion of the mouth mirror. If participants were uncooperative, additional behavioral approaches were used to encourage cooperation. Those approaches included using verbal instruction; modeling mouth movements; prompting mouth opening with a toothbrush; using a puppet; distracting the child with a favorite toy; providing positive reinforcement for opening mouth; providing negative reinforcement by escape after the oral assessment was completed; singing songs; including the parent, caregiver, or school staff in the examination process; using a picture activity schedule; and using a social story. For participants with a history of aggressive or extremely uncooperative behavior, parents, caregivers, or school staff would

decide whether to conduct the oral assessment. If necessary, parents or caregivers would assist by giving instructions or providing gentle restraint.

A letter was sent to the parents or caregivers summarizing the children's oral conditions, and a report was placed in the children's medical records at the residential school. Children from the residential facility who were in need of care were referred for dental treatment.

Results

Data were analyzed for all 55 participants with an autism spectrum disorder (ASD) and those with other developmental disabilities (DD). Descriptive statistics are used to present frequency data for each condition assessed. Additionally, Fisher's exact test of significance was used in cases where the smallest expected frequency was less than 5. Otherwise, chi-square tests were used to determine the significant difference between each group and oral condition.

Table I shows frequency and percent of the sample on 12 oral conditions for participants with an ASD. The upper portion of the table shows 10 oral conditions evaluated (columns) and the 4 scoring options (rows). In round figures, the table shows that 85% of the 39 participants with an ASD had visible plaque, with 1 participant in Urgent Need of Care (UNC); 62% had visible gingivitis (2 participants in UNC); 21% had visible caries (2 participants in UNC); 15% had restorative treatment (fillings) that indicate previous dental treatment; 44% had clinical signs of bruxism; 5% had delayed eruption or missing teeth (with 1 participant in UNC); 0% appeared to have an oral infection considered to be in UNC; 0% had a developmental anomaly involving the oral cavity; 26% had an oral injury with 23% involving teeth and 2% involving the cheeks, lips, tongue, or gingiva; and 49% were considered to be orally defensive.

Table I Oral Assessment Results for Participants with an ASD (n=39)
Number of participants (and frequencies) manifesting the criteria for each oral condition evaluated.

Scoring Options	Visible Plaque	Visible Gingivitis	Visible Caries	Visible Restorations	Clinical Signs of Bruxism	Delayed Eruption	Oral Infection	Develop anomalies	Oral Injuries	Oral Defensiveness
No	6 15.4%	15 38.5%	31 79.5%	33 84.6%	22 56.4%	37 94.9%	39 100%	39 100%	29 74.4%	20 51.3%
Yes	33 84.6%	24 61.5%	8 20.5%	6 15.4%	17 43.6%	2 5.1%	0 0%	0 0%	10 25.6%	19 48.7%
UNC	1 * 2.6%	2 * 5.1%	1 * 2.6%							

* The columns with numbers and percentages in the UNC row add to more than 39 and 100% because scores shown in the UNC row are also displayed in the Yes row.
Only three participants were in urgent need of care, one of which manifested two conditions that were in UNC, accounting for 4 scores shown.

	Class I Normal	Class II	Class III	Crowding	Crossbite
Occlusion (1 not scored)	18 46.2%	14 35.9%	717.9%	512.8%	12.6%

	Normal	Excess	Dry	Mucous
Salivary Flow	3487.2%	512.8%	0 0%	00%

Participants may receive more than one score for occlusion, for example Class II and crowding, therefore the numbers are greater than 39 and the percentage greater than 100%.

The bottom portion of Table I shows data for occlusion and salivary flow for participants with an ASD. The table shows that 54% of the children had abnormal occlusion with 36% manifesting Class II occlusion and 18% manifesting Class III occlusion; 13% had crowding and 2% had a crossbite. The lowest panel of Table I presents salivary flow results. The table shows that 13% had excess salivary flow, 0% had xerostomia, and 0% had saliva with a mucous consistency.

The frequencies and percentages in Table I include the participants whose conditions met not only the criteria for "yes" but also for UNC. The conditions that were considered to be in UNC appeared to be well established and needed therapeutic intervention before more serious emergency situations such as abscesses or acute infections developed. Three of the participants had 4 conditions that were considered to be in UNC. One participant had excess plaque accumulation and severe gingivitis, one participant had severe gingivitis, and one participant had severe decay.

Oral assessment results were compared between (a) children with an ASD who live with their parents/guardians and those who live at a residential school; (b) children with an ASD and children with another DD, not including ASD; and (c) children with an ASD ages 2.6 to 5.0 and those ages 9.0 to 21.0. Chi-square analyses and Fisher's exact test of significance are shown in Tables II, III and IV.

Table II Comparison of the Presence of Oral Conditions in Children with an ASD who Reside with Parents/Guardians vs. Children with an ASD who Live at a Residential School

Oral Condition Present	Lives with parents/ guardians (n=14)		Lives at residential school (n=25)		Chi-square	Probability
	Frequency	Percent	Frequency	Percent		
1. bruxism	10	71%	7	28%	6.88	p<.01
2. malocclusion	8	57%	13	52%	.09	
3. oral defensiveness	7	50%	12	48%	.91	
					Fisher's p-value	
1. plaque	11	79%	22	88%	.65	
2. gingivitis	3	21%	21	84%	.00	p<.01
3. visible caries	5	36%	3	12%	.11	
4. restorations	1	7%	5	20%	.39	
5. delayed eruption	0	0%	2	8%	.53	
6. oral infections	0	0%	0	0%		
7. developmental anomalies	0	0%	0	0%		
8. oral injuries	2	14%	8	32%	.28	
9. abnormal salivary flow	1	7%	4	16%	.64	

Table III Comparison of the Presence of Oral Conditions in Children with an ASD with Children with Another DD

Oral Condition Present	Children with an ASD (N=39)		Children with another DD (N=16)		Chi-square	Probability
	Frequency	Percent	Frequency	Percent		
1. restorations	6	15%	5	31%	1.78	
2. bruxism	17	44%	5	31%	0.72	
3. oral injuries	10	26%	10	63%	6.66	p <.01
4. malocclusion	21	54%	11	69%	0.31	
5. oral defensiveness	19	49%	8	50%	1.03	
					Fisher's p-value	
1. plaque	33	85%	15	94%	0.66	
2. gingivitis	24	62%	14	88%	0.11	
3. visible caries	8	21%	4	25%	0.48	
4. delayed eruption	2	5%	2	13%	0.57	
5. oral infections	0	0%	1	6%	0.29	
6. developmental anomalies	0	0%	3	19%	0.02	p <.05
7. abnormal salivary flow	5	13%	8	50%	0.00	p <.01

Table IV Comparison of the Presence of Oral Conditions in Children with an ASD ages 2.5-5.0 with Children with an ASD ages 9.0-21.0
(There were no participants between the ages or 5.1 and 8.11)

Oral Condition Present	Ages 2.5 to 5.0 (n=10)		Ages 9.0-21.0 (n=29)		Chi-square	Probability
	Frequency	Percent	Frequency	Percent		
1. oral defensiveness	7	70%	12	41%	2.44	
2. malocclusion	5	50%	16	55%	.08	
					Fisher's p-value	
. 1. plaque	8	80%	25	86%	.64	
2. gingivitis	1	10%	23	79%	.00	p <.01
3. visible caries	3	30%	5	17%	.16	
4. restorations	1	10%	5	17%	.55	
5. bruxism	10	100%	7	24%	.00	p <.01
6. delayed eruption	0	0%	2	7%	1.00	
7. oral infections	0	0%	0	0%		
8. developmental anomalies	0	0%	0	0%		
9. oral injuries	1	10%	9	31%	.18	
10. abnormal salivary flow	1	10%	4	14%	1.00	

When comparing the children based on type of residency, a statistically significant difference was detected with the presence of gingivitis and bruxism. Chi-square and p-values from Fisher's exact test of significance for each oral condition are presented in Table II. Fisher's exact test of significance indicated that children of the residential school had significantly more gingivitis than children who resided with their parents. In contrast, children who lived with their parents or guardians manifested more clinical signs of bruxism, X^2 (1, N=39) = 6.88, p<.01. There were no statistically significant differences between children who reside with their parents and those who live at the residential school for the other oral conditions assessed.

Table III shows results for the oral conditions for children with ASD and DD. When children with an ASD were compared to children with another DD, the latter had significantly more oral injuries, X^2 (1, N=55) = 6.66 p<.01, developmental anomalies (Fisher's p-value=.02), and abnormal salivary flow (Fisher's p-value=.00) than children with an ASD. None of the other oral conditions were found to be statistically significant between children with an ASD and those with another DD.

Children with an ASD were compared according to 2 age groups (See Table IV). Older children (ages 9.0 to 21.0) demonstrated significantly more gingivitis than the younger group (ages 2.6 to 5.0). In contrast, the younger age group showed more clinical signs of bruxism than the older children. None of the other oral condition differences were found to be statistically significant between the 2 age groups.

In addition to analyses found in the tables, frequencies associated with the levels of oral defensiveness are presented below. Of the participants with as ASD, 49% were orally defensive compared to 50% of children with other DD. Three participants with an ASD displayed aggressive behaviors toward the dental hygienists either by hitting, biting, pinching, or grabbing for the dental hygienist's eyeglasses.

Limitations and Conclusion

The use of a nonprobability sample limits the generalizability of the results of this study. Because of confidentiality and child protection laws, it is difficult to obtain a representative sample of individuals with an autism spectrum disorder (ASD); therefore, a convenience sample was used. Other limitations are the relatively small number of participants involved in the study and unequal size of the subgroups. Also, the categories of age and residence were not independent of each other. Caution is required in the interpretation of the individual chi-square analyses because as the number of nonindependent tests of significance increases, so does the probability of obtaining one or more Type I errors.[22] Evaluator bias must be

considered, even though steps were taken to establish interrater reliability. Lack of an intense overhead dental light and improper participant positioning made it difficult to see surfaces of some teeth. Ideally, oral assessments should be conducted with the patient reclined in a dental chair while using adequate lighting.

This study showed that with the exception of bruxism and gingivitis, there was not a significant difference in the oral health status of children with an ASD when comparing younger children to older children or when comparing children with an ASD who resided with their parents to those who lived at the residential school. Younger children who resided with their parents showed signs of bruxism significantly more and older children of the residential school had significantly more gingivitis than their comparison groups. Since few older children with an ASD showed signs of bruxism, young age rather than ASD may be the factor associated with bruxism. Many parents of children with an ASD express concern about their child's bruxism, yet bruxism is common in 13 to 26% of all children.[23] Additional studies are needed to investigate whether bruxism is a unique problem for children with an ASD. It is not surprising to find a significantly higher incidence of gingivitis in older children who lived at the residential school. Heavy plaque accumulation and hormonal influences are likely explanations for the high occurrence of gingivitis in this group. Moreover, children of the residential school may have inadequate oral care skills or may rely on caregivers who are unskilled in providing oral care to others, resulting in excessive plaque accumulation and subsequent gingivitis. Of concern, are the consequences of developing dental diseases as a result of constant plaque accumulation over time.

Considering the high incidence of oral defensiveness, one would expect the large amount of plaque accumulation found in children with an ASD. The presence of plaque was consistently high for all groups assessed. The risk of developing oral disease is increased when children resist daily oral hygiene as well as professional oral care procedures. Interestingly, the presence of caries in the participants was slightly lower than what is reported for children without disabilities in the Surgeon General's Report. According to *Oral Health in America*, over 50% of all 5.0-to-9.0-year-old children in the US have at least one cavity or filling.1 Since it is unknown whether this sample is representative of the population of children with an ASD, further investigation into the caries rate of children with an ASD is warranted. Oral infections, other than gingivitis, and developmental anomalies were not reported for any children with an ASD.

Oral conditions were similar when children with an ASD were compared to those with another developmental disability (DD), except when oral injuries, developmental anomalies, and salivary flow were considered. Children diagnosed with a DD, other than ASD, had significantly more oral injuries, developmental anomalies, and abnormal salivary flow than the children diagnosed with an ASD.

Oral defensiveness appeared to occur slightly less often in older children with an ASD, with approximately 60% meeting the criteria for compliance compared to only 30% of the children in the younger group with an ASD. No single behavior management approach was effective with all of the children. Most children appeared to understand that they were expected to open their mouth when the tooth brush was presented as a stimulus. Very few children were willing or able to hold their mouth open long enough for any procedure other than a simple visual inspection. The behavior and cooperation needed to complete the oral assessment cannot be compared to that required for intraoral procedures involving sharp dental instruments. Although the researchers were able to score most of the children on all oral conditions, it cannot be assumed that any intraoral procedure using dental instruments would be feasible without behavioral intervention, sedation, or restraint.

At the time of this study, no national studies had been conducted to determine the prevalence of oral and craniofacial diseases among the various populations with disabilities and studies of the oral health needs of subgroups within the disabled population were lacking.1 Existing publications report data for various populations with disabilities, but it is difficult to generalize findings to the various subgroups because of the heterogeneous nature of the population. Moreover, little is written about the oral status of children with an ASD. Additional studies are needed to expand the data base and determine whether children with an ASD are living with compromised oral health. The oral health status of children with an ASD needs further investigation to determine how they compare to other populations including typically developing agemates.

Evidence-based behavioral management approaches for children with ASD need to be developed to improve compliance with oral care procedures so parents, caregivers, and oral health care providers will have more efficient ways to promote oral health in children with an ASD. Institutes of dental and dental hygiene education can play an integral role in increasing

access to care for this population. In addition to conducting research and providing services to individuals with an ASD, it is the responsibility of dental and dental hygiene schools to adequately prepare their graduates to meet the needs of children with ASD. Mandating educational preparation in dental and dental hygiene programs through accreditation standards may help alleviate the perceived lack of preparation future dentists and dental hygienists have in the treatment of special needs individuals.

Appendix A

Appendix A
Evaluation Criteria for Scoring Oral Conditions

Condition	Scoring	Criteria
Plaque	0= no visible plaque 1= visible plaque (Silness & Loe PI 2) 10= UNC abundance of soft matter (Silness & Loe PI 3) Teeth assessed: anterior teeth only	Assessment of extent and thickness of plaque. Use of Silness & Loe Plaque Index: Yes= (PI 2) moderate accumulation of soft deposits within the gingival pocket that can be seen with the naked eye on the tooth or gingival margin. UNC= (PI 3) abundance of soft matter within the gingival pocket and/or on the tooth and gingival margin.
Gingival	0= no visible gingivitis 1= visible gingivitis 2= hyperplasia involving one or more teeth where tissue covers cervical 1/3 10= UNC spontaneous bleeding	Assessment of presence of gingivitis based on color, consistency, size/contour, and bleeding.
Caries	0= no visible cavitated lesions 1= suspicious cavitated lesion 10= UNC lesion .5mm or larger	Assessment of the integrity of enamel.
Restorations	0= no visible restorations 1= visible restorations	Assessment of past restorative care.
Bruxism	0= no visible attrition 1= visible attrition 10= UNC pulp visible	Assessment of enamel status as related to grinding.
Malocclusion	1= normal 2= Class II Division 1 Class II Division 2 3= Class III 4= Crowding 5= Crossbite 10= UNC malocclusion causing tooth fracture or potential for impaired chewing	Assessment of occlusion based on Angle's Classification of Occlusion. Patients may be scored in more than one category.
Delayed eruption/Missing teeth	0= WNL 1= anterior involvement 2= posterior involvement 10= UNC retained deciduous teeth, contributing to malocclusion	Assessment of the eruption patterns and presence of teeth.

Appendix A part 2

Infections	0= none 1= yes 10= UNC abscesses, yeast	Assessment of the mouth for infections involving teeth and soft tissues.
Developmental anomalies	0= none 1= yes 10= i.e. enamel dysplasia, anadontia, supernumerary teeth, microdontia, hypodontia, fusion, gemination, amelogenesis imperfecta, others.	Assessment of the development of oral structures.
Salivary flow	0= normal 1= excess 2= dry 3= mucous	Assessment of the quality and quantity of saliva.
Oral Injuries	0= none 1= soft tissues 2= teeth 10= UNC apparent recent or acute injuries	Assessment of the mouth for injuries to the teeth and soft tissues. Oral injuries are operationally defined as any soft tissue lesion resulting from injury (accidental or SIB) OR tooth fractures as confirmed by the caregiver or parent.
Oral defensiveness	0= opens willingly, allows clinician to lift lip, allows mirror insertion all with verbal instruction 1= opens willingly, allows clinician to lift lip, allows mirror insertion with prompt 2= opens and allows clinician to lift lip, but does not allow mirror insertion 3= opens only 4= allows clinician to lift lip only 5= shows anterior teeth only 6= refuses passively 7= refuses aggressively	Assessment of the patient's acceptance of the oral assessment. Participants were not considered to be orally defensive if they willingly opened their mouth and allowed for the insertion of the mouth mirror (scores 0 & 1). Participants were considered to be orally defensive if they did not willingly open and allow for the insertion of the mouth mirror (scores 2-7).

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Notes

Correspondence to: Charla Lautar, RDH, PhD at cjlautar@siu.edu .

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