

Analysis of Risk Factors in Children with Autism Spectrum Disorders in the Ukraine Associated with Early Childhood Caries

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Abstract

The number of children with ASD is growing in Ukraine. At the same time, the prevalence of caries in children under 6 years of age is increasing every year. There is no consensus in the scientific literature on the potential relationship between ASD, ECC in children and related factors. The main purpose is to study and evaluate the risk factors for ECC in children with ASD.

92 children aged 5 to 6 years were under observation. The main group included 69 children with ASD, and the control group included 23 healthy children without ASD. The study was conducted by using a questionnaire of parents' sanitary and hygienic knowledge and assessing children's manual skills. The hygiene index of Yu. A. Fedorov and V.V. Volodkina was used to assess the quality of oral hygiene in children aged 5-6 years. The state of the acid-base balance of mixed saliva was assessed using the pH index and for this purpose, test strips with a graduated scale of 5.2 - 7.4 (ISO 13485) were used.

We found that the oral hygiene was maintained twice a day only in 33.33% of children in the main group with ASD. The average value of the hygiene index in children of the main group with ASD is 2.70 ± 0.13 points, which indicates poor hygiene. In children with ASD pH of the oral fluid averaged 5.96 ± 0.07 and it was interpreted as slightly acidic.

Based on the on the results above, the sanitary and hygienic behavior, the nature of nutrition, food preferences, and the quality of hygienic care analyzed in this study are directly related to the development of ECC in children 5-6 years old with ASD and are the important risk factors. In addition, risk factors in children with and without ASD differ and are elevated in children with the autistic spectrum. Thus, nutrition correction and the development of preventive oral hygiene programs are considered especially important for children with ASD.

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Introduction

In the last decades, a large increase in the prevalence of ASD has been observed, generating claims about an "epidemic" of autism^{1 2}. WHO estimated that worldwide, 1 in 160 children has an ASD with an incidence rate of 6.25 per 100,000.00 people. This mental

anomaly affects all ethnic groups and socio-economic levels and is constantly increasing every year in the world, including Ukraine. It has been observed the increases in the number of children with ASD annually in Ukraine (ranging from 28.2 to 35.7% every year)^{3 4}. We assume that the official data do not reflect the true picture of morbidity due to the difficulties of ASD diagnostics in Ukraine^{5 6}. Along with this, according to statistics, the prevalence of caries in children under 6 years of age (inclusive) is growing every year^{7 8 9}. The term "early childhood caries" (ECC) describes such a condition as "the presence of one or more carious, removed (due to caries) or sealed surfaces of the crown of any temporary tooth in a

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child from birth to 71 months" ^{9 10 11}.

There is no consensus in the academic literature regarding the potential association between ASD, ECC in children and related factors, as studies show conflicting results ^{8 12 13}. Possible causes of the varying intensity and prevalence of ECC in children include congenital and social factors, behaviors, eating habits, oral hygiene, and differences in the saliva composition of children with ASD. The fact is that ECC remains an important oral health problem in children with ASD, since its prevalence in this population ranges from 91.3% at an intensity of 5.86 ± 0.56 ¹⁴ to 100% at an intensity of 7.57 ± 0.44 ¹⁰.

Factors such as socio-economic status, educational level of parents or guardians, access to dental services, type of disability, behaviors, eating habits, orthodontic abnormalities and increased sensory sensitivity can make children more susceptible to tooth decay that's why children with ASD are in a vulnerable and unprotected group due to the complexity of their condition.

The aim of the study was to determine and evaluate the risk factors for ECC in children with ASD.

Materials and methods

According to the WHO method, the age of 5-6 years is one of the key ages for studying dental diseases ¹⁴. In Ukraine, 92 children aged 5 to 6 years were under observation, the average age of the examined children was 65.52 ± 2.53 months (approx. 5 years 5 months). The main group included 69 children with ASD, and the control group included 23 healthy children without ASD. In the main group of examined children with ASD, boys prevailed - 58 (84.06%), girls were 5.3 times less - 11 (15.94%), and that is, the ratio of girls to boys was 1:5.3. The gender distribution in the control group of children without ASD was equal.

The diagnosis of the children was established on the basis of the inpatient examination card or the conclusion of the chief pediatric psychiatrist of the Ministry of Health of Ukraine. All parents/guardians signed an informed consent in accordance with the Helsinki Declaration ¹³. The examination of children was performed on the basis of the municipal non-profit enterprise "Children's Consultative and

Diagnostic Center of the Darnytskyi district of Kiev" and the Department of Pediatric Therapeutic Dentistry of the private higher educational institution "Kiev Medical University". A "Dental patient's medical card" (Form No. 043/o) was issued for each child.

To assess the sanitary and hygienic knowledge of parents and manual skills of 69 children with ASD and 23 children without these conditions, respectively, a questionnaire was introduced. The questionnaire included 26 questions that helped to find out how children brush their teeth (independently, under the supervision of parents / caregivers or parents / caregivers brush their teeth, the number of cleanses per day, whether they rinse their mouth, whether they use additional hygiene products after eating, chewing gum, toothpicks, floss). In addition, the focus was on the model of eating behavior; in particular, nutrition-related issues such as diet, type of diet, dietary preferences (eating habits and specific foods).

The hygiene index of Yu. A. Fedorov and V.V. Volodkina was used to assess the quality of oral hygiene in children aged 5-6 years ¹⁰. To preparation of iodine with a socket, the methodology is used vestibular surface of 43, 42, 41, 31, 32, 33 teeth. The area of the painted surface is estimated in points: 1 – lack of color; 2 – the color of 1/4 of the tooth crown (or 25% of the crown surface); 3 – the color of 1/2 of the tooth crown (or 50% of the crown surface); 4 – staining 3/4 of the tooth crown (or 75% of the crown surface); 5 – staining the entire crown surface the tooth (or 100% of the crown surface). To calculate the hygiene index, the scores are summed up and then divided by the number of teeth examined (6). Interpretation of the results: 1.1-1.5 points – good level; 1.6-2.0 points – satisfactory level; 2.1-2.5 points – unsatisfactory level; 2.6-3.4 points – bad level; 3.5-5.0 points – very bad level of hygiene.

Saliva is a multi-layered secretion. The quality of saliva is just as crucial as the quantity. Saliva is necessary for preserving the integrity of oral structures, personal connections, digestion, and acid–base balance. The acid–base balance in one's oral environment is always being challenged. It happens every time we eat a meal, and when microorganisms are present. At a pH of 5 or 5.5, the demineralization of the enamel and hard tooth structures occurs ¹³.

The state of the acid-base balance of

mixed saliva was assessed using the pH index, which is a standard criterion for ongoing biochemical processes in the oral cavity and helps to identify the formation of dental deposits, as well as the re- and demineralization of enamel. For this purpose, test strips with a graduated scale of 5.2 - 7.4 (ISO 13485) were used.

Results

From our cohort 36 children (52.17%) of the main group with ASD attended the educational and correctional preschool kindergarten "Child with a future" in Kiev, and 23 children (100%) of the control group without ASD attended to the kindergarten, i.e. they were placed in a specialized institution. For the main group with ASD, 33 children (47.83%) were treated at home, i.e. they were not institutionalized.

The term "eating behavior" is used to denote a set of eating habits. Eating behavior can be normal or pathological. The results of a questionnaire survey of parents regarding the eating behavior of their children of the main group with ASD and the control group without ASD are presented in Table 1.

	Children with ACD ,the main group, n=69		Children without ACD control group, n=23	
	Absolute	%	Absolute	%
The eating regimen:				
support	50	72.46	21	91.30
not support	19	27.53	2	8.70
Types of eating behavior:				
normal (chewing, swallowing)	63	91.30	23	100
delayed (chewing, holding the cheek)	6	8.70	0	0
Food preferences:				
sweet	63	91.30	16	69.57
soft	44	63.77	8	34.78
sticky	38	55.07	2	8.70
Food preferences:				
chocolate	19	27.54	12	52.17
lollipops	6	8.70	9	39.13
cookies	25	36.23	4	17.39
non-carbonated drinks	57	82.61	19	82.61
Eating sweets between meals	67	97.10	18	78.26
Consumption of cow's milk:				
Every day	2	2.90	16	69.57
Not every day	50	72.46	4	17.39
Never	17	24.64	3	13.04
Eating fruits:				
Every day	5	7.25	21	91.30
Not every day	47	68.12	2	8.70
Never	17	24.63	0	0
Eating vegetables:				
Every day	5	7.25	21	91.30
Not every day	47	68.12	2	8.70
Never	17	24.63	0	0

Table 1. Results of the questioning on eating behavior of children with ASD.

Parents of the main group of children with ASD (27.53%) were less likely to follow their children's diet compared with 8.70% of parents of the control group of children without ASD, respectively; that is, children with ASD are more

likely to eat 3.16 times more from time to time. All children of the control group without ASD (100%) had a normal type of eating behavior, i.e. they chewed and swallowed food. 8.70% of children with ASD had a delayed type of food intake, i.e. chewing and holding food in the cheek, and 91.30% of children with ASD had a normal type of eating behavior, chewing and swallowing food.

Children of the main group with ASD preferred sweet foods that provoke caries 1.31 times more often (91.30%) than children of the control group without ASD (69.57%). The consumption of soft, processed foods was observed in children with ASD 1.83 times more often (63.77%) than in children without ASD (34.78%), which led to the formation and accumulation of dental deposits. Sticky food remaining on the teeth and causing fermentation with subsequent rotting was chosen by children of the main group with ASD 6.33 times more often (55.07%) than children without ASD (8.70%). Children of the control group without ASD consumed chocolate 1.89 times more often (52.17%) than children of the main group with ASD (27.54%), sucked sweets 4.50 times more often (39.13%) than children with ASD (8.70%).

Children with ASD are 2.08 times (36.23%) more likely to eat cookies than children without ASD (17.39%). The cariogenic situation in the oral cavity in children of both groups is also created by taking sugar-containing non-carbonated drinks in large quantities during the day (82.61%). Almost all children of the main group with ASD (97.10%) similarly prefer sweet foods as a snack between meals, unlike children of the control group without ASD (78.26%).

The high content of calcium in milk (12 mg%) and other components that inhibit the microorganisms (microbiota) of the oral cavity causes of the caries preventive effect of milk, preventing the demineralization of enamel.

Children of the main group with ASD consumed cow's milk 23.99 times less daily (2.90%) than children of the control group without ASD (69.57%). In most cases (72.46%), children with ASD did not drink cow's milk every day. This can probably be explained by the fact that many parents of children with ASD adhere to a casein-free and gluten-free diet of their children.

The majority of children in the control group without ASD consumed fruits and vegetables every day (91.30%), children in the main group with ASD did not consume them

every day (68.12%). To prevent plaque formation, it is recommended to supplement meals with fruits or raw vegetables rich in fiber, which perform the function of a natural toothbrush.

The results of the assessment of manual oral care skills of children of the main and control groups are presented in Table 2.

Oral hygiene skills	Number of children, n=56		Quality of oral hygiene		Healthy children, points	p _i
	Absolute	%	ASD children, points	Number of children, n=42		
brushing by parents / caregivers, total	19	27.54	1.77±0.04	—	—	—
twice a day	9	13.04				
once a day	9	13.04				
irregularly	1	1.45				
brushing under the supervision of parents / caregivers, total	21	30.43	2.18±0.08	—	—	—
twice a day	8	11.59				
once a day	11	15.94				
irregularly	2	2.90				
independent brushing, total	29	42.03	3.68±0.10	23	100	1.91±0.08
twice a day	6	8.70				
once a day	14	20.29				
irregularly	9	13.04				
Total	69	100	2.70±0.13	23	100	1.91±0.08
p ₁			0.230			—
p ₂			0.624			—
p ₃			0.714			—

Table 2. Hygiene quality of 5-6 year olds with ASD compared to healthy children (M ± m), Determined by the hygiene index.

Children of the control group without ASD brushed their teeth on their own twice a day in 100% of cases (Table 2). Oral hygiene was performed twice a day only in 33.33% of children in the main group with ASD; once a day - in 49.28%. Only 17.39% of parents of children did not regularly brush their teeth. Most parents of children with ASD did not follow the recommendations of pediatric dentists and 71.01% of children brushed their teeth before breakfast. Similarly, according to parents, by the evening, children's sensory sensitivity increases, as a result, serious behavioral difficulties arise, and only 33.33% of the children are able to brush his teeth after dinner. In the survey, parents of 91.30% of children with ASD and 34.78% of children without ASD noted that their children do not rinse their mouths after eating and eating sweets. All parents interviewed confirmed that their children, both with and without ASD, do not use additional hygiene products.

Unfortunately, children with developmental disabilities can be noncompliant with health care procedures. Successful clinical examination on the first attempt was achieved in 19 (27.5%) children of the main group with ASD, in 22 (31.88%) – on the second attempt, the remaining 28 children (40.58%) – it took more than three attempts. In children of the control group without ASD, a successful clinical

examination on the first attempt was achieved in 95.65%.

Assessing the hygienic condition of the oral cavity in points, we found that the average value of the hygiene index in children of the main group with ASD is 2.70±0.13 points, which indicates poor hygiene, in children of the control group without ASD - 1.91±0.08 points, which corresponds to a satisfactory state of oral hygiene. Unlike the children of the control group without ASD, one in four children of the main group with ASD had their oral cavity cared for by their parents (Table 2). The highest values of the oral hygiene index (3.68±0.10 points) were found in children of the main group with ASD who brushed their teeth on their own, and corresponded to a very poor oral condition (Fig. 1).



Figure 1. Child A.P., 5 years old, ASD. Determination of the quality of oral hygiene according to the index of Yu.A. Fedorov, V.V. Volodkina. Hygiene Index (5+4+3+3+4+5)/6=24/6=4 points. Interpretation of the results: very poor oral hygiene.

In children who brushed their teeth under the supervision of parents and/or guardians (hygiene index = 2.18±0.08 points), an unsatisfactory condition of the oral cavity was noted. Lower hygiene index values were found in children whose teeth were cleaned by parents/guardians (1.77±0.04 points), which corresponded to a satisfactory oral cavity condition. Thus, children with ASD are similarly heavily dependent on parents/guardians who take care of their oral hygiene and play a key role in forming positive attitudes and habits regarding oral health. The children of the control group

without ASD brushed their teeth on their own (hygiene index = 1.91 ± 0.08 points), which corresponded to a satisfactory condition of the oral cavity.

Saliva has a pH normal range of 6.2-7.6 with 6.7 being the average pH. Resting pH of mouth does not fall below 6.3. In the oral cavity, the pH is maintained near neutrality (6.7-7.3) by saliva.

Analysis of the main indicator of oral fluid homeostasis - pH - showed that the concentration of H^+ in the mixed saliva of children of the main group with ASD and the control group without ASD was within wide limits (Table 3): from acidic to alkaline (5.0–7.5).

In children with ASD, the pH of the oral fluid averaged 5.96 ± 0.07 and was interpreted as slightly acidic; in children without ASD, it averaged 6.76 ± 0.09 - neutral, which corresponded to the normal state (Table 3).

Groups	Children with ASD the main group	Children without ASD control group
Number of children examined, n	69	23
pH value	5.96 ± 0.07	6.76 ± 0.09

Table 3. Saliva pH value in the study groups (the average).

Discussion

There is no data on the impact of ASD on oral health, as well as factors associated with the occurrence of ECC in children with ASD, evaluated in this study.

The risk factors for the development of dental caries in children with ASD were studied, in particular, the level of sanitary and hygienic knowledge and manual skills of children, their eating behavior, oral hygiene, pH of mixed saliva.

Children 5-6 years old of the main group with ASD showed poor oral hygiene (2.70 ± 0.13 points) compared with children of the control group of the same age without ASD (1.91 ± 0.08 points). The highest hygiene index values (3.68 ± 0.10 points) were found in children of the main group with ASD who brushed their teeth on their own, which corresponded to a very poor state of oral hygiene. Children aged younger than 6 years still had limited skills for toothbrushing. As a result, without toothbrushing assistance from adults, they were not able to completely remove plaque on their teeth, and thus increased the risk of developing dental caries ¹⁵.

In our study, it was found that in children of the main group with ASD, the pH value of the oral fluid is shifted to the acidic side, which similarly affects the processes of enamel demineralization ($p=0.007$) ⁸.

In some children with ASD, sweet foods are often given as behavioral rewards ¹⁵. Furthermore, restricting children with ASD from sugar consumption may become another challenge for parents/carer as children with ASD have a strong affinity for sweets ¹⁶. Various nutritional problems such as pickiness, preferences for specific foods, delayed eating behavior, keeping food in the mouth and refusing to eat it, daily consumption of sweet, soft and sticky foods, non-carbonated sugary drinks (juices, compotes, sweet tea) between main meals lead to an increased risk of developing caries in children with ASD. Around 51% of the autism kids had snack between the meal time for more than twice a day and did not do any cleaning strategy such as drink water or brushing after eating the snack. Snacking frequency was significantly associated with increased number of teeth experiencing caries with pulp involvement or more severe conditions ¹⁵.

Autism kids who brushed once a day or less had a double chance to have more severe caries than their counterparts who brushed twice a day or more ¹⁵. Due to the fact that 71.01% of children in the main group with ASD similarly brush their teeth before breakfast and do not caress their mouths, food residues remain in their mouths throughout the day and cause a slightly acidic reaction of the oral fluid. And the fact that in the evening children with ASD have serious behavioral difficulties, and 66.67% do not brush their teeth after dinner, leftovers and plaque remain in the mouth until morning, which is one of the main triggers of enamel demineralization and the development of early dental caries in children. One of the factors that influenced the high prevalence of caries in children with autism was their parent/carer. The data showed that most of the parent/carer tended to let their children brushed their teeth according to their child's willingness ¹⁵.

However, proper oral hygiene practices are extremely difficult for many children with ASD. 4 Children with ASD were known to have a physical impairment that usually prevents them to do self-oral hygiene practices, including toothbrushing. They may require extensive

training or assistance from their parents/carer to perform it and to make it as a daily routine habit. For parents/carer, the efforts to help children with ASD adopting proper oral hygiene practices can be stressful with regard to the time and energy required¹⁷.

The autism kids who participated in this study were mainly in the mild category of autism; thus, the results could not be generalized for the whole children with autism.

Conclusions

Based on the above results, the sanitary and hygienic behavior, the nature of nutrition, food preferences, and the quality of hygienic care analyzed in this study are directly related to the development of ECC in children 5-6 years old with ASD and are the important risk factors. In addition, risk factors in children with and without ASD differ and are elevated in children with the autistic spectrum.

Thus, nutrition correction and the development of preventive oral hygiene programs are considered especially important for children with ASD.

Declaration of Interest

The authors report no conflict of interest.

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