

# Associations between Diet, Dietary and Oral Hygiene Habits with Caries Occurrence and Severity in Children with Autism at Dammam City, Saudi Arabia

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## Abstract

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**AIM:** The purpose of the study is to achieve the baseline information of the autistic child's oral health status about the diet, dietary and hygiene habits. The association of these factors with dental caries were assessed.

**MATERIAL AND METHODS:** The survey was composed of self-administered questionnaires to parents about their children's' demographic data followed by questions related to diet, dietary and hygiene habits. This is later followed by oral examination for estimating the decayed, missing and filled [dmft] scores as per WHO norms. The variables are analysed using t-tests and ANOVA. Pearson's correlation coefficients were calculated for each of the independent variables to examine for autocorrelation.

**RESULTS:** The mean age for the present study is 5.8 years with more predilections of caries in females. The autistic children prefer soft diet and pouch it in oral cavity resulting in increased caries though not significant. Other foods like nuts and pulses confectioneries and soft drinks resulted in increased caries, and our study shows significant relation. Consumption of sugars between meals and increased quantity of sugar per day also increased dental caries with highly significant results in our study. Hygiene habits also made a difference in the occurrence of caries though, in our study, it's not significant.

**CONCLUSIONS:** The study suggests that the oral health education programs should be conducted for the parents, caregivers and the teachers about the diet, dietary and the hygiene habits and the role they play in maintaining the oral hygiene.

## Introduction

Autism or autistic disorder is a serious epoch of life due to developmental disability which after a profound examination medically, psychologically and neurologically, four definitive criteria were to be fulfilled [1] [2].

1. Severe abnormality in social interaction;
2. Severe abnormality in communication skills even in most frequently speaking language;
3. Very confined, monotonous and stereotyped pattern in his/her behaviour; and

4. Starts very early (before the age of 3 years).

Autistic children are unique in their diet pattern, dietary habits and their hygiene habits leading to a compromised intraoral condition. When diet and oral health is considered, Moynihan stated that "Good diet is essential for the development and maintenance of healthy teeth, but healthy teeth are important in enabling the consumption of a varied and healthy diet throughout the life cycle," thus highlighting the reciprocal relationship between diet and oral health [3]. Parental and informal clinical reports, alongside with a few research investigations, it gives us a hint that children with autism have bizarre dietary patterns [4] [5] [6]. These are regularly depicted as excessively

particular, with antipathies for particular textures, colours, smells, and temperatures and stubborn for particular brands of foods [4].

These children in their daily routine are provided with food rewards mostly in the form of sweets. Restricted diet for these children by making them eat limited types of food or in specific the physician recommended diet like the gluten/casein-free or partially g-tube fed or low acid diet [7] [8] [9] [10].

Different people incline towards foods in their daily life, so there is a part of the individual variation in their dietary habits. These habits play a very consequential role in dental caries with conflicting results from the previous studies. Like for example, the intake of sugar plays a very significant role in dental caries (Gustaffson et al. 1954, Nizel and Papas, 1989; Rugg-Gunn 1989) was confirmed long back. But several procedural imperfections built in these studies make it hard to confirm a convinced association between dietary habits and dental caries (Screenby, 1975; Newbrun, 1982) [11]. But its role cannot be taken trivially from the recent studies [12] [13] where it is proved that dietary habits take a very important role.

Oral hygiene practices are voluntary physical activities that have at least two requirements: motivation and manual dexterity [14]. Thus, increase in dental caries would be more in children who are physically or mentally challenged individuals [15]. Like in this study autistic children were taken into consideration to find any association between diet, dietary and hygiene habits with the occurrence of dental caries.

Dental caries is a disorder with a combination of factors, and it is arduous to correlate all these factors at the same time. There have been no studies documented in literature in this part of Saudi Arabia estimating the occurrence of dental caries about a specific diet, dietary and hygiene habits in autistic children. So an attempt was made to correlate these factors in children who have autism in Dammam city. A cross-sectional study was designed for the parents to answer the questionnaire and correlated each of them with the prevalence of dental caries.

The purpose of the study is to assess the association of diet, dietary, and hygiene habits with the occurrence of dental caries.

## Material and Methods

After getting this study approved by the institutional review board (IRB), Riyadh Colleges of Dentistry and Pharmacy (Riyadh Elm University), an official letter from the College Board was used for

further study in autistic schools in Dammam city, Saudi Arabia. The study was conducted in two steps. Firstly answering the questionnaire by the parent and later oral examination of the child. The sample for our study was taken from three special schools for autistic children in Dammam city, Saudi Arabia.

### Study Instrument

The self-administered questionnaire combined from previously reported researchers [12][13] gathering information about the close-ended questions into four parts as demographic characteristics (age, gender, educational level and income of the parents) followed by 18 questions related to diet (6 question), dietary habits (6 question) and hygiene habits (6 questions).

The consumption of specific diet related to dental caries was evaluated and was assessed with this structured questionnaire. This part of the questionnaire was focused on the consumption of soft diet, confectionaries, soft drinks, nuts and pulses, fruits and vegetables. The response options were regular or occasional. The dietary habits included food rewards, recommended diet, and frequency of sugar intake, fast food and snacks. Oral hygiene habits included here are whether the child brush or not, brushing and the ease of difficulty for the parent. The questionnaire also includes the frequency of dental visit and the reason for their visit. Also asked about by whom the children get their teeth brushed (mother/child himself/caregiver/sibling).

To avoid irrelevant answers by the patients who were not well acquainted with English, an English-Arabic rendition of the survey was defined. The idea of rewording was to obtain an instrument with theoretical similarity. The first English survey was converted into Arabic dialect by a bilingual local Arabic speaker and from that point indiscriminately back-interpreted by another bilingual local Arabic speaker. Through these thorough cycles of interpretation and back interpretation, after getting convinced that the actual meaning of the survey was maintained. A pilot contemplates completed utilising this bilingual instrument to guarantee identicalness, clearness, and understanding. This was done according to Kotha SB et al., [16].

To reduce the bias in answering the questionnaire by the parents, the third person (teacher) distributed and made them answer away from the dentist [17].

### Oral examination

The children with Autism were examined at special schools, seated on a comfortable chair, under natural light using sterile portable equipment which included mouth mirror, explorer and cotton pellets. Tell-Show-Do (TSD) technique was used to manage

these children.

Examination of the oral cavity for dmft for the patients was done according to World Health Organization caries diagnostic criteria [18]. The two examiners were selected to examine the children and the method followed was according to that done by Kotha SB et al., [16].

### Data collection and statistical analysis

After a brief description of the study to the mothers, they were given two days' time to answer the self-administered questionnaire about diet, dietary and hygiene habits of their autistic children. After getting approval from the parent, it was followed by an oral examination of the child. The data were analysed statistically using SPSS software SPSS 16.0 (SPSS, Inc., Chicago, IL, USA). The variables are analyzed using t-tests and ANOVA. Pearson's correlation coefficients were calculated for each of the independent variables to examine for autocorrelation.

## Results

The mean age for the present study is 5.8 years with almost an equal distribution among males and females where in which the females (4.55) found to have more caries in comparison to males (3.42) though not statistically significant. The results of other factors like the mother's ( $P = 0.346$ ) and father's ( $P = 0.679$ ) education about dental caries found to be not significant. The caries occurrence is reduced in the group where the parents have a better education. The income of the family (ANOVA) also showed no significance ( $P = 0.816$ ) though it was found that caries is more in low-income group (Table 1).

**Table 1: Sociodemographic characteristics in relation to dental caries**

S. No	Demographic data	Groups	dmfs		t	p-value
			Mean	S.D		
Gender		Male	3.42	3.044	-1.142	0.258
		Female	4.55	2.505		
Mother's education		School	4.00	3.433	0.944	0.346
		Graduation and more	3.28	2.479		
Father's education		School	3.85	3.619	0.416	0.679
		Graduation and more	3.52	2.476		
Income		<5000	4.00	4.472	0.204	0.816
		5000-10000	3.69	2.681		
		10000 and above	3.25	2.745		

### Dietary preferences and dental caries

It was observed that autistic children preferred soft diet making them more susceptible to caries though not statistically significant ( $P = 0.7$ ). Regular consumption of confectionaries increases dental caries (5.08) than children who take them occasionally (1.38) and which seems to be highly significant

between two groups with  $P = 0.000$ . Similar results are also observed in children who regularly drink soft drinks (5.39) than children who take them occasionally (2.12) with a  $P$  value of 0.000. When comparing the other food groups like nuts and pulses, there is a significant correlation between regular (5.09) and occasional consumption (2.74) groups, and it was found to be significant ( $P < 0.05$ ). Other healthy foods included in our study are fruits and vegetables where in which the caries is increased in children who consume these occasionally compared to a group having it regularly. The results are not significant. These results conclude that regular intake of confectionaries, soft drinks, and nuts and pulses increase the occurrence of dental caries (Table 2).

**Table 2: Diet preferences in relation to dental caries**

S. No	Dietary preferences	Groups	dmft		t	p-value
			Mean	S.D		
1	Soft diet	Yes	3.80	2.72	0.323	0.748
		No	3.54	3.10		
2	Confectioneries	Regularly	5.08	2.69	5.994	0.000
		Occasionally	1.38	1.71		
3	Nuts and pulses	Regularly	5.09	2.85	3.224	0.002
		Occasionally	2.74	2.69		
4	Soft drinks	Regularly	5.39	2.98	5.111	0.000
		Occasionally	2.12	1.98		
5	Fruits	Regularly	2.92	2.985	-0.958	0.342
		Occasionally	3.81	2.965		
6	Vegetables	Regularly	3.62	2.879	-0.015	0.998
		Occasionally	3.63	3.235		

### Dietary habits and dental caries

Food rewards for the autistic children are usually in the form of sweets showed increased susceptibility for dental caries which is not significant ( $P = 0.2$ ). The physician recommended a diet in specific for autistic children coincidentally reduce dental caries (3.22) compared to the group not consuming this recommended diet (3.69) though not statistically significant ( $P = 0.6$ ). Sugar intake regarding quantity having two groups in our study, those consuming sugar more than two spoons per day (dmft = 5.5) and less than two spoons per day (dmft = 1.42). The results show that there is high significance ( $P = 0.000$ ). Similar results are seen in children having sugar in between meals (dmft = 5.19) in comparison to the group not having (dmft = 1.90). Though not significant in the study, unhealthy lifestyle practices like frequent snacking ( $P = 0.461$ ), regularly having fast foods ( $P = 0.140$ ) increased dental caries (Table 3).

**Table 3: Dietary habits about dental caries**

S. No	Dietary habits	Groups	dmft		t	p-value
			Mean	S.D		
1	Food rewards	Yes	3.87	3.06	1.207	0.232
		No	2.79	2.51		
2	Recommended diet	Yes	3.22	2.48	-0.436	0.665
		No	3.69	3.05		
3	Sugars/day	> 2 spoons/day	5.05	2.718	5.818	0.000
		1-2 spoons	1.42	1.742		
4	Sugar between meals	Yes	5.19	2.799	5.171	0.000
		No	1.90	2.076		
5	Fast food	Regularly	3.77	3.006	1.495	0.140
		Occasionally	1.50	1.000		
6	Snacking	Regularly	4.00	3.207	0.743	0.461
		Occasionally	3.41	2.844		

**Table 4: Hygiene habits about dental caries**

S. No	Hygiene Habits	Groups	dmft		t	p-value
			Mean	S.D		
1	Brushing method	Brush and Water	3.72	3.611	0.123	0.885
		Mishwak only	4.25	3.096		
		Brush+paste	3.51	2.694		
2	Brushing	Sometimes	4.21	3.620	0.847	0.400
		Regularly	3.45	2.765		
3	Ease of brushing	Difficulty	3.97	2.658	0.449	0.640
		Moderately difficult	3.25	3.138		
		Easy	3.20	4.324		
4	Dental visit	Never	3.63	2.977	1.922	0.136
		If there is a problem	4.41	3.081		
		Occasionally	1.75	1.832		
		Regularly	1.00			

### Hygiene habits and dental caries

Table 4 shows the distribution of parents' responses of how the hygiene habits are maintained of which whether the child is getting brushed regularly or not and the method of brushing about dental caries. The results through ANOVA showed that children using brush and paste (3.51) have fewer caries than compared to other groups who are using either Mishwak (4.25) or brush and water without paste (3.72) to clean the oral cavity. The results shown here in our study are not significant ( $P = 0.8$ ). The group which brushes regularly have reduced caries compared to the group who does irregular brushing though not significant ( $P = 0.4$ ). Regarding ease of difficulty, it is understood that brushing an autistic child is a big task and so there is an increase in caries in this group of children (3.97) in comparison to other groups where the parents who feel brushing is moderately difficult (3.25) or easy (3.20). The results here are not significant ( $P = 0.640$ ).

The results show that only 14.8% of the children were able to brush their teeth on their own, while the remaining 85.2% needed help during tooth brushing. More than half (73.8%) of the children were helped by their mothers in brushing their teeth. 93.4% preferred manual brushing over the use of the electric brush.

**Table 5: Pearson correlation coefficients to assess the association between dental caries with diet, dietary and hygiene habits**

	Diet	Dietary habits	Hygiene habits
dmfs	-0.591*	-0.057	-0.146

Table 5 showed the Pearson correlation to assess the association between the type of diet, dietary and hygiene habits with dental caries resulted in the diet plays a very significant role about dental caries, and it was significant ( $P < 0.05$ ).

## Discussion

The purpose of the study is because, in Saudi Arabia, very little research is being concentrated on

the association of diet, dietary and hygiene habits with dental caries in children with autism. In Saudi Arabia, though autism is more prevalent, the dental care for children with cerebral palsy and Down's syndrome are handled better because these conditions are diagnosed at birth unlike autism where the children are completely normal at birth and is diagnosed later resulting in less direct involvement of the dentists to give instructions and warn about the factors that affect the maintenance of oral hygiene [17].

Before discussing the actual results of the study, the reason for choosing school as the place of study because schools are the best site for the children to cooperate as they are acquainted with this environment, and these children are very dependent on routine and continuity unlike a new place that may evoke a negative behaviour [19].

The caretakers were requested to participate in our study to make the patients open their mouth for oral examination and for some children parental involvement was taken because these children cannot easily make contact with the unfamiliar people. This explained the need for the caretaker and the parent for oral examination [19] [20] [21] [22].

In this study, male predilection is more compared to the females in par with previously reported researches [2] [19] [23] [24] [25] [26] [27] [28] most probably because of high level of fetal testosterone and potential genetic/ chromosomal effects [19] [29].

Numerous researchers demonstrated that various factors are directly responsible for the occurrence of dental caries, but the predictive power of certain factors like mother's and father's education and their income were considered less important. Though the results are not significant (mother's education  $P$ -value = 0.3, father's education  $P$ -value = 0.6) in this study, the parental education plays a very significant role in dental caries. The parent's education helps the children maintain their oral hygiene as they comprehend the significance of good oral habits and so pass on to their children [30]. Parental income is related to a socioeconomic status where the parents of the autistic children with higher income, will have lower dental caries because the parents can provide good facilities to maintain their oral hygiene [23]. The results also showed that children whose parents income is less showed more caries occurrence though not significant ( $P = 0.8$ ).

Studies showed that children with autism prefer specific type of food which made us to select specific dietary preferences (confectionaries, soft drinks, nuts and pulses, fruits and vegetables) mentioned in our questionnaire [31] along with certain dietary habits (food rewards, recommended diet, sugars per day, sugar between meals, fast food and snacking).

It is evident that the autistic children prefer

soft food which increases the incidence of dental caries [32] as they prefer to pouch the food in the oral cavity instead of swallowing due to poor tongue coordination leading to increased occurrence of dental caries [29] [33] [34] have similar results though not significant ( $P$ -value = 0.7) in the present study.

It was observed that the intake of confectionaries and soft drinks regularly increased dental caries as in our study show highly significant relation ( $P$ -value less than 0.001). Children consuming confectionaries four times a day were almost 20 times more chances for the child to develop dental caries [12]. There are various studies supporting the significant relation between caries and soft drinks and are significantly related [12] [35] [36] [37].

The nuts and pulses act bifunctionally about dental caries. These type of foods reduce dental caries because of more fat content (e.g., peanuts) coating the teeth and thus lowers the retention of consumed food. Alternatively, fats may have toxic effects on oral bacteria and thus reduce the sugar solubility [38]. Because of the fibrous content of nuts and pulses increase in saliva production and so the buffering action thereby reduction of caries. The converse results are shown in this study and are significant ( $P$ -value = 0.002) probably nuts rich in starch content, reduces the clearance from the oral cavity and autistic children have the habit of pouching food in the mouth increase the chances of caries [38].

Previous researchers [4] [39] [40] [41] [42] showed that autistic children are very sensitive to bitter taste leading to refusal of certain foods and it could be the potential reason for reduced intake of vegetables in par with our study where 68.9% of the children rejected having vegetables. In contrast, According to Diolordi L et al., [39] fruits are preferred by the autistic children may be because of its texture and sweet taste wherein our study, 78.7% of the children preferred having fruits. About dental caries, previous researchers [13] analysed that fruits/vegetables are having a snack replacing the sugar or sweet reduced dental caries. Similar results were achieved but not significant.

The question asked to the child whether he augments appropriate behaviour with food rewards, 23% of the children approved to reinforce but unfortunately the reward was in the form of sugars/sweets increased dental caries. No significant association ( $P$ -value = 0.2) was found between dental caries and food rewards as in [7] [43].

Diet for the autistic children is restricted like for example gluten and casein because it was incited with a couple of hypotheses is that the aberrant metabolism of these two proteins may develop an excessive opioid activity in the central nervous system, altering its function [44]. The other reason is that if there is an abnormal gut barrier or intestinal permeability, it results in leaking of gluten, casein, and their metabolites into the bloodstream and to the

central nervous system [44]. This combined with the metabolic defect may contribute to developing autistic symptoms. This gives the reason to encourage a gluten-free and casein-free (GFCF) diet for autistic children [44]. According to Avsar et al [45] showed that the regular use of this physician prescribed GFCF diet reduces the occurrence of dental caries which was proved by Acer el in his research that there is low prevalence in the colonization of mutans streptococci (MS) and lactobacillus (LB) [45] and so reduced dental caries. The results of our study show that the caries is reduced in children who are on physician recommended diet but not significant ( $P$  value = 0.6).

Our examination did not research the complexities of what kinds of snacks were consumed in between meals (regardless of whether it contained high starch content). However, this present research has mentioned an objective fact that children who were in the propensity for eating in between meals or increase in sugars intake per day had higher dmft scores. This finding would serve as an imperative contribution to educate the children about evading in-between meals eating behavior. Most children have a tendency to go to fast food centers and eat undesirable snacks in-between meals that are generally high in sugar and fat, as many studies [12] [13] [30] [40] pointed that incessant eating of snack, sugar and cooked starch between meals will enhance chances of caries. American Dental Association has suggested that everyone irrespective of age must restrict themselves in eating and drinking in-between meals and when they wanted to snack incline towards nutritious nourishment recognized by the US Department of Agriculture Dietary Guidelines [12]. Our investigation likewise found that there was a very high significant relation of increasing sugars approximately by more than two spoons per day and the habit of eating in-between meals with dental caries ( $P$  value < 0.001). No distinction in occurrence of caries when the children have the habit of frequent snacking in fast food centers.

Most of the autistic children because of their physical impairments and poor manual dexterity within them needed help from their parents or caregivers [17]. The mothers' part and eagerness with respect to their disabled child's oral health was recognized in numerous researches. It is additionally significant that most Saudi families are in the propensity for contracting caretakers, to administer help to their kids and perform family tasks. Though caretakes take the major role, in our study mothers' (73.8%) took the major responsibility in brushing their autistic kids [47]. Window of opportunity to brush for these children is very less so use of electric brush may help but because of the insignificant sound makes the child increase in anxiety [48] end up not brushing so most of the families in our study preferred to use manual brushing (93.4%) over electronic tooth brush. Regarding the dental visit, very interestingly, the participants in our study showed no significant

differences in regards to the reason for visiting the dentist as in previous research [48]. Most of the children (49.2%) among our sample never went to the dentist because of increased anxiety by the child because of the foreign place, acclimatising to new sounds and smell exaggerates sensitivities making the child uncomfortable. These all make the dentist extreme difficulty leading to embarrassment to the parent so try to give extreme care to the child to avoid dental treatment [20] [48] but because of their type of food, dietary and hygiene habits never will the dental care is handled without the dentists' support. That's the reason; many children are taken to the dentist only if they have a problem with 36.1% of our study population attended the dentists.

*Limitations:* Small sample size; Our study did not explore the complexities of what kinds of snacks were eaten in between meals (whether it contained high sugar content or not); The autistic children not going to any of these special schools are not considered in the study; We didn't define clearly in the questionnaire the definition of regular and occasional in the questionnaire which might be a confusion to the parents while answering.

Further studies are recommended to overcome these limitations

Based on the results, it is concluded that the parents should be educated on how to maintain the good oral hygiene particularly for autistic children which is an integral part of the optimal dental health via proper diet, dietary habits and adequate oral hygiene by regularly visiting the dentist to have a long-term good oral health. Future studies should focus on projects that would encourage the parents or caregivers in improving the oral hygiene of these autistic children.

## References

- American Psychiatric Association: Diagnostic and Statistical. Manual of Mental Disorders, Fourth Edition, Text Revision. Washington, DC, American Psychiatric Association, 2000.
- Vishnu Rekha C, Arangannal P, Shahed H. Oral health status of children with autistic disorder in Chennai. *Eur Arch Paediatr Dent.* 2012; 13(3):126–31. <https://doi.org/10.1007/BF03262858> PMID:22652209
- Moynihan P. The interrelationship between diet and oral health. *Proc Nutr Soc* 2005; 64:571-80. WHO, 2005. Adolescent Health. Available from: [http://www.who.int/topics/adolescent\\_health/en/](http://www.who.int/topics/adolescent_health/en/).
- 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. <https://doi.org/10.1016/j.jpeds.2010.02.013> PMID:20362301 PMID:PMC2936505
- Schreck KA, Williams K, Smith AF. A comparison of eating behaviors between children with and without autism. *J Autism De Dev Disord.* 2004; 34:433-8. <https://doi.org/10.1023/B:JADD.0000037419.78531.86>
- Ahearn WH, Castine T, Nault K, Green G. An assessment of food acceptance in children with autism or pervasive developmental disorder not otherwise specified. *J Autism Dev Disord.* 2001; 31:505-11. <https://doi.org/10.1023/A:1012221026124> PMID:11794415
- Marshall, J., Sheller, B., & Mancl, L. (2010). Caries-risk assessment and caries status of children with autism. *Pediatr Dent.* 2010; 32(1):69-75. PMID:20298657
- Stein LI, Polido JC, Najera SO, Cermak SA. Oral care experiences and challenges in children with autism spectrum disorders. *Pediatr Dent.* 2012; 34:387-91. PMID:23211914
- Klein U, Nowak AJ. Characteristics of patients with autistic disorder presenting for dental treatment: A survey and chart review. *Spec Care Dentist* 1999; 19:200-7. <https://doi.org/10.1111/j.1754-4505.1999.tb01386.x> PMID:10765886
- Shapira J, Mann J, Tamari 1, et al. Oral health status and dental needs of an autistic population of children and young adults. *Spec Care Dentist.* 1989; 9:38-41. <https://doi.org/10.1111/j.1754-4505.1989.tb01022.x> PMID:2533709
- Serra Majem L, Garcia Closas R, Ramon JM, Manau C, Cuenca E, Krasse B. Dietary habits and dental caries in a population of Spanish schoolchildren with low levels of caries experience. *Caries Res.* 1993; 27:488-94. <https://doi.org/10.1159/000261586> PMID:8281564
- Punitha VC, Amudhan A, Sivaprakasam P, Rathanaprabu V. Role of dietary habits and diet in caries occurrence and severity among urban adolescent school children. *J Pharm Bioallied Sci.* 2015; 7(Suppl1):S296-300. <https://doi.org/10.4103/0975-7406.155963> PMID:26015737 PMID:PMC4439697
- Gonçalves J de A, Moreira EA, Rauhen MS, Rossi A, Borgatto AF. Associations between caries experience, nutritional status, oral hygiene, and diet in a multigenerational cohort. *Pediatr Dent.* 2016; 38:203–211.
- Shapira J, Stabholz A. A comprehensive 30-month preventive dental health program in a pre-adolescent population with Down's syndrome: A longitudinal study. *Spec Care Dentist.* 1996; 16: 33-37. <https://doi.org/10.1111/j.1754-4505.1996.tb01541.x> PMID:9084333
- Al-Hussayeen A, Al-Sadhan SA. Oral hygiene practices and dietary habits among children with Down's syndrome in Riyadh, Saudi Arabia. *Saudi Dent J.* 2006; 18:141–8.
- Kotha SB, Chaudhary M, Terkawi S, Ahmed M, Ghabban SN, Fernandez RAA. Correlation of Perceived Self-Rated Oral Health Status with Various Dental Health and Awareness Factors. *Journal of International Society of Preventive & Community Dentistry.* 2017; 7(Suppl 2):S119-S124. <https://doi.org/10.4103/jispcd.JISPCD.304.17> PMID:29184839 PMID:PMC5682704
- Zakaria Murshid E. Parents' dental knowledge and oral hygiene habits in Saudi children with autism spectrum disorder. *Global J Med Res.* 2014; 14.
- World Health Organization. Oral Health Survey: Basic Methods. 4th ed. Geneva: World Health Organization, 1997.
- Richa, Yashoda R, Puranik MP. Oral health status and parental perception of child oral health related quality-of-life of children with autism in Bangalore, India. *J Indian Soc Pedod Prev Dent.* 2014; 32:135–9. <https://doi.org/10.4103/0970-4388.130967> PMID:24739913
- Elmore JL, Bruhn AM, Bobzien JL. Interventions for the Reduction of Dental Anxiety and Corresponding Behavioral Deficits in Children with Autism Spectrum Disorder. *J Dent Hyg.* 2016; 90(2):111-20. PMID:27105789
- Wibisono WL, Suharsini M, Wiguna T, Sudiroatmodjo B, Budiardjo SB, Auerkari EI. Perception of dental visit pictures in children with autism spectrum disorder and their caretakers: A qualitative study. *Journal of International Society of Preventive & Community Dentistry.* 2016; 6(4):359-365. <https://doi.org/10.4103/2231-0762.186791> PMID:27583225



PMCID:PMC4981939

22. Pilebro C, Bäckman B. Teaching oral hygiene to children with autism. *Int J Paediatr Dent.* 2005; 15:1-9. <https://doi.org/10.1111/j.1365-263X.2005.00589.x> PMID:15663439
23. Sarnat H, Samuel E, Ashkenazi-Alfasi N, Peretz B. Oral health characteristics of pre-school children with autistic syndrome disorder. *J Clin Pediatr Dent.* 2016; 40(1):21–5. <https://doi.org/10.17796/1053-4628-40.1.21> PMID:26696102
24. Subramaniam P, Gupta M. Oral health status of autistic children in India. *J Clin Pediatr Dent.* 2011; 36:43-7. <https://doi.org/10.17796/jcpd.36.1.16287842uj536x13> PMID:22900443
25. Jaber MA. Dental caries experience, oral health status and treatment needs of dental patients with autism. *J Appl Oral Sci.* 2011; 19:212-7. <https://doi.org/10.1590/S1678-77572011000300006> PMID:21625735 PMCID:PMC4234331
26. Loo CY, Graham RM, Hughes CV. The caries experience and behavior of dental patients with autism spectrum disorder. *J Am Dent Assoc.* 2008; 139:1518-24. <https://doi.org/10.14219/jada.archive.2008.0078> PMID:18978390
27. Klein U, Nowak AJ. Autistic disorder: A review for the pediatric dentist. *Pediatr Dent.* 1998; 20:312-7. PMID:9803429
28. Murshid EZ. Oral health status, dental needs, habits and behavior attitude towards dental treatment of a group of autistic children in Riyadh. Saudi Arabia. *Saudi Dent J.* 2005; 17:132-9.
29. Al-Maweri SA, Halboub ES, Al-Soneidar WA, Al-Sufyani GA. Oral lesions and dental status of autistic children in Yemen: A case-control study. *J Int Soc Prev Community Dent.* 2014; 4(Suppl 3):199–203. <https://doi.org/10.4103/2231-0762.149040> PMID:25625079 PMCID:PMC4304059
30. Purohita BM, Singh A. Oral health status of 12-year-old children with disabilities and controls in Southern India. *WHO South East Asia J Public Health.* 2012; 1(3):330–8. <https://doi.org/10.4103/2224-3151.207029> PMID:28615559
31. Bandini LG, Anderson SE, Curtin C, et al. Food Selectivity in Children with Autism Spectrum Disorders and Typically Developing Children. *The Journal of pediatrics.* 2010; 157(2):259-264. <https://doi.org/10.1016/j.jpeds.2010.02.013> PMID:20362301 PMCID:PMC2936505
32. Rai K, Hegde AM, Jose N. Salivary antioxidants and oral health in children with autism. *Arch Oral Biol.* 2012; 57:1116–20. <https://doi.org/10.1016/j.archoralbio.2012.03.006> PMID:22521893
33. Vajawat M, Deepika PC. Comparative evaluation of oral hygiene practices and oral health status in autistic and normal individuals. *J Int Soc Prev Community Dent.* 2012; 2:58–63. <https://doi.org/10.4103/2231-0762.109369> PMID:24478969 PMCID:PMC3894080
34. Murshid EZ. Diet, oral hygiene practices and dental health in autistic children in Riyadh, Saudi Arabia. *Oral Health Dent Manag.* 2014; 13:91-6. PMID:24603923
35. Almushayt AS, Sharaf AA, Meligy OS, Tallab HY. Dietary and feeding habits in a sample of pre-school children in severe early childhood caries (S-ECC). *JKAU Med Sci.* 2009; 16:13-36. <https://doi.org/10.4197/Med.16-4.2>
36. Sohn W, Burt BA, Sowers MR. Carbonated soft drinks and dental caries in the primary dentition. *J Dent Res.* 2006; 85:262-6. <https://doi.org/10.1177/154405910608500311> PMID:16498075
37. Alshehri A. Social and Behavioral Determinants of Early Childhood Caries in the Aseer Region of Saudi Arabia. *Pediatr Dent Care.* 2016; 1:114.
38. Henry W. Fields, Jr., Steven M. Adair In: Paul S. Casamassimo; Henry W. Fields Jr.; Dennis J. McTigue; Arthur Nowak, eds. *Pediatric Dentistry - Infancy Through Adolescence.* 5th ed. St. Louis, Mo: Elsevier Saunders, 2012: 420-421.
39. Diolordi, L, del Balzo, V, Bernabei, P. Eating habits and dietary patterns in children with autism. *Eat Weight Disord.* 2014; 19: 295–301. <https://doi.org/10.1007/s40519-014-0137-0> PMID:24981567
40. Ranjan S, Nasser JA. Nutritional status of individuals with autism spectrum disorders: do we know enough? *Adv Nutr.* 2015; 6:397-407. <https://doi.org/10.3945/an.114.007914> PMID:26178024 PMCID:PMC4496734
41. Meguid N, Anwar M, Zaki S, Kandeel W, Ahmed N, Tewfik I. Dietary Patterns of Children with Autism Spectrum Disorder: A Study Based in Egypt. *Open Access Maced J Med Sci.* 2015; 3(2):262-267. <https://doi.org/10.3889/oamjms.2015.051> PMID:27275232 PMCID:PMC4877864
42. Suarez MA, Crinion KM. Food Choices of Children with Autism Spectrum Disorders. *Int J School Health.* 2015; 2(3):e27502.
43. Weil TN, Inglehart MR. Three- to 21-year-old patients with autism spectrum disorders: Parents' perceptions of severity of symptoms, oral health, and oral health-related behavior. *Pediatr Dent.* 2012; 34(7):473-9. PMID:23265164
44. Piwowarczyk A, Horvath A, Łukasik J, Pisula E, Szajewska H. Gluten- and casein-free diet and autism spectrum disorders in children: a systematic review. *Eur J Nutr.* 2017; 2017.
45. Shetyer E, Berson T, Lachmanovitz O, Hidas A, Wilschanski M, Meneachem M, Shachar E, Shapira J, Steinberg D, Moskovitz M. Oral health status and salivary properties in relation to gluten free diet in children with celiac disease. *J Pediatr Gastroenterol Nutr.* 2013; 57(1):49–52. <https://doi.org/10.1097/MPG.0b013e31828b3705> PMID:23403442
46. Gupta P, Gupta N, Singh HP. Prevalence of dental caries in relation to body mass index, daily sugar intake, and oral hygiene status in 12-year-old school children in Mathura city: A pilot study. *Int J Pediatr.* 2014; 2014:921823. <https://doi.org/10.1155/2014/921823> PMID:24688550 PMCID:PMC3945027
47. Murshid EZ. Effectiveness of a preparatory aid in facilitating oral assessment in a group of Saudi children with autism spectrum disorders in Central Saudi Arabia. *Saudi Medical Journal.* 2017; 38(5):533-540. <https://doi.org/10.15537/smj.2017.5.17398> PMID:28439605 PMCID:PMC5447216
48. Capozza L, Bimsten E. Preferences of parents of children with autism spectrum disorders concerning oral health and dental treatment. *Pediatr Dent.* 2012; 34(7): 480-4. PMID:23265165