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Salivary antioxidants and oral health in children with autism

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ABSTRACT

Individuals with autism vary widely in abilities, intelligence, and behaviours. Autistic children have preferences for soft and sweetened food making them susceptible to caries. A wide spectrum of medical and behavioural symptoms is exhibited by children with autism, which makes routine dental care very difficult in them. Mental retardation is evident in approximately 70% of individuals with autism and most psychiatric disorders including autism are associated with increased oxidative stress.

Objectives: To evaluate the oral health status of children with autism and to determine the salivary pH and total salivary antioxidant concentration (TAC).

Materials and methods: 101 subjects with autism between age group of 6 and 12 year were part of the study and 50 normal healthy siblings of same age group were taken as control group. Oral health status was analysed using oral hygiene index-simplified and dentition status index. The salivary total anti-oxidant level was estimated using phosphomolybdic acid using spectrophotometric method and the salivary pH using the pH indicating paper. The results were statistically analyzed using Mann–Whitney U test.

Results: A statistically very highly significant difference was seen in the mean oral hygiene index scores (autistic group – 1.2 and control group – 1, $P < 0.001$) and the mean salivary total antioxidant concentration (autistic group – $5.7 \mu\text{g/ml}$ and control group – $38 \mu\text{g/ml}$, $P < 0.001$). No statistical significant difference was observed in the dental caries status and the salivary pH of autistic group and the control group.

Conclusions: Similar dental caries status was observed in children with autism and their healthy normal siblings. Oral hygiene was poor in children with autism whereas the Salivary TAC was significantly reduced in autistic children.

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1. Introduction

Autism is a complex neurological disorder which compromises of physical, psychological, emotional and social components. Individuals with autism vary widely in abilities, intelligence, and behaviours. There are enormous variations in the behavioural patterns and the severity of illness among individuals with autism.¹

Autistic children have preferences for soft and sweetened food^{2,3} making them susceptible to caries. Speculation that the

lack of one of the protective mechanisms may pose a threat to the oral health of children with autism. Various studies^{4,5} have found no or little difference in the caries status of children with autism when compared with normal healthy individual thereby necessitating the need to assess the protective role of saliva.

A wide spectrum of medical, psychological and behavioural symptoms is exhibited by children with autism, which makes routine dental care very difficult in them.⁶ This behavioural and physical conditions limits these patients from maintaining a good oral hygiene.

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Most psychiatric disorders including autism are associated with increased oxidative stress.⁷ The behaviour pattern of these children exhibiting temper tantrums, hyperactivity, self injurious behaviour and their inability to express themselves due to impaired communication and emotional reciprocity further increases the stress levels and may alter the antioxidant levels and general well being of the individual.

As there is paucity of studies on autism and there is little or very few facts available on the oral health status and dental needs of children with autism in India, hence, relevance of this study. Hence, the need to evaluate the oral health status, salivary pH and salivary total antioxidant concentration of these children.

2. Materials and methods

101 subjects with autism between age group of 6 and 12 years of both sexes attending various special schools were part of the study and 50 normal healthy siblings of same age group were taken as control group. Initially the study group was intended to be divided into 3 groups based on their IQ as high functioning (IQ > 70), medium functioning (IQ between 50 and 70) and low functioning (IQ < 50), but as no children with high functioning autism was encountered during the study it was later divided into 2 groups as medium functioning and low functioning. The control group comprised of siblings of these children with no delayed developmental milestones and had good academic performance. The siblings were selected as the controls to minimize the variability of factors responsible for caries and oral hygiene such as diet, intake of refined sugars and oral health practices. A three day diet chart was also recorded for the study and the control group.

The children with Autism were examined at special schools, seated on a comfortable chair, under natural light using sterile portable equipments which included mouth mirror, explorer and cotton pellets. The unstimulated whole saliva samples were collected from the study group and control group. The unstimulated whole saliva samples were collected between 9 and 10 a.m. in a graduated cylinder. Since cooperation of the patient was difficult to obtain to collect saliva in the coach man position, the saliva which was pooled in the oral cavity during the oral examination was collected on a graduated cylinder. Oral health status and treatment needs were analysed using oral hygiene index-simplified and dentition status and treatment needs of WHO oral health

assessment form. The salivary total anti-oxidant level was estimated by phosphomolybdate method using spectrophotometer⁸ and the salivary pH using the pH indicating paper (Merk & co.). The results were statistically analyzed using Mann-Whitney *U* test and Kruskal Wallis *H* test.

3. Results

A total of 101 autistic children were examined, of which 48 were medium functioning (IQ between 50 and 70) and 53 in the low functioning group (IQ < 50). The siblings were selected as the control so as to match the variables affecting caries and oral hygiene as closely as possible. Since siblings were selected as the control group and the possibility of finding siblings for these children would be less, the control group was set as 50. A three day diet chart was also recorded for both the study and control group to assess the intake of carbohydrates and refined sugars. The diet charts among the study and the control group were comparable in terms of these variables. Salivary samples of three autistic children could not be collected due to their limited ability to cooperate and therefore a total of 98 salivary samples were collected and salivary parameters of these 98 samples were estimated.

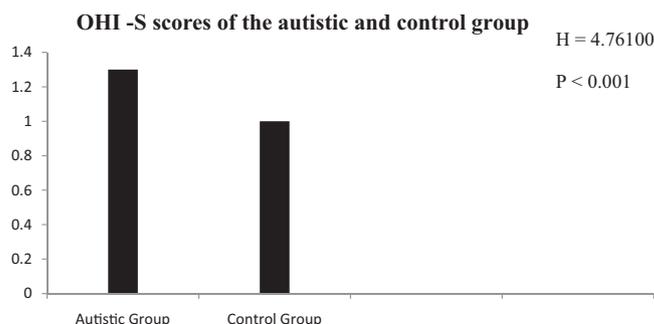
Out of 101 autistic children 66 children had caries. It was observed that 74 children had mixed dentition. In this mixed dentition group, primary teeth of 31 children were affected by dental caries. The median value for both the autistic group and the control group was 0 which was statistically not significant ($P = 0.056$). On further subdividing the study group as low and medium functioning, no significant difference ($P = 0.118$) was observed.

The oral hygiene index in the control group showed a median value of 1 (score indicating good oral hygiene) and, that of the autistic group was 1.2 (scores indicating fair oral hygiene), which was statistically significant ($P < 0.001$) (Graph 1).

On further subdividing the study group, low functioning group showed a median value of 1.4 and medium functioning with a median value of 1.2 which was statistically highly significant ($P < 0.001$) (Graph 2).

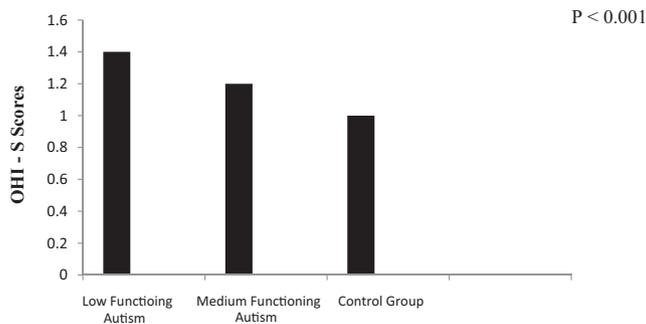
The salivary pH of the study and the control group showed a median value of 7 which was statistically non significant ($P = 0.376$). No significant difference ($P = 0.508$) was observed on dividing the study group.

Salivary total antioxidant capacity showed a statistically significant difference ($P < 0.001$) between the study group with



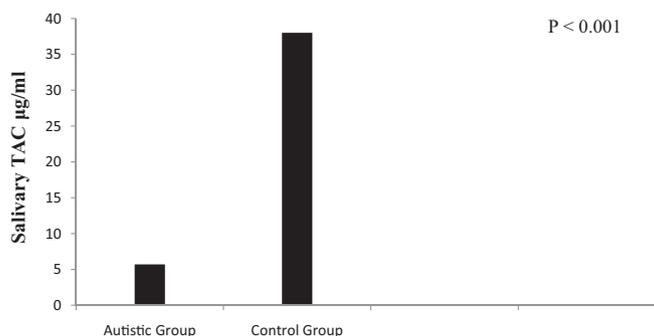
Graph 1 – Oral hygiene index – simplified in study and control group (H = 4.76100, P < 0.001).

OHI - S Scores of the Autistic and Control group H = 26.098



Graph 2 – Oral hygiene index – simplified in study and control group (H = 26.098, P < 0.001).

Salivary TAC of Autistic and Control Group Z = 7.29300

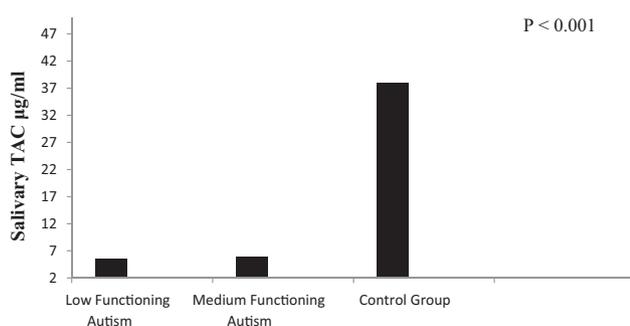


Graph 3 – Salivary TAC in study and control group (Z = 7.29300, P < 0.001).

median value of 5.7 µg/ml and the control group with median value of 38 µg/ml (Graph 3). Even on subdividing the group a statistical significant difference ($P < 0.001$) was observed with low functioning showing a median value of 5.5 µg/dl and medium functioning with median value of 6 µg/dl (Graph 4).

Spearman's correlation was applied to assess the presence of any correlation between the carious primary teeth and salivary TAC where $r = -0.084$ and between the carious permanent teeth and salivary TAC where $r = -0.043$ which was statistically non significant. Hence poor correlation was observed for primary carious tooth and the permanent carious tooth with respect to salivary TAC.

Salivary TAC of Autistic and Control Group H = 54.792



Graph 4 – Salivary TAC in study and control group (H = 54.792, P < 0.001).

4. Discussion

Autism is a complex neurological disorder which comprises physical, psychological, emotional, and social components. Individuals with autism vary widely in abilities, intelligence, and behaviours. This developmental abnormality is a major hindrance in providing preventive home care as well as dental care in office making them susceptible to oral diseases.

The results of the present study demonstrated that the incidence of dental caries in children with autism was less than that of their healthy normal siblings but was statistically non significant ($P = 0.056$). The results obtained were in agreement with another study,⁹ which found that the caries prevalence was similar in both groups and was not in concurrence with studies^{4,10} where in they found the incidence of caries to be less in autistic individuals than controls. The low prevalence of caries in children with autism may be due to the presence of other protective biological factors that prevents manifestation of dental caries like appreciable levels of SIgA, lysozyme, lactoferrin and peroxidases, salivary flow rate and salivary pH.¹¹

On further assessing the dental caries status between the medium functioning and low functioning autistic group no statistical significant difference was obtained which can again be attributed to the aforementioned biological factors.

Saliva is rich in antioxidants. Uric acid, albumin, ascorbic acid, glutathione and antioxidant enzymes are present in saliva.¹² Saliva being the first biological fluid met by external substances ingested as food, drinks, microorganisms, it represents the first line of defence against oxidative stress.¹³ Oxidative stress is implicated in various pathological conditions such as cancer, cardiovascular disease, neurological disorders (Alzheimer and Parkinson's diseases), rheumatoid arthritis, diabetes, ischemia/reperfusion, ageing.¹⁴ Oxidative stress is implicated now in the pathology of several oral diseases.¹⁵⁻¹⁹ Hence, the salivary TAC gives an indication to the susceptibility of the individual to various oral diseases.

Total salivary antioxidant levels, in children with autism (mean = 8.14 $\mu\text{g/ml}$) was low compared to their siblings (mean = 43.31 $\mu\text{g/ml}$). This was statistically very significant. This can be attributed to emotional and psychological stress due to the inability to interpret or predict and anticipate the behaviour of others, as well as the failure to use facial expression and body language to interact with others, often leads to social conflict²⁰ which was also observed present in the study group. Distinct impairment was seen in communication and social interaction skills in these children. And the presence of a stranger, was an anxiety triggering factor which could be recognised by the presence of self stimulatory motor movements which precipitates in anxious/stressful conditions. It was reported that numerous physiological and pathological processes including emotional or psychological stress increase the bodily concentration of oxidizing substances, known as reactive oxygen species (ROS) or, more commonly, free radicals causing decreased salivary antioxidant levels in the saliva.⁷

Repetitive trauma due to self injurious behaviour leads to tissue damage i.e. break in the continuity of the epithelium which in turn again increases the oxidative stress in the body. And about 59.4% of autistic children exhibited SIB in the study which could be one of the reasons that the antioxidant levels in these children were low compared to 20% in the control group which exhibited other parafunctional habits such as thumb sucking, mouth breathing and tongue thrusting which were not self mutilating in nature and moreover majority of these SIB were associated with the head and neck region thereby affecting the oral structures directly or indirectly.

The inability to maintain oral hygiene, lip incompetency due to perioral hypotonic musculature which makes them anatomical mouth breathers are the predisposing factors resulting in compromised gingival health status. The oral hygiene index indicated a poor score in these autistic children than their healthy siblings making them more susceptible to generalised gingivitis. The presence of gingivitis itself is reported to cause an increased production of free radical species.^{21,22}

On determining the salivary TAC in the medium functioning and low functioning autistic group a statistically significant decrease in the salivary TAC was observed in low functioning group. This could possibly due to the more severely compromised ability of these individuals leading to emotional and psychological challenge which itself acts as a hindrance in performing the daily activities, making them susceptible to frequent stressful conditions. The increased oral hygiene scores and the increased incidence of SIB in low

functioning group may be attributed to decrease in salivary TAC.

Poor correlation was observed between the presence of caries and the salivary TAC as oppose to that reported in the study by Uberos et al.²³ Even on assessment of correlation of salivary TAC with caries in primary and permanent teeth, poor correlation was observed. This could be due to the possibility of concomitant presence of aforementioned various systemic and local stress producing factors which also contribute to the increased oxidative stress in these children.

In spite of decreased salivary TAC in children with autism, the caries status of these children were comparable to that of their siblings this could be justified by the presence of various protective biological factors present in the saliva¹¹ which was beyond the scope of this study. And also, due to the supervision and restriction of refined sugar diet of these children.

Oral hygiene score was fair for children with autism compared to that of their siblings who exhibited good oral hygiene ($P < 0.001$). On examination we found that Autistic children had comparatively poor oral hygiene than their counterparts. This can be attributed to the fact that a wide spectrum of medical and behavioural symptoms exhibited by children with autism, which makes routine dental care very difficult in them.²⁴ Autistic children possess different physical conditions which includes hyperactive knee jerk, poor muscle tone and poor muscle co-ordination² and various non specific neurological symptoms or signs such as motor in-coordination, delayed development of hand dominance²⁰ which limits their motor dexterity, thus preventing the maintenance of good oral hygiene.

On assessment of the oral hygiene scores between medium functioning and low functioning autistic group, a statistical significant increase in the scores was observed in the low functioning group which probably can be explained by the more severely compromised cognitive, sensory and motor skills of these individuals which hinders in the maintenance of oral health. More severely affected individuals, exhibit uncooperative behaviour and also challenge their daily care givers with reduced compliance when tried to help with their oral hygiene. This could be another contributing factor towards an increase in the oral hygiene scores in this group of children.

The caries status of these children with autism is not different compared to their counterparts in spite of having a comparatively poor oral hygiene. Now this could be explained by the fact that the oral hygiene of these children is fair compared to the good oral hygiene of their siblings and not poor as per the oral hygiene index – simplified. And also the presence of aforementioned protective salivary factors and supervised and restricted diet of these children.

Salivary pH did not differ statistically in children with autism and their siblings. This can be one of the reasons that the dental caries status was insignificant in both the groups. But the caries status cannot solely be explained by the role of salivary pH, since multiple factors come into play in the progression of caries.

Because of these physio-pathological process occurring in these individuals showing elevated oral hygiene index scores causing a possible inflammation of gingiva, presence of SIB leading to break in the continuity of epithelium and the

inherent emotional and psychological factors can be suggestive of possible predisposing factors which is reflected by the low salivary antioxidant levels in the present study.

The need for reinforcement of oral hygiene in these children were of utmost significance considering the oral health neglect encountered due to negligence on part by the parents and on part by the practitioner. Hence, prevention, early reinforcement and constant repetition of oral hygiene care should be the mainstay from early in life, as strict routine are the characteristics of these individuals. This will aid in preventing future complication that would be a challenge to treat due to behavioural, cognitive complications that may be encountered.

5. Conclusion

- Similar dental caries status was observed in children with autism and their healthy normal siblings.
- Oral hygiene was poor in children with autism.
- Salivary TAC was significantly reduced in autistic children than their healthy counterparts.

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Competing interests

None.

Ethical approval

This study was approved by the Ethical Committee of A.B Shetty Memorial Institute of Dental Sciences, Mangalore.

REFERENCES

1. Muthu M, Pratibha K. Management of child with autism and severe bruxism: a case report. *J Ind Soc Ped Prev Dent* June 2008;82–4.
2. Klein U, Nowak A. Autistic disorder – a review for the pediatric dentist. *AAPD* 1998;20(5):312–7.
3. Weddell J, Sanders B, Jones J. Dental problems of children with disabilities. In: McDonald R, Avery D, Dean J, editors. *Dentistry for the child and adolescent*. 8th ed. Elsevier Mosby; 2004. p. 543.
4. Namal N, Vehit HE, Koksall S. Do autistic children have higher levels of caries? A cross sectional study in Turkish children. *J Indian Soc Pedod Prev Dent* 2007;25(2):97–102.
5. Dorota T, Peggy A. Dental needs and status of autistic children: results from the National Survey of Children's Health. *Pediatr Dent* 2008;30:54–8.
6. Medina A, Sogbe R. Factual oral lesions in an autistic paediatric patient. *IJPD* 2003;133:130–7.
7. Tsaluchidu S, Cocchi M, Tonello L, Puri BK. Fatty acids and oxidative stress in psychiatric disorders. *BMC Psychiatry* 2008;17(8 (Suppl. 1)):S5.
8. Preto B, Pineda M. Spectrophotometric quantitation of antioxidant capacity through the formation of phosphomolybdenum complex. Specific application to the determination of vitamin E. *Analyt Biochem* 1999;269:337–41.
9. DeMattei R, Cuvo A, Maurizio S. Oral assessment of children with an autism spectrum disorder. *J Dent Hyg* 2007;81(3):65.
10. Cheen Y, Richard M, Christopher V. The caries experience and the behaviour of dental patients with autism spectrum disorder. *JADA* 2008;139:1518–24.
11. Hara A, Zero D. The caries environment: saliva, pellicle, diet and hard tissue ultrastructure. Young D, Fontana M, Wolff M, editors. *Current concepts in cardiology*, 54(3). DCNA; 2010. p. 457.
12. Daniela M, Maria G, Alexandra T, Andreea D, Ra˘dulescu R. The antioxidant potential of saliva: clinical significance in oral diseases. *Ther Pharmacol Clin Toxicol* 2011;15(2):139–43.
13. Battino M, Ferreiro MS, Gallardo I, Newman HN, Bullion P. The antioxidant capacity of saliva. *J Clin Periodontol* 2002;29:189–94.
14. Valko M, Leibfritz D, Moncol J, Cronin MTD, Mazur M, Teser J. Free radicals and antioxidants in normal physiological functions and human disease. *Int J Biochem Cell Biol* 2006;39:44–84.
15. Sculley DV, Langley-Evans SC. Salivary antioxidants and periodontal disease status. *Proc Nutr Soc* 2002;6:137–43.
16. Akalin FA, Baltacioglu E, Alver A, Karabulut E. Lipid peroxidation levels and total oxidant status in serum, saliva and gingival crevicular fluid in patients with chronic periodontitis. *J Clin Periodontol* 2007;34:558–65.
17. Konopka T, Krol K, Kopec W, Gerber H. Total antioxidant status and 8-hydroxy-2'-deoxyguanosine levels in gingival and peripheral blood of periodontitis patients. *Arch Immunol Ther* 2007;55:417–25.
18. Borges I, Machado-Moreira EA, Filho DW, Bittencourt de Oliveira T, Spirelle da Silva MB, Frode TS. Proinflammatory and oxidative stress markers in patients with periodontal disease. *Mediat Inflamm* 2007:1–5.
19. Cenk FC, Yasin C, Abdulkadir Y, Ufuk S, Canakci V. Increased levels of 8-hydroxydeoxyguanosine and malondialdehyde and its relationship with antioxidant enzymes in saliva of periodontitis patients. *Eur J Dent* 2009;3:100–6.
20. Friedlander A, Yageila J, Paterno V, Mahler M. The neuropathology, medical management and dental implications of autism. *JADA* 2006;137:1517–27.
21. Chapple I. Role of free radicals and antioxidants in the pathogenesis of the inflammatory periodontal diseases. *J Clin Pathol Mol Pathol* 1996;49:M247–55.
22. Gutteridge JM. Lipid peroxidation and antioxidants as biomarkers of tissue damage. *Clin Chem* 1995;41(12 Pt. 2):1819–28.
23. Uberos J, Alarcon J, Penalver M, et al. Influence of the antioxidant content of saliva on dental caries in an at-risk community. *Br Dent J* 2008;205:E5.
24. Muthu M, Pratibha K. Management of child with autism and severe bruxism: a case report. *J Indian Soc Pedod Prev Dent* 2008:82–4.