ORIGINAL ARTICLE

Comparative evaluation of salivary constituents and oral health status in children with Down's syndrome

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ABSTRACT

Aim: To evaluate and correlate salivary constituents and oral health status in children with Down's syndrome. **Materials and Methods:** Seventy-five children in the age group of 4–14 years were included in the study. The control group consisted of 25 healthy children. The study group consisting of children with Down's syndrome was divided into study Group I which consisted of 25 institutionalized children and study Group II consisted of 25 noninstitutionalized children. Caries score and oral hygiene status of each child were calculated. Unstimulated saliva was collected from each child, and salivary levels of sodium, potassium, calcium, magnesium, phosphorus, and zinc were evaluated. **Results:** Lowest decayed, missing, and filled teeth scores were found in noninstitutionalized Down's syndrome children and highest oral hygiene index-simplified scores were found among institutionalized Down's syndrome children. Levels of sodium ions were seen to be highest in the control group; magnesium levels were highest in an institutionalized group of children with Down's syndrome, whereas potassium, calcium, phosphorus, and zinc levels were found to be highest among a noninstitutionalized group of children with Down's syndrome. Salivary calcium showed a significant negative correlation with dental caries. **Conclusion:** Salivary calcium and zinc play a protective role against dental caries. Increased dietary calcium and zinc in addition to education regarding oral hygiene practices may improve overall oral health among children.

Key words
Dental caries, Down's syndrome, saliva

INTRODUCTION

Down's syndrome is a genetic disorder resulting from an extra copy of chromosome 21 and the most commonly recognized genetic cause of mental retardation.[1] The syndrome is characterized by short stature, characteristic facial features with a protruding tongue, a wide range of learning difficulties, congenital heart disease, gastrointestinal disorders, and other features.[2] It is associated with some peculiarities of the oral cavity, which include frequent malocclusions, temporomandibular joint dysfunction, tooth malalignment, and bruxism. Dental anomalies such as microdontia, hypodontia, partial anodontia, supernumerary teeth, diastema, tooth agenesis, and delayed eruption are also common. Many authors have found periodontal diseases to be more prevalent in these individuals.[3] However, investigators have found that percentages of occurrence of dental caries were lower in Down's syndrome individuals.[4,5] Some of the morphological anomalies, such as delayed eruption and microdontia, may be protective against caries formation.[6] Saliva can affect the incidence of dental caries in many ways, one of them being a

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reduction in enamel solubility by a continuous supply of minerals, particularly calcium, and by buffering and antibacterial activity.[7] Electrolytes in saliva especially calcium, phosphorus, and magnesium are necessary to maintain the integrity of teeth and considered to be an important variable explaining the difference in caries experience.[8] Zinc, an essential element for various body functions, helps in mineralization of enamel and has seen to reduce the susceptibility to dental caries.[9] The role of sodium and potassium in relation to dental caries is not well-substantiated. However, along with potassium, sodium has seen to play a role in the regulation of salivary flow rate.[10] Hence, the concentration of these trace elements in saliva may be related to the caries experience among children. Conflicting results have been recorded in salivary changes among Down's syndrome patients.[11-13] Hence, the aim of the present study was to evaluate and correlate salivary constituents and oral health status in children with Down's syndrome.

MATERIALS AND METHODS

The study group consisted of fifty children diagnosed with Down's syndrome in the age group of 4–14 years. It was further divided into two groups of 25 each. Study Group I consisted of institutionalized children with Down's syndrome. Study Group II consisted of noninstitutionalized children with Down's syndrome. The control group consisted of 25 healthy children in the age group of 4–14 years, who attended as outpatients of the department. Following the institutional ethical committee approval, saliva samples were collected with the parent's consent. Oral health status was evaluated using WHO oral health assessment form for children (2013). Dental caries status was recorded with decayed, missing, and filled teeth (DMFT/dmft) index; oral hygiene status was recorded using oral hygiene index-simplified (OHI-S) index.

Saliva sample collection

Unstimulated saliva was collected in the morning hours by asking the patient to sit in a relaxed position with no movements and talking for few minutes. Approximately, 1.5 ml of saliva was collected in eppendorff tubes and wide mouth sterile containers. Samples were preserved under refrigeration until further processing.

Estimation of salivary ions

Sodium and potassium levels in saliva were determined using ion selective electrolyte analyzer. Estimation of calcium, phosphorus, magnesium, and zinc was done using a calorimetric method by using *in vitro* kits. Standardization calibration curves were plotted for calcium, phosphorus, magnesium, and zinc, and concentration of the ions was determined.

RESULTS

On comparison of caries status in all the groups, lowest mean DMFT/dmft scores were obtained in the study Group II (1.28 ± 1.40) and highest mean DMFT/dmft scores were obtained in the control group (4.6 ± 2.60). The difference in the mean DMFT/dmft scores among all the three groups was statistically significant ($P < 0.01$). Highest mean OHI-S scores were obtained in the study Group I (1.02 ± 0.47). Lowest mean OHI-S scores were obtained in the control group (0.22 ± 0.11). The difference in the mean OHI-S scores was statistically significant among all the three groups ($P < 0.01$) [Table 1]. The level of salivary sodium ions was highest in the control group (33.73 ± 4.86) and lowest in the study Group II (26.35 ± 4.72), whereas the K, Ca, P, and Zn ions were highest in study Group II (24.22 ± 3.80, 6.30 ± 3.13, 15.72 ± 4.97, and 10 ± 3.06), respectively, and least in control group (18.94 ± 2.70, 4.11 ± 1.15, 6.46 ± 1.52, and 7.04 ± 2.35), respectively. However, the levels of salivary Mg ions were in highest in the study Group I (1.18 ± 0.67) followed by control group (0.62 ± 0.26) and least in the study Group II (0.51 ± 0.16). The levels of the salivary ions were found to be statistically significant among all the three groups ($P < 0.01$) [Table 2]. Salivary sodium and magnesium showed a positive but statistically insignificant correlation with dental caries ($P > 0.01$). Potassium, calcium, phosphorus, and zinc showed a

Table 1: Comparison of oral health status (dental caries and oral hygiene index-simplified) of the study groups and control group

Groups	*n*	Mean±SD	
		DMFT/dmft	OHI-S
Study Group I	25	1.48±1.69	1.02±0.47
Study Group II	25	1.28±1.40	0.80±0.53
Control group	25	4.60±2.60	0.22±0.11
F		6.937	2.515
P		0.001*	0.001*

*P <0.01 (highly significant). OHI-S – Oral hygiene index-simplified, SD – Standard deviation, DMFT – Decayed, missing, and filled teeth

Table 2: Comparison of salivary ions of the study groups and control group

Salivary ions	Mean±SD			*F*	*P*
	Study Group I	Study Group II	Control group		
Na	27.00±4.30	26.35±4.72	33.73±4.86	19.474	0.000*
K	23.52±2.09	24.22±3.80	18.94±2.70	23.625	0.000*
Ca	5.91±2.39	6.30±3.13	4.11±1.15	6.077	0.004*
Mg	1.18±0.67	0.51±0.16	0.62±0.26	17.946	0.000*
P	13.38±3.65	15.72±4.97	6.46±1.52	43.092	0.000*
Zn	10.00±3.71	10.00±3.06	7.04±2.35	7.630	0.001*

*P <0.01 (highly significant). SD – Standard deviation

negative correlation with dental caries. Calcium showed a significant negative correlation ($P > 0.01$). Sodium, potassium, calcium, magnesium, and phosphorus showed positive but the insignificant correlation with oral hygiene scores ($P > 0.01$). Zinc showed a negative correlation with oral hygiene scores which was statistically insignificant ($P > 0.01$).

DISCUSSION

The physical and mental capability of people with Down's syndrome varies widely, and ordinary activities of daily living including maintenance of oral hygiene may present challenges. Usually, oral care of individuals with physical and mental disabilities remains neglected, which makes them suffer from various oral problems including dental caries and periodontal diseases. However, interestingly it was found by various authors that worldwide caries prevalence in Down's syndrome is lower as compared with other individuals.[4,5] Moreover, Zigmond *et al.* in 2006 found the periodontal disease to develop more rapidly and extensively in Down's syndrome children as compared with age matched controls.[3] In the present study, study groups consisted of institutionalized children and noninstitutionalized children with Down's syndrome. Institutionalized children with Down's syndrome were expected to have monitored oral hygiene practices, whereas noninstitutionalized children would be under the personal care of their parents or caregivers.

Saliva plays an essential role in maintaining the integrity of the oral structures. It mainly consists of water (99.5%), organic (0.3%), and inorganic and trace elements (0.2%). It is composed of anions, cations, nonelectrolytes, amino acids, proteins, carbohydrates, and lipids.[14] Trace minerals with proper concentrations in the dental tissues also have important roles in the appropriate development of erupting teeth and inhibition of caries.[8,9] Electrolytes such as sodium, potassium, calcium, chloride, magnesium, bicarbonate, and phosphate (PO_4^{3-}) are present in saliva. Electrolytes in saliva, especially calcium and phosphorus, are necessary to maintain the integrity of teeth. Foremost among the constituents of saliva, magnesium may be expected to enhance this potential.[15] Moreover, among various trace elements, zinc is an essential element for many body functions, including enzyme activity, gene expression, intestinal epithelial regeneration, and a variety of immune mechanisms.[16] As a trace mineral, dietary zinc is also important for the mineralization of the enamel and is known to reduce the susceptibility to dental caries.[9,17] Low zinc content of saliva has shown to be associated with a higher frequency of dental caries.[18] Salivary ions also influence the composition of dental plaque and calculus. Calcium, phosphorus, and magnesium are found to be the principle components of calculus formation, whereas sodium and zinc are said to be present in trace amounts.[10] However, there is inadequate availability of data concerning the association between zinc and oral health. Hence, the association of zinc with caries experience and oral hygiene in children with Down's syndrome was considered in the present study.

In the present study, highest OHI-S scores were seen among institutionalized children with Down's syndrome (1.02), followed by noninstitutionalized children with Down's syndrome (0.80) and healthy children (0.22). This was in accordance with a study carried out by Oredugba in 2007, who found poor oral hygiene among Down's syndrome children as compared to the normal counterparts. He attributed this finding to lack of manual dexterity in these children to carry out routine oral hygiene practices and lack of oral health education among these children and their caretakers.[14] In the present study, the highest level of caries was found among healthy children (4.60), followed by institutionalized Down's syndrome children (1.48) and noninstitutionalized Down's syndrome children (1.28). These results were in contradiction with a study carried out by Al-Khadra in 2011, who found higher caries experience among Down's syndrome children. He concluded that higher caries experience among these individuals in their study may be due to poor oral hygiene.[19] They stated that oral hygiene plays an important role in the initiation and progression of dental caries and periodontal disease.[20,21]

In the present study, institutionalized children with Down's syndrome showed poor oral hygiene with highest OHI-S scores (1.02 ± 0.47). When the caregivers of institutionalized Down's syndrome children were asked regarding their oral hygiene practices, it was revealed that there was negligence regarding the routine oral hygiene measures on their caregiver's part, which might be the reason for poor oral hygiene among this group of children. In addition, the higher levels of salivary magnesium and zinc ions were seen in this group. When correlated with dental caries, an increase in magnesium levels was found with increased dental caries which was statistically not significant ($P > 0.01$). The findings of the present study were in accordance with a study carried out by Featherstone in 1983, who had found a positive correlation of magnesium ions with dental caries and explained that magnesium is a caries-promoting mineral as it inhibits remineralization.[22] Contradictory results were found in the study carried out by Al-Zahawi and Al-Refai in 2007 who found a significant negative correlation of magnesium with dental caries.[23] A negative correlation of zinc was found with dental caries. The findings of the present study were in accordance with the study carried out by Zahir and Sarkar in 2006 where they found the presence of zinc in saliva of caries-free individuals.[8] Zinc reduces the rate of enamel demineralization by interacting predominantly at the PO_4^{3-} sites on the apatite structure during its mechanism in reducing demineralization, which further suppresses

the PO_4^{3-} ion release as found in an *in vitro* study carried out by Mohammed *et al.*[24] Findings contradictory with results of the present study were seen in the study conducted by Hegde *et al.* in 2014 where levels of zinc were found to be significantly high in caries-active individuals.[25]

Noninstitutionalized children with Down's syndrome showed the lowest amount of dental caries (1.28) which may be related to the higher levels of salivary potassium, calcium, and phosphorus in this group. These ions prevent dissolution of enamel due to acid attack; provided that the saliva has free access to the enamel surface.[26] The negative correlation of calcium with dental caries in the present study was statistically significant. The findings of the present study were in accordance with a study carried out by Radhi *et al.* in 2012, who found the lower amount of caries and higher salivary calcium in Down's syndrome children.[27] Shannon and Feller in 1979 also found the higher levels of phosphorus in caries-free children.[28] Clark and Levine in 1927 suggested that dietary phosphorus intake may have an important caries-preventive role.[29] However, differences of levels of these ions between the institutionalized and noninstitutionalized group of Down's syndrome children may be due to various factors such as dietary differences and differences in routine oral hygiene practices.

Regarding the levels of sodium and potassium in the present study, a significant difference was obtained in healthy to noninstitutionalized and healthy to institutionalized Down's children. Radhi *et al.* in 2012 related the higher levels of sodium and potassium with lower caries incidence among Down's syndrome children.[27] Whereas, Siqueira *et al.* in 2004 found the higher levels of sodium but lower levels of potassium in the saliva of Down's syndrome children. They concluded that there is alteration in the metabolism of the duct and/or acinar cells of salivary glands of Down's syndrome children.[11] When correlated with dental caries, potassium showed a negative correlation with dental caries which was not statistically significant ($P > 0.01$), whereas sodium showed a positive correlation with dental caries. Incorporation of caries protective ions in the diet as well as routinely used oral hygiene measures like dentifrices may reduce caries experience among children. In addition, education regarding oral hygiene measures to the caregivers of individuals with Down's syndrome might help in improving overall oral hygiene which would subsequently reduce dental caries experience and periodontal diseases among these individuals.

CONCLUSION

Dental caries was found to be reduced in children with Down's syndrome with least amount of dental caries in noninstitutionalized Down's syndrome children. Moreover, children with Down's syndrome showed poorer oral hygiene when compared with normal children with highest OHI-S scores in institutionalized Down's syndrome children. Salivary zinc showed a negative correlation with dental caries and oral hygiene scores. A significant negative correlation of calcium ions was found with dental caries suggestive of their protective role in dental caries and increasing dietary intake of calcium might help in reducing caries experience among children.

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Conflicts of interest
There are no conflicts of interest.

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