# Comparative Assessment of Dental Caries Status and Selected Salivary Constituents in Children with Cerebral Palsy

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## ABSTRACT

**Aim:** To assess and compare the dental caries status and selected salivary constituents in cerebral palsy children and healthy children.

**Methods:** A total of 100 children aged between 3 to 13 years were included in the study. The study group consisted of 50 children with cerebral palsy registered under the Indira Gandhi Institute of Child Health, Bangalore, and the control group consisted of 50 healthy children who visited the Department of Pediatric and Preventive Dentistry, V S Dental College and Hospital, Bangalore for a routine dental check-up. Salivary constituents like calcium, phosphorous, sodium, potassium, magnesium, and chloride were assessed using salivary kits. Dental caries was recorded according to WHO criteria.

**Results:** Salivary calcium, potassium, chloride, and phosphorous levels were increased and salivary sodium and magnesium concentrations were decreased in cerebral palsy children when compared to healthy children. Statistically significant results were obtained only in salivary potassium and phosphorous levels and the DMFT/dmft scores were higher in cerebral palsy children when compared to healthy children.

**Conclusion:** Children with cerebral palsy are more prone to dental caries when compared to healthy children due to various factors like motor and coordination difficulties, food pouching due to difficulty in swallowing, and poor oral care and hygiene. The variations seen in the salivary electrolyte concentrations in cerebral palsy children could also be a causative factor for the increased risk of developing dental caries and negatively affecting the quality of life in these children.

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**Keywords**: Cerebral palsy, Dental Caries, Salivary Constituents.

## 1. Introduction:

Cerebral palsy is a group of non-progressive, permanent disorders that involves motor impairment caused by a lesion during the development of the brain. Common systemic manifestations in CP include epilepsy, learning difficulties, mental retardation, sensory limitation, speech disorders, and loss of hearing. The prevalence of CP is 2.4 per 1000 children and it is the most common cause of severe physical disability in childhood (Siqueira, et al. 2007; Santos, et al. 2010). Various types of cerebral palsy can be observed based on the type of motion alteration presented such as spastic, athetoid, ataxic and mixed (Subramanian, Babu, and Rodriguez, 2010).

Dental caries is a multifactorial infectious disease in which different biological, economic, cultural, environmental, and social factors interact (Roberto et al. 2012). It involves internal defense factors such as saliva, tooth surface morphology, general health, nutritional and hormonal status, and external factors like diet, microbial flora, oral hygiene, and fluoride availability (Lenander-Lumikari and Loimaranta, 2000). Dental problems associated with CP children include carious teeth, periodontitis, malocclusion, bruxism, and drooling (Chandna, Adlakha, and Joshi, 2011). The dental status of these children showed more extracted and unrestored teeth, very poor oral hygiene and gingival health, and also exhibited delayed eruption and higher levels of tooth wear (Pope and Curzon, 1991). Maintaining the oral health status of individuals with CP requires systematic hygiene practices that demand supervision of their oral hygiene, however, this process of participation is neglected by the caretakers leading to poor oral health which in turn affect

their well-being and negatively impact their quality of life (Diniz, et al. 2015).

Saliva is a heterogenous fluid secreted by the salivary glands. It has various biological factors that protect the tooth from caries development and facilitate remineralization. This ability of saliva to affect caries development depends on the quantity and composition of the secretions (Pandey, et al. 2015)

Saliva is composed of inorganic and organic constituents like bicarbonates which allow buffering, calcium and phosphate which maintains tooth mineral integrity, a wide variety of proteins that have biologic functions of particular importance to oral health (Dodds, Johnson and Yeh, 2005). Children with CP show reduced salivary flow rate, decreased sodium concentrations, increased potassium levels, reduction in digestive and antimicrobial enzyme activities, and also show delayed recovery of salivary pH (Santos, et al. 2011).

Any variations in the values of these salivary constituents will lead to the progression of dental caries. Hence, the purpose of this study was to assess and compare the dental caries status and selected salivary constituents in cerebral palsy children and healthy children.

## 2. Methodology:

A total of 100 children were included in the study, aged 3-13 years. The study group consisted of 50 children with cerebral palsy registered under the Indira Gandhi Institute of Child Health, Bangalore, and the control group consisted of 50 healthy children who visited the Department of Pediatric and Preventive Dentistry, V S Dental College and Hospital, Bangalore for a routine dental check-up.

Institutional ethical committee clearance was obtained. Signed informed written consent was obtained from the parents/caregivers of the children participating in the study. Children with other systemic disorders excluding cerebral palsy, use of any drugs which interfere with salivary secretion (anticholinergic, and neuroleptic drugs) for at least 72 hours before the examination, and a history of head and neck radiation and surgical procedures to reduce drooling were excluded from the study.

All the children including the study and control group were examined under standardized conditions by a single qualified examiner. Caries evaluation was performed using optimal artificial light, mouth mirror, and probe. Dental caries were recorded according to World Health Organization (2013). Decayed, missing, and filled teeth were evaluated using the DMFT/dmft index for permanent and primary dentition.

Saliva collection was carried out in the daytime and children were asked not to eat or drink anything at least 60 minutes before the collection. The collected saliva was sent to the laboratory, Department of Biochemistry for assessment of selected salivary constituents (calcium, phosphorous, magnesium, sodium, potassium, and chloride) in a screw-capped bottle.

Statistical analysis was done using SPSS 22.0 (SPSS Inc., Chicago, IL) and the level of significance was set at $p<0.05$. Descriptive statistics were performed to assess the mean and standard deviation of the respective groups. The normality of the data was assessed using Shapiro Wilkinson test. Inferential statistics to find out the difference between the groups was done using an independent t-test.

## 3. Results:

A total of 100 children were examined for DMFT/dmft score and salivary constituents levels of calcium, phosphorous, magnesium, sodium, potassium and chloride. The study included 50 CP children and 50 healthy children with a mean age of about 9.06±2.56 years in control and 9.32 ± 2.19 years in the CP group (Table 1).

*Table 1: Comparison of age*

| | Normal | Cerebral Palsy | P-Value (Independent t-Test) |
|---|---|---|---|
| AGE | 9.06±2.56 | 9.32±2.19 | 0.58 |

Mean DMFT was found to be 0.78±1.29 and 0.22±0.64 in CP children and in healthy children respectively, which was statistically significant ($p = 0.004$). The decayed component (D) of the DMFT was found to be higher in the CP group as compared to that of the healthy group and the difference was statistically significant ($p = 0.003$) (Table 2).

*Table 2: Comparison of mean DMFT between the groups*

| | Normal | Cerebral Palsy | P-Value (Independent t-Test) |
|---|---|---|---|
| D | 0.2±0.60 | 0.74±1.17 | 0.003* |
| M | 0±0 | 0±0 | 1 |
| F | 0.04±0.19 | 0.02±0.14 | 0.55 |
| DMFT | 0.22±0.64 | 0.78±1.29 | 0.004* |

Mean dmft in the CP children was found to be 2.82±2.84 and 1.28±1.60 in the healthy children. The results were found to be statistically significant ($p = 0.0001$). The decayed (d) and missing (m) component of dmft was found to be higher in CP children than healthy children and the difference was statistically significant $p = 0.0002$ for decayed component and $p = 0.0001$ for the missing component. The filling component (f) of the dmft was found to be higher in healthy children as compared to that of CP children, with a statistically significant difference ($p = 0.01$) (Table 3).

*Table 3. Comparison of mean dmft between the groups*

| | Normal | Cerebral Palsy | P Value (Independent t Test) |
|---|---|---|---|
| D | 0.8±1.27 | 2.24±2.27 | 0.0002* |
| M | 0.16±0.54 | 0.58±1.14 | 0.0001* |
| F | 0.32±0.84 | 0±0 | 0.01* |
| DMFT | 1.28±1.60 | 2.82±2.84 | 0.0001* |

After assessing the salivary parameters, salivary phosphorous and potassium concentrations were increased in cerebral palsy children with a statistically significant difference. (p = 0.01, p = 0.001 respectively) (Table 4).

*Table 4. Comparison of salivary constituents between the groups*

| | Normal | Cerebral Palsy | P-Value (Independent t-test) |
|---|---|---|---|
| *Calcium* | 5.30±2.72 | 5.63±1.62 | 0.46 |
| *Magnesium* | 0.66±0.73 | 0.64±0.29 | 0.85 |
| *Sodium* | 15.8±8.79 | 13.9±6.66 | 0.22 |
| *Potassium* | 21.36±4.38 | 25.24±6.97 | 0.001* |
| *Chloride* | 19.93±6.47 | 20.26±6.73 | 0.80 |
| *Phosphorous* | 16.06±3.31 | 18.96±7.47 | 0.01* |

**4. Discussion:**

Cerebral palsy is a common neurodevelopmental condition in childhood and is higher in premature infants and twin births. Its incidence is 2 to 2.5 per 1000 live births worldwide (Rosenbaum, 2003). According to the nature of the motor disorder observed, CP is classified into spastic, dyskinetic, ataxic, and mixed. The neuromuscular problems inherent in CP can significantly affect oral health in several ways. These include changes in structure to the orofacial region, development of parafunctional habits, feeding problems, difficulties with maintaining oral hygiene, dental caries and encountering barriers to oral care access (Dougherty, 2009).

Dental caries is a unique multifactorial infectious disease. The severity of dental caries is affected by various internal and external factors such as saliva, tooth surface morphology, diet, the microbial flora colonizing the teeth, oral hygiene, and fluoride availability (Roberto, et al. 2012). It is well known that saliva plays an important role in the equilibrium between demineralization and remineralization of enamel in a potentially cariogenic oral environment (Subramanian, Babu, Rodriguez, 2010). The ability of saliva to affect the development of caries is dependent upon the quantity and composition of the secretions (Pandey, et al. 2015). A decrease in the salivary flow rate increases the risk of dental caries and also its changes in the protein and electrolyte composition (Siqueira, et al. 2007). A significant portion of children with cerebral palsy remains at high risk for caries development. The variations of the salivary constituents observed in this study can certainly affect caries incidence.

In the present study concentrations of calcium were high in cerebral palsy children compared to healthy children, but no statistically significant difference was observed between the groups. These were comparable with Siqueira W L, et al. (2007) who also reported that no statistically significant difference was found between the groups. In contrast, results obtained by Nada J. Radhi (2011) found that salivary calcium levels were lesser in CP children.

There was a significant increase in the salivary phosphorous concentrations in CP children compared to healthy children and the difference was statistically significant. Siqueira W L, et al. (2007) also reported an increase in salivary phosphorous concentrations in CP children but was not statistically significant. However, a contrary study done by Nada J. Radhi (2011) showed low concentrations of salivary phosphorous in CP children compared to healthy children.

Calcium and phosphorous are ions that are found in saliva that are directly related to the incidence of caries, maturation, or remineralization of enamel and calculus formation. They are the main factors controlling the stability of enamel. Calcium is secreted into saliva along with proteins and the concentration of calcium increases at increasing flow rates (Siqueira W L, et al. 2007) So, the altered concentration of these ions in saliva may result in disruption of these normal functions.

In the present study magnesium values were lower in CP children compared to healthy children. No statistical significance was observed between the groups. Siqueira W L, et al. (2007) also reported lower magnesium values in CP children.

Magnesium is involved as a co-factor and as an activator to a wide spectrum of enzymatic actions. About 70% of the body magnesium is present as apatites in bone, enamel and dentin. It exerts an effect on neuromuscular irritability which is similar to that of the calcium ions. A deficiency in magnesium leads to disturbances in the neuromuscular and vascular changes as well as changes in the teeth (Rajendra and Sivapathasundharam, 2012).

Salivary sodium levels were observed to be lower in the present study, and there was no statistically significant difference was found between the groups. Similarly, a study done by MTB Santos, et al. (2010), Tahmassebi J. F, (2003) showed no changes in the sodium concentrations of the groups studied. Studies done by Siqueira W L, et al. (2007), Nada J. Radhi (2011) showed lower concentrations of salivary sodium in the CP group and was statistically significant.

The variation in sodium and potassium concentrations suggests that there might be some injury in the energy-dependent reabsorption of electrolytes in the

duct system of the salivary gland which is associated with CP and also there is a significant linear correlation between sodium concentrations and the flow rate (Siqueira W L, et al. 2007) So, lower sodium concentrations in saliva may lead to reduced flow rate which in turn result in increased dental caries.

In the present study, salivary potassium concentration was higher in the CP children compared to normal children and was statistically significant. Siqueira W L, et al. (2007), Tahmassebi J. F, (2003), MTB Santos, et al. (2010) also have reported increased salivary potassium concentration in CP children. In contrast, a study done by Nada J. Radhi (2011) reported low concentrations of salivary potassium in CP children.

It is also stated that the muscular alterations seen in CP children may be due to the increase in potassium concentrations in blood and consequently in saliva which is related to motor disorders that are present in these children (Siqueira, et al. 2007).

In the present study, salivary chloride levels were observed to be higher in CP children compared to healthy children and there was no statistical difference between the groups. A study was done by MTB Santos, et al. (2010) also showed increased salivary chloride levels in CP children but there was a statistically significant difference between the groups.

These changes in the salivary electrolyte suggest that there is a compromise of the duct system of salivary glands in individuals with CP. While passing through the duct system, the primary saliva which is secreted in the acini of the salivary glands undergoes reabsorption of sodium and chloride and excretion of potassium and bicarbonate. The submandibular gland changes its secretory capacity, largely paracellular, according to the degree of osmolality of the medium. These changes are mediated by an osmosensor system in the basal membrane of the salivary gland. The hypohydration status probably causes an osmotic imbalance that alters the functions performed by the ducts of the salivary glands (Santos, et al. 2010)

These variations in the salivary electrolyte concentration corroborate with previous studies done by Siqueira W L, et al. (2007), MTB Santos, et al. (2010) who suggested that the neurological damage present in CP children might impair the ion exchange in salivary glands leading to diminished salivary flow rate which could be one of the factors influencing dental caries amongst these children.

With regard to dental caries in permanent and primary dentition, the mean DMFT was 0.78 and 0.22 in CP and healthy children respectively which was statistically significant (P=0.004). The mean dmft in healthy children was 1.28 whereas for CP children it was found to be 2.82, which was statistically significant (P= 0.0001). These findings suggest that cerebral palsy children had higher DMFT/dmft scores when compared to healthy children.

Studies done by MTB Santos, et al. (2002), Nallegowda, et al. (2005), Priya Subramanian (2010), Chandna, et al. (2011), Nada J. Radhi (2011), Nidhi Sinha, et al. (2015), Andreia (2015), Venkatesh Babu, et al. (2017), Akhter, et al. (2019) have also reported that dental caries were significantly higher in cerebral palsy children. In the contrary, one of the significant findings found in a study done by Nallegowda, et al. (2005) showed that cerebral palsy children with drooling were not affected with carious teeth.

The results obtained in the present study showed that the dental caries were higher and the F (filled) component of DMFT/dmft was very much lesser in CP children when compared to healthy children which is similar to the result reported by De Camargo and Antunes (2008) in which they assessed the prevalence of untreated dental caries in children with CP and found a higher prevalence of untreated caries in these children when compared with the healthy children.

Our findings suggest that the children with CP had high dental caries experience and that it can lead to a negative impact on the oral health-related quality of life (OHRQoL) amongst CP children and their parents or caregivers.

**5. Conclusion:**

The increased dental caries in children with cerebral palsy could be due to their motor and coordination difficulties, food pouching due to difficulty in swallowing, and poor oral care and hygiene. The variations seen in the salivary electrolyte concentrations in cerebral palsy children could also be a causative factor for the increased risk of developing dental caries and negatively affecting the quality of life in these children. Therefore, it should be emphasized that proper preventive care and early dental management is given to these children.

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