

Comparative Assessment of Salivary Osmolality as a Caries risk indicator in Cerebral palsy Children

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Introduction

Cerebral palsy (CP) the most common cause of severe physical disability in childhood is defined as a group of permanent disorders that involve movement and posture development causing limitation of activity, which can be attributed to non progressive disturbances occurring in the developing fetal or infant brain [1,2]. Cerebral palsy is classified as spastic and non-spastic type. Spastic CP defines patient presenting with stiffness of muscles and awkward movement where as Non-spastic CP presents ataxic (lack of motor co-ordination), athetoid (ceaseless involuntary writhing movements) and mixed conditions [3]. Cerebral palsy children are often misinterpreted as mentally disabled due to the presence of primitive postural reactions or reflexes and speech defects [4]. Children with cerebral palsy have poor nutritional state compared to healthy children. Dental caries is an oral health burden in both primary and permanent dentition of cerebral palsy children, as these patients exhibit higher percentage of decayed and lost teeth than healthy children [5,6]. The process of dental caries is dependent on both organic and inorganic components of saliva. Children with CP display low unstimulated salivary flow rates, pH and buffer capacity, variation in enzyme activities and sialic acid concentrations. These children also display increased salivary osmolality and total protein concentration as well as increased, urine and plasma osmolalities, suggestive of impaired hydration [7,8]. Low unstimulated salivary flow rates have been reported as an important risk factor for dental caries in cerebral palsy children [9]. As salivary osmolality is significantly correlated with salivary flow rate, it is presumed that salivary osmolality could be a better dental caries risk indicator in CP children. Hitherto very few studies have been reported in literature pertaining to salivary osmolality as a caries risk indicator in children. Thus the present study was undertaken to evaluate and compare oral health status and salivary osmolality in children with cerebral palsy and healthy children.

Materials and Methods

The study consists of 30 healthy children aged 6-12 years who visited the Department of Pediatric and Preventive Dentistry, V.S Dental College and Hospital for a routine dental check up and 30 cerebral palsy children aged 6-12 years who were registered under Department of Neurology, Indira Gandhi Institute of Child Health. Institutional Ethical committee clearance was obtained. Signed written informed consent was obtained from the parents/guardians of the children participating in the study. Children using any drug that could interfere with salivary secretion (anticholinergic and neuroleptic drugs, benzodiazepines) for at least 72 hours before examination, those with a history of head and neck radiation, children who underwent any surgery to reduce drooling and non cooperative children were excluded from the study. Clinical assessment was carried out by a single trained calibrated examiner using DMFT and dmft index by WHO criteria 1997. Examination of the children of both the groups were done on dental chair under natural light. Intra-examiner reliability was found with a Kappa score of 0.82. Saliva was collected by making the child sit on the dental chair such that the floor of the mouth is maintained parallel to the ground. Child's mouth was cleaned with the help of a sterile gauze and tweezer. The plain hub of the syringe was placed over the floor of the mouth. Once the saliva gets

pooled, using the plunger of the syringe, unstimulated whole saliva was collected by withdrawing it to a level of 2ml. The saliva withdrawn, is immediately emptied into the sterile test tube (BOROSIL) which was then sealed with the rubber stopper. The collected salivary sample was stored and transported to the laboratory at -40°C until analysis through ice cold storage medium. Salivary osmolality was determined using chemical analyzer AU 680. The results were subjected to statistical analysis.

Results

The present study was undertaken to evaluate and compare oral health status and salivary osmolality in children with cerebral palsy and healthy children. The mean age of healthy children were 10.4 (standard deviation-1.87) and cerebral palsy children were 6.9 (standard deviation-0.87)(Figure 1). The prevalence of dental caries of both primary and permanent teeth were evaluated by calculating the DMFT/dmft scores. The mean DMFT/dmft score for healthy children was 3.37 (standard deviation-1.56) and for cerebral palsy children it was 6.07(standard deviation-2.42)(Figure 2). The salivary osmolality values were recorded for both the groups. The mean values for healthy children were 40.52(standard deviation-4.92)and for cerebral palsy children 59.51(standard deviation-15.66)(Figure 3). The prevalence of dental caries and salivary osmolality values of cerebral palsy children were compared to healthy children using independent sample T test. It was observed that there was a statistically significant difference between DMFT/dmft scores of cerebral palsy children and healthy children (P=0.013). Also statistically significant difference was found between salivary osmolality of cerebral palsy children and healthy children (P=0.000). Univariate Poisson regression analysis was applied for the association among some independent variables (age and salivary osmolality) and caries experience. Salivary osmolality was positively associated with dmft/DMFT values (P=0.000). Age of the children did not show any significant association with caries experience (P=0.451)(Table 1)

TABLE 1: Univariate Poisson regression analysis

Variables	Rate ratio (95% CI)	P value
Age	1.067 (0.901- 1.264)	0.451
Osmolality	1.018 (1.009-1.026)	0.000

Figure 1: Distribution based on age of the children

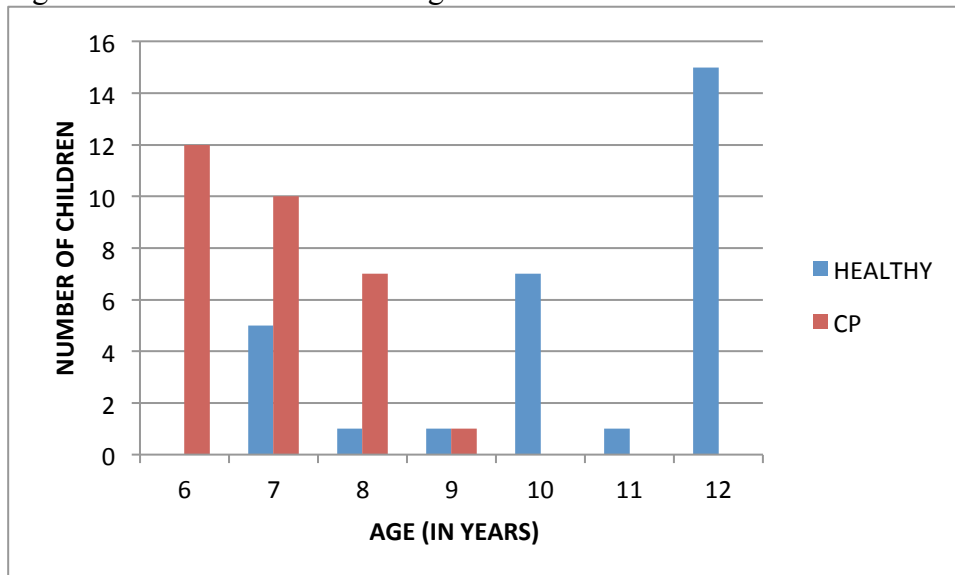


Figure 2: Distribution based on DMFT/dmft

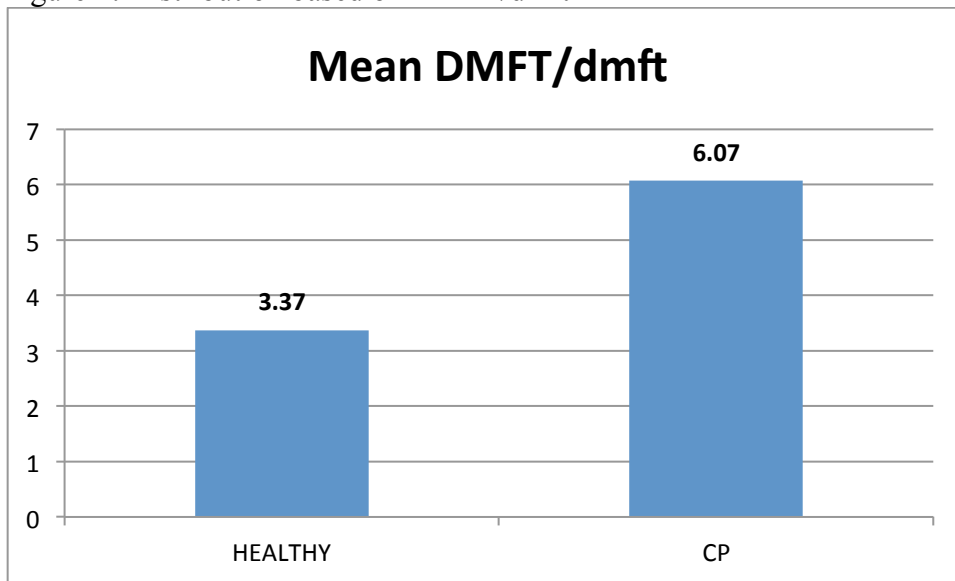
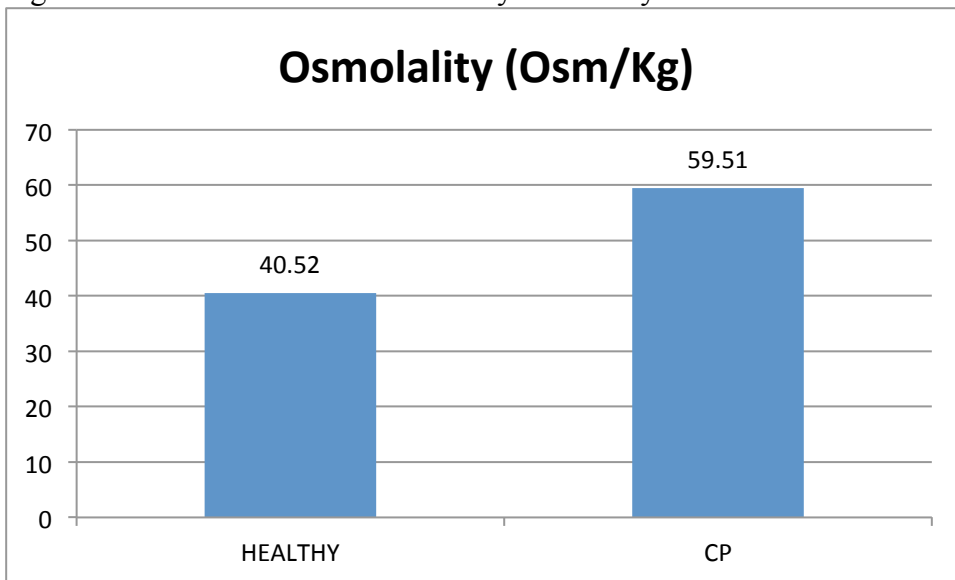


Figure 3: Distribution based on salivary osmolality



Discussion

The major oral health problems seen in children with cerebral palsy include carious teeth, periodontitis, malocclusion, bruxism and drooling of saliva [10,11,12]. It is also considered that saliva plays an important role in prevention of dental caries. A large number of inorganic and organic components influence the protective functions of saliva against dental caries. Osmolality is the number of osmotically active particles of solute contained in 1 litre of solution and it is expressed in milliosmoles of solute particles per kilogram of water. The present study was undertaken to evaluate and compare oral health status and salivary osmolality in children with cerebral palsy and healthy children.

In this study, 60 children were included in the age range of 6-12 years. Among them 30(50%) children were suffering from cerebral palsy and 30(50%) were healthy children. Prevalence of dental caries were evaluated using DMFT/deft index in which it was observed that in healthy children the mean value was 3.37 whereas for children with cerebral palsy it was found to be 6.07, which was statistically significant ($P=0.013$). These findings indicate that cerebral palsy children had higher

DMFT/dmft scores compared to healthy children. These findings are comparable to the results reported, in which they found higher DMFT/deft scores in cerebral palsy children compared to healthy children [2,13,14,15,16]. It is also stated that the severity and prevalence of dental caries were higher in cerebral palsy children compared to other handicapped groups and also cerebral palsy children had greater prevalence of dental caries in the primary dentition than in healthy children [17,18]. Contrary to the above studies, it has been reported that children with and without cerebral palsy had similar caries experience and also there was no significant difference found in def scores in mixed dentition in CP children [19, 20].

Higher dental caries experiences in cerebral palsy children are associated with their demographic, socio-economic, oral health perception, systemic information and lack of oral hygiene [21,22]. Food pouching was reported significantly higher in cerebral palsy children when compared to healthy children, due to their inability of oral structures to perform normal deglutition [23]. The higher prevalence of dental caries in cerebral palsy children may be due to lack of oral hygiene maintenance, poor socio-economic status, poor oral motor co-ordination and less awareness of oral health among parents/caretakers of these children.

As the predominant fluid constituent of saliva is water (97–99.5%), which enters saliva from plasma across acinar cells, it is stated that hypohydration may cause salivary gland hypofunction [24]. Hypohydration is a condition seen in CP individuals probably due to the fact that they are mainly dependent on their caregivers to offer them liquids; they usually do not complain of thirst and moreover, it is difficult for most of them to swallow all the water that is offered [25]. When the flow rate of saliva is increased, the concentration of protein, sodium, chloride and bicarbonate are increased whereas, magnesium and phosphorus are decreased. The increased concentration of bicarbonate diffuses into plaque, neutralizes plaque acids, increases the pH of the plaque and favors remineralization of teeth. It is stated that CP children have reduced salivary flow rate, total protein concentration and increased salivary osmolality suggesting a state of hypohydration in these individuals [26].

Salivary osmolality is a reliable parameter for evaluating hydration status in CP individuals, since it correlates with plasma and urine osmolality [27]. Reduction in salivary flow rate and increase in osmolality and total protein concentration in the saliva of individuals lead to procedures that cause loss of water, which are correlated with other parameters of body dehydration [26]. These changes could be caused due to hypohydration in CP children which may be reflected in saliva fluid, which could alter the function of saliva and the earlier this condition is identified the greater is the chance of administering preventive measures [8]. Children with cerebral palsy were observed to be severely oral motor dysfunctional, shows poor co-operation, fed on liquid diets and these children may be at higher risk of oral diseases [23,28]. These difficulties involved in CP children make it difficult to collect urine, blood or other body fluids and justify the use of saliva to monitor systemic conditions which is an excellent and noninvasive technique. Since children with cerebral palsy exhibit low salivary flow rate, it can be assumed that salivary osmolality could serve as better risk indicator than flow rate.

Evaluation of the salivary osmolality is a noninvasive means to determine the fluid volume and concentration in real time, with excellent precision, accuracy and reliability. This procedure exhibits less individual variation than that observed for the unstimulated whole saliva flow rate [29]. Only a small amount of saliva is necessary to evaluate the salivary osmolality using a chemical analyzer AU680. In the present study the mean value for salivary osmolality in cerebral palsy children were higher (59.51) than healthy children (40.52) which is statistically significant ($P=0.000$). The findings of the present study indicate that salivary osmolality values were higher in cerebral palsy children when compared to healthy children ($P=0.000$) and also caries incidence was found to be higher in CP children ($P=0.013$). Salivary osmolality was positively associated with DMFT/deft values ($P=0.000$) [Table 1]. Comparable results were reported in previous study in which they found a significant association between osmolality and caries experience in cerebral palsy children [30]. This is the first study undertaken to evaluate and compare oral health status and salivary osmolality in children with cerebral palsy and healthy children.

In children with cerebral palsy, feeding dysfunctions such as alterations in mastication and swallowing may lead to reduced dietary intake, prolonged feeding time and poor nutritional status which is accompanied by compromised physical performance. Decreased levels of hydration (dehydration) may cause diminished salivary output, which could compromise the protective function exerted by saliva and lead to increased risk of oral diseases [36]. Dental management of these children begins with prevention and thus maintenance of a caries-free dentition. It is imperative that parents are advised about the importance of oral care and that preventive care is delivered as early as possible and is reinforced at every dental visit, so that the need for active treatment is minimal. Children with cerebral palsy do not tend to attend dental checkups /Appointments unless they have severe toothache or swelling. This may be due to inadequate knowledge and awareness about importance of oral health care among these children and their care takers.

Considering evidence from other studies also, it is reasonable to conclude that oral health is poor compared to healthy children and salivary osmolality is one of the caries risk indicator for dental caries in cerebral palsy children. This could be attributed to compromised oral motor performance which could interfere with fluid intake resulting in hypohydration in cerebral palsy children and enhances bacterial agglutination and a biofilm formation which increases the caries risk. Furthermore, salivary osmolality should be tested in cohort studies to evaluate the osmolality with caries incidence on a larger scale.

Conclusion

From the findings of the present study it can be concluded that Salivary Osmolality could serve as potential risk indicator for dental caries in children suffering from cerebral palsy. Salivary osmolality values were found to be high in cerebral palsy children along with higher prevalence of dental caries compared to healthy children. A comprehensive understanding of the oral health condition of children with cerebral palsy is essential for the purpose of proper dental management of these children. Dental treatment modifications are necessary for such children to provide a better oral health care. Emphasis should be given on preventive care by providing awareness through oral health education programs for the parents/caregivers so that aggressive treatment involving greater risks are avoided

Compliance with Ethical Standards:

Funding: No funding

Conflicts of interest: The authors declare that they have no conflict of interest.

Ethical Approval: All procedures performed in the study involving human participants were in accordance with ethical standards of the institution and/or national research committee with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent: Informed consent was obtained from all individual participants in the study.

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