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Original Research

Salivary pH as a prediction tool for dental caries

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ABSTRACT:
Abstract
Background: To evaluate caries activity by contrasting the pH levels in children without caries with those who have caries and explore the connections between these two groups. **Materials & Methods:** In this study, a sample of 40 children aged between 5 and 9 years was selected. The children were divided into two groups: (i) a caries-free group consisting of 20 children, and (ii) a caries-active group with 20 children. The significance level for all statistical tests was set at a p-value of 0.05 or lower. **Results:** An observation revealed that the average pH values were higher in the caries-free group, implying that as the tested parameters increase, caries activity tends to decrease. **Conclusion:** There is a clear correlation between the physicochemical characteristics of saliva, including its pH, and the presence of caries activity.
Keywords: saliva, pH, dental caries.

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INTRODUCTION

Oral cavity is constantly exposed to the influence of adverse environmental factors and saliva is the first secretion to come in contact with exogenous substances. This complex biofluid represents a mixture of various fluids and components that helps in maintaining the oral health. [1] Dental caries is a chronic, infectious, and irreversible disease of the calcified tissues of teeth, which demineralises the inorganic portion and destroys the organic substance of the tooth, which often leads to cavitation. [2] The word "caries" is derived from a Latin word meaning "rot" or decay. It is a complex and dynamic process where many factors influence and initiate disease progression. [3] Epidemiological studies measuring the prevalence and severity of dental caries have used modified versions of Klein and colleagues' decayed, missing, and filled (DMF) or Gruebbel's decayed, extraction indicated, and filled (def) indexes; however, these indexes only capture cavitated lesions. [4] The pervasiveness of dental caries in India is 50-60%. An interplay of three principal factors is responsible for this multi-factorial disease host: teeth and saliva, microorganisms in the form of dental plaque, and substrate (diet).

Saliva plays a very important role in oral health. Based on the constituents of saliva, it adopts properties such as lubrication, clearance of unwanted substances, digestion, neutralization of acids or bases, protection against demineralization and also an antimicrobial role. [5] Theoretically, saliva affects the incidence of dental caries in four ways: (1) as a mechanical cleansing agent that results in less accumulation of plaque, (2) by reducing enamel solubility by means of calcium, phosphate and fluoride, (3) by buffering and neutralizing the acids produced by cariogenic organisms or introduced directly through diet and (4) by antibacterial activity. [6] Saliva composition is an important factor in determining the prevalence of caries. [7] For relative protection against dental cavities, flow rate, buffer capacity, calcium, phosphate and fluoride concentrations are essentials. [5] The saliva circulating in the mouth at any given time is termed as whole saliva, and it comprises of a mixture of secretions from the major and minor salivary glands and traces from the gingival crevicular fluid. [8] Saliva definitely promotes oral health and hence lack of its secretion contributes to the disease process. The saliva, by constantly bathing the teeth and oral mucosa, functions as a cleansing solution, a lubricant, a buffer and an ion reservoir of calcium and phosphate, which are essential for the remineralization of initial carious lesions. [9] There is often a correlation between pH changes in plaque and sugar clearance from saliva. The low salivary pH provides an acidogenic environment for the growth of aciduric bacteria leading to dental caries which again further lowers the salivary pH leading to a vicious cycle. [10] Hence, this study was conducted to evaluate caries activity by contrasting the pH levels in children without caries with those who have caries and explore the connections between these two groups.

Materials & Methods:

In this study, a sample of 40 children aged between 5 and 9 years was selected. The children were divided into two groups: (i) a caries-free group consisting of 20 children, and (ii) a caries-active group with 20 children. The samples were sent to a laboratory for pH analysis using an electrode pH meter. The data collected was then analyzed using SPSS software. To assess differences in means for normally distributed data, an independent t-test was employed, and a chi-squared test was performed. The significance level for all statistical tests was set at a p-value of 0.05 or lower.

Results:

A total of 40 subjects were enrolled. The age group included was 5 to 9 years. An observation revealed that the average pH values were higher in the caries-free group, implying that as the tested parameters increase, caries activity tends to decrease.

Table 1: mean value of pH in both groups

	Group	N	Mean	P –value
pH	Caries –free	20	7.22	0.0001*
	Caries-active	20	6.05	

*; Significance

Discussion:

Among the various protective functions of saliva, including diluting and cleaning the oral cavity, serving as a host defense, and buffering and enabling ion exchange, certain salivary characteristics outside the normal range of values may contribute to the caries process.[11] Dental caries results from the dissolution of minerals from the tooth surface by organic acids formed from the bacterial fermentation of sugars. The capacity of saliva to flush microorganisms and substrates and maintain oral cleanliness may be influenced by its consistency and flow rate. [12,13] Salivary pH and buffering capacity can contribute to the ion exchanges during re-mineralization and demineralization of enamel, with supersaturation of calcium and phosphate at pH 7 and in the presence of fluoride. [14] The concentration of hydrogen ions (pH) at the tooth surface also will affect the rate of demineralization. [14] The statements above are based primarily on the results of in vitro studies that reveal the biological plausibility for changes in salivary characteristics to contribute to the development of dental caries. Hence, this study was conducted to evaluate caries activity by contrasting the pH levels in children without caries with those who have caries and explore the connections between these two groups.

In the present study, a total of 40 subjects were enrolled. The age group included was 5 to 9 years. A study by Singh S et al, study sample of 80 children, aged between 4 and 8 years were included in the study. Caries status of each child was recorded using DMFS. They were divided into two groups: (i) caries-free group (40) and (ii) caries-active group (40). After collecting the salivary samples, mutans were determined using Saliva-Check mutans kit and buffering capacity by Saliva-Check Buffer kit. The results obtained were tabulated and subjected to statistical analysis. The pH, buffering capacity, calcium and phosphorous level were found to be increased with the decrease in the caries activity of the children whereas amylase activity was increased with the increase in caries activity. It was observed that 77.5% children were tested positive and 22.5% were tested negative for mutans in caries-active group whereas 100% children were tested negative for mutans in caries-free group. The physicochemical properties of saliva, such as pH, buffering capacity, calcium, phosphorous, amylase and Streptococcus mutans has a definite relationship with caries activity. [15]

In the present study, an observation revealed that the average pH values were higher in the caries-free group, implying that as the tested parameters increase, caries activity tends to decrease. Another study by Choudhary A et al, study was done on a population consisting of 400 school-going children in the age group of six to 12 years. Oral examination was undertaken by a single examiner, who is the study's principal investigator, to avoid inter-examiner variability. Testing of resting saliva was done for evaluation of visual inspection of the level of hydration, saliva consistency, pH measurement, saliva quantity, and buffering capacity. There was no significant difference in resting salivary flow rate between children with decayed, missing, and filled teeth (DMFT) scores less than 5 and DMFT scores of 5. The mean buffering capacity of stimulated saliva was found to be significantly more among children with DMFT scores less than 5 than children with DMFT scores of 5 or more. The mean pH of resting saliva was found to be significantly higher among children with DMFT scores less than 5 than children with DMFT scores of 5 or more. The prevalence of caries based on age was maximum in mixed dentition and minimum in primary dentition. In contrast, the difference in severity based on age was maximum in permanent dentition. The prevalence of caries was higher in children whose parents were aware of dental health; the difference was more significant in children with primary and mixed dentition. This study showed that salivary parameters such as salivary flow rate, salivary pH, and salivary buffering capacity among school-going children correlated with the prevalence of caries. [16] Animireddy D et al, a total of 75 school children of age group between 4 and 12 years were selected and divided into three equal groups: Group I, Group II and Group III, consisting of 25 subjects each. Group I included caries-free subjects, Group II included subjects with minimal caries and Group III included subjects with nursing caries. Saliva samples were collected from all subjects and were estimated for flow rate, pH, buffering capacity and viscosity. There was a significant decrease in the mean salivary flow rate, salivary ph and salivary buffer capacity and a significant increase in the salivary viscosity among caries-free subjects, subjects with minimal caries and subjects with nursing caries. The physicochemical properties of saliva, such as salivary flow rate, pH, buffering capacity and viscosity, has a relation with caries activity in children and act as markers of caries activity. [17] Cunha-Cruz J et al, low resting pH (≤ 6.0) in the overall sample and low stimulated salivary flow rate (≤ 0.6 milliliter/minute) in older adults (≥ 65 years old) were associated with increased dental caries (RR, 1.6; 95 percent confidence interval [CI], 1.1–2.2; RR, 2.4; 95 percent CI, 1.5–3.8, respectively). Low buffering capacity was associated with decreased dental caries in children and adolescents (RR, 0.3; 95 percent CI, 0.1–1.0; RR, 0.2; 95 percent CI, 0.1–0.7, respectively). A thick, sticky or frothy salivary consistency also was associated with decreased dental caries in adults (RR, 0.6; 95 percent CI, 0.4–1.0). Associations between other salivary characteristics and dental caries for the overall sample and within each age group were not statistically significant. Salivary characteristics were associated weakly with previous dental caries experience, but the authors did not find consistent trends among the three age groups. Different salivary characteristics were associated with an increased caries experience in older adults and a lowered caries experience in children and adolescents and adults. [18] Saliva maintains the integrity of oral hard and soft tissues and protects against immunologic bacterial, fungal and viral infections. [9] Saliva controls the equilibrium between demineralization and remineralization in a cariogenic environment. Salivary buffers can reverse the low pH in plaque and allow for oral clearance thus preventing demineralization of enamel. The flow rate and viscosity of saliva may also influence the development of caries. [19]

Conclusion:

There is a clear correlation between the physicochemical characteristics of saliva, including its pH, and the presence of caries activity.

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