International Journal of Community Medicine and Public Health
Annapoorna HB et al. Int J Community Med Public Health. 2020 Dec;7(12):4865-4868
http://www.ijcmph.com
pISSN 2394-6032 | eISSN 2394-6040

DOI: https://dx.doi.org/10.18203/2394-6040.ijcmph20205154

Original Research Article

Effects of the salivary flow rate, pH, viscosity and buffering capacity on dental caries experience in government school children in Bangalore city

Annapoorna H. B., Dipayan Datta*

Department of Public Health Dentistry, Triveni Institute of Dental Sciences, Hospital and Research Centre, Bilaspur, Chhattisgarh, India

Received: 23 June 2020
Revised: 14 September 2020
Accepted: 15 September 2020

***Correspondence:**
Dr. Dipayan Datta,
E-mail: datta.dipayan2@gmail.com

Copyright: © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT

Background: The present study was undertaken to evaluate effect of the salivary flow rate, pH, viscosity and buffering capacity on caries experience in government school children.
Methods: This case-control study was conducted amongst the Government school children of Bangalore city aged 6-14 years. A total of 180 school children were selected out of what 90 were selected for the test group based on the presence of one or more active dental caries and another 90 were selected for the control group who were free of dental caries at the time of examination. Saliva samples were collected from all subjects and were estimated for flow rate, pH, viscosity and buffering capacity.
Results: Mean salivary flow rate, pH and buffer capacity have been found to be significantly lower and mean salivary viscosity has been found to be significantly higher among children with dental caries.
Conclusions: The physical and biochemical properties of saliva, such as salivary flow rate, pH, buffering capacity and viscosity are significantly related with the caries experience in children.

Keywords: Salivary flow rate, Salivary pH, Salivary buffering capacity, Salivary viscosity, Caries experience

INTRODUCTION

Dental caries is a chronic, complex, multifactorial disease for which myriad etiologic host and environmental factors have been proposed. It remains as a widely prevalent bacterial infection despite tremendous advances in its prevention and treatment. According to the epidemiological model and contemporary etiological findings, it is generally believed that caries occurs as a result of three primary, essential factors (1) host (enamel quality, histo-morphological properties of enamel surface, properties of saliva), (2) causative agents (dental plaque, microorganisms and oral flora) and (3) environment (dietary habits, food properties), along with time being included as the fourth factor.[1]

Saliva, the oral fluid is secreted by the salivary glands at the rate of 0.3 ml to a maximum of 1.1 ml per minute amounting to 0.5 to 1 litre per day. It is present as a thin film around the teeth and soft tissues whose average thickness is of the order of only 0.1 mm. The principal properties of saliva which is of crucial importance in the protection of the teeth against caries are: (a) clearance of dietary sugars and the dilution effect; (b) the neutralizing and buffering of the acids in the plaque and (c) the provision of ions for remineralisation.[2,3]

The most important variables affecting the salivary sugar clearance are the unstimulated salivary flow rate as well as the stimulated salivary flow rate which could be related to the volumes of saliva in the mouth immediately before and

after swallowing. Another important salivary factor is its viscosity. Viscosity is defined as the resistance offered by the liquid to flow, hence lower the viscosity; rapid is the clearance of the sugar from the oral cavity and lesser the carious process.[4,5]

The most possible reasons for change in the oral balance that is favouring demineralization may be answered by measuring important salivary parameters. Evaluating the composition of saliva in individuals who are at risk of developing dental caries can pave the way to make recommendations that will cater specifically to individual's needs.[6] Along with the role of saliva, oral hygiene practice and dietary habits also have significant impact on oral health. Hence this study was done with the objective to evaluate the role of salivary parameters in dental caries assessment as there is a considerable inter-subject variation in the composition of the saliva and dietary habits.

METHODS

This study was a case-control study which was conducted from January, 2007 to July, 2007 amongst the Government school children of Bangalore city aged 6-14 years to assess the effect of salivary flow rate, pH, viscosity, buffering capacity and dietary factors on their caries experience. A list of government schools was obtained from the deputy director of public instructions (DDPI) and schools were selected randomly. Informed consent was obtained from the parents of the school children for clinical examination as well as saliva collection. Children with any chronic systemic diseases or under any long-term medication or undergoing chemotherapy/radiotherapy for cancer treatment were excluded from the study.

The sample size was calculated using G*power software version 3.1.9.2 with alpha error of 0 05, beta error of 0.1, effect size of 0.5 and power of the study of 90%. A total of 180 school children were selected out of what 90 were selected for the test group based on the presence of one or more active dental caries and another 90 were selected for the control group who were free of dental caries at the time of examination.

The clinical examination was carried out by a trained examiner to record the caries experience of the children by using DMFT index given by Klein, Palmar and Knutson (1938) as well as DMFT index as given by Gruebell (1944). GC Saliva kit (consisting of small graduated disposable cup, paraffin wax, pH strips, pH standard chart, buffer strips, buffer standard chart and 2 ml pipette) and Ostwald's viscometer were used for the collection and assessment of the characteristics of resting and stimulated saliva. The demographic and dietary data were obtained by a structured questionnaire containing questions about: type of cleaning aids (finger, twig or toothbrush), type of material used (tooth paste or tooth powder), frequency of cleaning (once daily or twice daily), type of diet (vegetarian or mixed) and frequency of sugar exposure (less than 3 times a day or more than 3 times a day).

Statistical analysis

The statistical software used was SPSS v.20. At first, to check the normality of the data, Kolmogorv-Smirnov test was applied which showed that the data was not following normal distribution hence non-parametric test was required to be applied. Mann-Whitney U test was applied to compare the variable between the groups and Wilcoxon Signed rank test was applied to compare the characteristics of resting and stimulated saliva within the groups. Significance level was determined as 5% (α=0.05).

RESULTS

Among the participants, 47% were male and 53% were female in test group and 49% were male and 51% were female in control group. In the test group, 19% used finger, 2% used twig and 79% used toothbrush as cleaning aid. In the control group, 8% used finger, 1% used twig and 91% used toothbrush as cleaning aid. In the test group, 22% used tooth powder and 78% used tooth paste as cleaning material. In the control group, 11% used tooth powder and 89% used tooth paste as cleaning material. In the test group, 84% cleaned their teeth once daily and 16% cleaned their teeth twice daily. In the control group, 64% cleaned their teeth once daily and 36% cleaned their teeth twice daily (Table 1).

Table 1: Oral hygiene practice of the children.

Variables		Test group (N)	Control group (N)
Gender	Male	42	44
	Female	48	46
Type of cleaning aids	Finger	17	7
	Twig	2	1
	Tooth brush	71	82
Type of material used	Tooth powder	20	10
	Tooth paste	70	80
Frequency of cleaning	Once daily	76	58
	Twice daily	14	32

The assessment of the dietary habit showed that the participants consume both vegetarian and mixed (vegetarian and non-vegetarian) type of diet. In the test group, 16.8% children were vegetarians while 83.3% children had mixed diet. In the control group, 21.1% children were vegetarians while 78.9% children had mixed diet. In the test group, 48.9% children were exposed to sugar up to 3 times a day and 51.1% children were exposed to sugar more than 3 times a day. In the control group, 97.6% children were exposed to sugar up to 3 times a day and 2.4% children were exposed to sugar more than 3 times a day (Figure 1).

The assessment of the salivary characteristics revealed that, the flow rate of resting saliva was higher (0.49±0.18 ml/minute) in the control group i.e. children with no dental caries than the test group i.e. children with dental caries ($p<0.05$) and the flow rate of stimulated saliva was higher (1.53±0.62 ml/minute) in the control group than the test group ($p<0.05$). The pH of resting saliva was higher (7.17±0.43) in the control group than the test group ($p<0.05$) and the pH of stimulated saliva is higher (7.68±0.22) in the control group than the test group ($p<0.05$). The viscosity of resting saliva was higher (11.64±0.73) in the test group than the control group ($p<0.05$) and the viscosity of stimulated saliva was higher (10.28±0.77) in the test group than the control group ($p<0.05$). The buffering capacity of resting saliva was higher (9.59±1.38) in the control group than the test group ($p<0.05$) and the buffering capacity of stimulated saliva was higher (11.78±0.76) in the control group than the test group ($p<0.05$). The intragroup comparison of flow rate, pH, viscosity and buffering capacity between resting and stimulated saliva showed that significant differences ($p<0.05$) exist between them (Table 2).

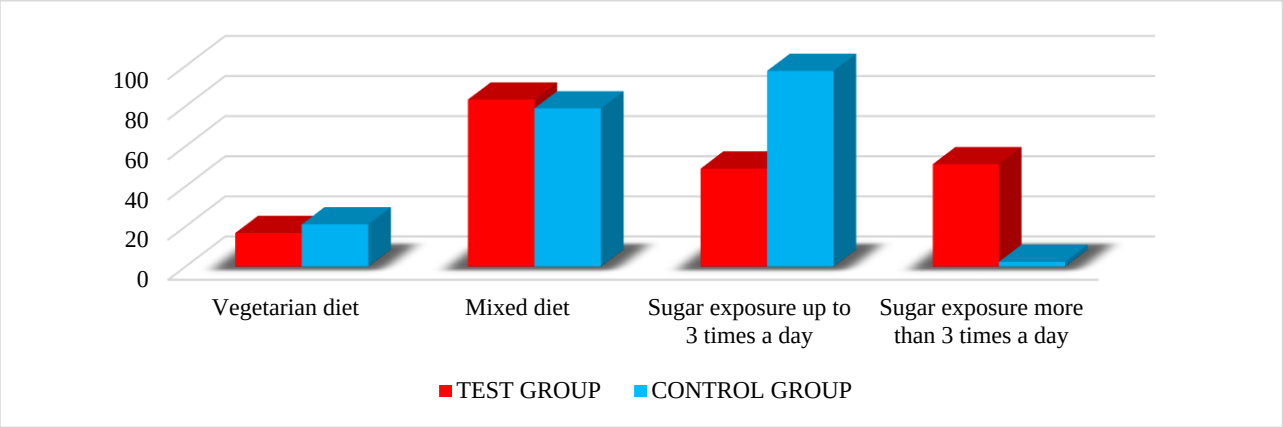

Figure 1: Dietary habits of the children.

Table 2: Comparison of the characteristics of saliva between test and control groups.

Characteristics		Test group (Mean ± SD)	Control group (Mean ± SD)	P value
Flow rate	Resting	0.44±0.20	0.49±0.18	0.045*
	Stimulated	1.37±0.58	1.53±0.62	<0.001*
	P value	<0.001#	<0.001#	
pH	Resting	6.98±0.46	7.17±0.43	<0.001*
	Stimulated	7.51±0.33	7.68±0.22	<0.001*
	P value	<0.001#	<0.001#	
Viscosity	Resting	11.64±0.73	11.13±0.63	<0.001*
	Stimulated	10.28±0.77	9.96±0.54	<0.001*
	P value	<0.001#	<0.001#	
Buffering capacity	Resting	5.40±1.61	9.59±1.38	<0.001*
	Stimulated	9.00±1.05	11.78±0.76	<0.001*
	P value	<0.001#	<0.001#	

*Mann-Whitney U test showed intergroup difference is statistically significant ($p<0.05$), # Wilcoxon Signed rank test showed intragroup difference is statistically significant ($p<0.05$).

DISCUSSION

The present study showed the flow rate of both resting and stimulated saliva was lower in children with dental caries. The dental caries process is controlled to a large extent by a natural protective mechanism inherent within the saliva. The most important caries protective functions of saliva are the cleansing and the neutralizing effects of acids which is dependent on the flow rate.[7] Rahman et al reported mean salivary flow rate 0.14 ml/minute among children with caries experience.[8] The decreased in the mean salivary flow rate observed among the caries active groups than the caries free groups in this study is in agreement with previous studies.[9] These also support the idea that under resting conditions without exogenous stimulation that is linked with feeding, there is a slow flow of saliva, which only keeps the mouth moist and lubricates the mucous membrane. Nasiru and Edgar et al reported that unstimulated flow is what is secreted by the salivary glands majority of the time and is essential for providing the protection functions to the teeth against dental caries.[10,11] Leone et al and Verma et al found that the pH of both resting and stimulated saliva was lower in caries affected children.[12,13] The viscosity was found to be higher in

children with dental caries for both resting and stimulated saliva. The increased viscosity can lead to the reduction of the natural flow of saliva resulting in improper cleansing and further dental decay as per the findings of Abou et al and Yarata et al.[14,15] The buffering capacity of both resting and stimulated saliva was lower in caries affected children. Preethi et al and Abou et al suggested that salivary buffers can reverse the low pH in plaque and allow for oral clearance thus preventing demineralization of enamel.[14,16]

The study also revealed that children using tooth brush with tooth paste and brush their teeth more than once daily are less prone to have caries experience. It is a proven fact that better maintenance of oral hygiene reduces the risk of dental caries.[17] Children exposed to sugar more than thrice a day are more likely to develop dental caries. Previous researches showed that diet with high sugar and calories are associated with dental caries.[18]

Limitations of the study were that because of the modest sample size, explanatory and confounding variables were dichotomised. Oral health practices and soft drink consumption were self-reported, hence, there are chances of over- or under-estimation.

CONCLUSION

Saliva plays an important role in oral health. Its functions on lubrication, cleansing, digestion, neutralization of acids or bases, protection against demineralization and microorganisms are mostly dependent upon its physical and chemical properties. It has been established in the present study that along with the oral hygiene practice and frequency of sugar consumption, the flow rate, pH, viscosity and buffering capacity of saliva has a significant relationship with caries experience in children. Surveys in large scale are required to extrapolate the findings of this study.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Ismail A T, Sohn W, Lim S, Willen JM. Predictors of dental caries progression in primary teeth. J Dent Res. 2009;88(3):270-5.
2. Gopinath VK, Arzreanne. Saliva as a diagnostic tool for assessment of dental caries. Arch Orofac Sci. 2006;1:57-9.
3. Malamud D. Saliva as a diagnostic fluid. Dent Clin North Am. 2011;55:159-78.
4. Prethi BP, Pyati A, Dodawad R. Evaluation of flow rate, pH, buffering capacity, calcium, total protein and total antioxidant levels of saliva in caries free and caries active children. Biomed Res. 2010;21(3):289-94.
5. Mandel ID. The role of saliva in maintaining oral homeostasis. J Am Dent Assoc. 1989;119:298-304.
6. Abiola AA, Eyitope OO, Sonny OJ, Oyinkan OS. Dental caries occurrence and associated oral hygiene practices among rural and urban Nigerian pre-school children. J Dentist Oral Hygiene. 2009;1(5):64-70.
7. Kaur A, Kwatra K S, Kamboj P. Evaluation of non-microbial salivary caries activity parameters and salivary biochemical indicators in predicting dental caries. J Indian Soc Pedod Prev Dent. 2013;30:212-7.
8. Rahman NA, Yusoff A, Daud MK, Kamaruzaman FN. Salivary parameters, dental caries experience and treatment needs of hearing-impaired children in a special school for deaf in Kelantan, Malaysia. Arch Orofac Sci. 2015;10(1):17-23.
9. Prabhakar AR, Reshma D, Raju OS. Evaluation of flow rate, pH, buffering capacity, calcium, total protein and total antioxidant capacity levels of saliva in caries free and caries active children- an in vivo study. Int J Clin Pediatr Dent. 2009;2(1):9-12.
10. Nasiru WO. Salivary flow rate, buffering capacity and dental caries among 6-12-year-old school children, age and gender in Nigeria: A comparative study. IOSR J Dent Med Sci. 2019;18(1):72-9.
11. Edgar WM, Highman SM, Manning RH. Saliva stimulation and caries prevention. Adv Dent Res. 1994;8(2):239-45.
12. Leone CW, Oppenheim FG. Physical and chemical aspects of saliva as indicators of risk for dental caries in humans. J Dent Educ. 2001;65(10):1054-62.
13. Varma S, Banerjee A, Bartlett D. An in vivo investigation of associations between saliva properties, caries prevalence and potential lesion activity in an adult UK population. J Dent. 2008;36(4):294-9.
14. Abou El-Yazeed M, Taha S, El Shehaby F, Salem G. Relationship between salivary composition and dental caries among a group of Egyptian down syndrome children. Aus J Basic Appl Sci. 2009;3:720-30.
15. Yarata A, Koc L, Emeklia N. Salivary sialic acid, protein, salivary flow rate, pH, buffering capacity and caries indices in subjects with Down's syndrome. J Dentist. 1999;27:115-8.
16. Preethi BP, Reshma D, Anand P. Evaluation of flow rate, pH, buffering capacity, calcium, total protein and total antioxidant capacity levels of saliva in caries free and caries active children: An in vivo study. Indian J Clin Biochem. 2010;25:425-8.
17. Hujoel PP, Hojoel MLA, Kotsakis GA. Personal oral hygiene and dental caries: A systematic review of randomised controlled trials. Gerodontol. 2018;35:282-9.
18. Moynihan P. Sugars and dental caries: evidence for setting a recommended threshold for intake. Adv Nutr. 2016;7:149-56.

Cite this article as: Annapoorna HB, Datta D. Effects of the salivary flow rate, pH, viscosity and buffering capacity on dental caries experience in government school children in Bangalore city. Int J Community Med Public Health 2020;7:4865-8.