Original Article

Correlation of Dental Caries Severity with Physical Properties of Saliva in Connection with Nutrition Status among a Group of Adolescent

Sarah Hikmat Yousif, Alhan Ahmed Qasim

Department of Pediatric and Preventive Dentistry, College of Dentistry, University of Baghdad, Baghdad, Iraq

Abstract

Background: One of the most common oral health problems in the world, dental caries, is a multifactorial sickness. Interactions between saliva, fermentable carbohydrates, acid-producing bacteria, and several host factors cause it. **Objective:** This study was conducted among a group of adolescents to evaluate the correlation of dental caries severity with the physical properties of saliva in connection with nutrition status among a group of adolescents. **Materials and Methods:** In total, 90 teenagers of both genders, aged 15, participated in the current observational (comparison) study. The participants were split into two groups: 60 had previously had caries (the study group) and 30 had not (the control group). Adolescents with diverse caries experiences were separated into two groups in accordance with World Health Organization (WHO) recommendations from 2013: 30 of them had moderately carious (1–3) teeth, and 30 had severely carious experiences (Decay-Missing-Filled Teeth [DMFT] > 10). Caries' experience was measured using the DMFT Index. Weight, height, and body mass index (BMI) measurements were used to determine nutritional status. Based on their BMI, adolescents were categorized as having a healthy weight, being at risk of becoming overweight, or being overweight. **Results:** The current study's findings show that both salivation rate and salivary and potential of hydrogen (pH) mostly decrease within nutritional status and caries severity groups but with no significant difference except in the total sample in salivation rate among nutritional status, its result is significant; also, there is a significant result between healthy and overweight in salivary flow rate, whereas other results are not significant. **Conclusion:** This study concluded that obesity is one of the factors responsible for deranged salivary parameters, that is, diminished stimulated salivary flow rate, buffer capacity, and salivary pH, which in turn has an adverse effect on oral health.

Keywords: Adolescents, dental caries, nutrition status, salivary flow rate, salivary pH

Introduction

Adolescence is a complex, multisystem transitional process involving the transition from childhood immaturity and social dependency into adulthood with the goal and expectation of fulfilled developmental potential, personal agency, and social accountability.[1]

Adolescence is one of the most rapid stages of physical development, accounting for one-third of all growth in a lifetime, and it begins with the onset of puberty. There is a great deal of cultural and individual variation during this stage of life.[2]

Dental caries, one of the most common problems in oral health, is a complex disease with numerous causes. Acid-producing bacteria, fermentable carbohydrates, and many host elements (such as saliva) interact in complex ways to cause this condition. Bacteria are largely responsible for this illness.[3,4]

Diet and nutrition have both local and systemic effects on the etiology and pathogenesis of dental caries.[5] The effect of nutrition on saliva quality as a function of

Access this article online

Quick Response Code:

Website: https://journals.lww.com/mjby

DOI: 10.4103/MJBL.MJBL_130_23

Address for correspondence: Sarah Hikmat Yousif, Department of Pediatric and Preventive Dentistry, College of Dentistry, University of Baghdad, Baghdad, Iraq. E-mail: sara.Hekmat1202a@codental.uobaghdad.edu.iq

Submission: 07-Feb-2023 **Accepted:** 27-Feb-2023 **Published:** 02-Feb-2024

How to cite this article: Yousif SH, Qasim AA. Correlation of dental caries severity with physical properties of saliva in connection with nutrition status among a group of adolescent. Med J Babylon 2023;20:715-20.

saliva buffering capacity. There is some debate about the relationship between dental caries and body weight.[6]

Saliva is essential for maintaining oral health and physiology. It has been shown to be a reliable diagnostic tool for detecting a wide range of biomarkers. It can be used for oral diagnosis because it protects the host organism. Salivary proteins have numerous benefits for tooth health, including cleaning the mouth, preventing tooth decay, halting demineralization, promoting remineralization, quickly neutralizing acids, and protecting the mouth from infection.[6–8]

Pellicle protein works with the calcium and phosphate ions in saliva to promote the remineralization of enamel, which slows demineralization. Salivary (glyco) proteins play an important role in dental hygiene by inhibiting the growth of oral bacteria by preventing their adhesion to the enamel pellicle.[9,10]

Saliva flow rate is important in accelerating the cleansing action of the oral cavity by removing shedding soft tissue cells, bacteria, and food remnants, as well as buffer action that reduces the cariogenic environment orally.[11,12]

Salivary pH has a direct relationship with flow rate, and a higher flow rate leads to a higher pH value by buffering action, which can reach 7.8 at the highest flow rate.[13]

Caries can be diagnosed and treated with DMFT. The DMFT records tooth deterioration, loss, and restorations.[14] This index measures the percentage of teeth that have been impacted, filled, or lost due to caries to assess the severity of dental caries.[15] The DMFT index, which is made up of the variables number of decaying teeth, number of teeth excised for caries, and number of filled teeth is used to assess the prevalence of permanent tooth decay. This oral health reporting score is above average in terms of validity, consistency, and sensitivity. Face validity and sensitivity are reported to be high in the published WHO literature on oral health surveys.[16]

Everyone is at risk for acquiring dental caries, but adolescents are at a higher risk. There is a correlation between the sugar intake of adolescents and dental caries.[17] Studies have shown that teens had a higher prevalence of dental caries than other age groups.[18,19] However, the causes linked with dental caries, particularly among adolescents, are poorly understood. This investigation sought to investigate the physical properties of saliva linked with the severity of dental caries in connection to teenagers' nutritional status.

Materials and Methods

After a thorough examination of 380 adolescents (aged 15-years-old) of both sexes, 90 were chosen and divided into two groups: 60 who had previously experienced caries (the study group) and 30 who had not (the control group). According to WHO guidelines, in 2013, teenagers with various caries experiences were divided into two groups: 30 of them had moderate (1–3) carious teeth and 30 had severe (DMFT > 10) experiences. The DMFT index fractions were used to quantify the caries experience.

Anthropometric measurements were used to assess nutritional status: weight measurement, adolescents were weighed using a bathroom scale. Height measurement, the adolescent's height was measured using a stature meter height. Body mass index (BMI) measurement, this index is a number calculated from the adolescent's weight and height using the following formula: BMI = weight (kg)/height^2 (M^2) (WHO, 2000).[20] Adolescents were divided into three groups based on their nutritional status: healthy weight, at risk of being overweight, and overweight.

The sample size was calculated using "G power 3.1.9.7" (written by Franz-Faul, Universitatis Kiel, Germany). With the power of the study set at 90%, the alpha error of probability set at 0.05 with two-sided, and the assumption that the effect size is 0.40 (large) with six groups, the sample size comes out to 82 subjects. By adding 10% as an error rate, the net sample size comes out to 90 subjects.

Inclusion criteria

- Patients without systemic or local diseases have an impact on the production of saliva.
- Patients generally consent to participate in the study.

Exclusion criteria

- Adolescent with a systemic illness.
- Patients on a restricted diet.
- Patients who utilized fluoride to build their teeth.
- Adolescent beginning orthodontic treatment due to structural dental abnormalities.

Sample collection

Saliva samples will be taken in the morning for each adolescent (9–12 AM). The collection of unstimulated salivary samples will be placed under standardized conditions in accordance with the guidelines provided by Navazesh and Kumar[21]:

1. Before saliva collection, the individual should be told to refrain from smoking, eating, chewing gum, and drinking for 1 h.
2. After rinsing his mouth out with distilled water and relaxing for at least 5 min, the individual should be seated on a chair.
3. The participant should be taught to stop moving and place his forehead over the test tube that is kept beneath it.
4. The individual should be told to keep her mouth open for 5 min to allow saliva to drip into the tube.

5. The individual was instructed to immediately spit any residual saliva into the test tube at the conclusion of the saliva collecting time. The real path should take 5 min to complete.

Saliva is placed in a cooler box and sent to the lab, where it is centrifuged for 10 min at 3000 rpm. Once the foam has completely disappeared, the salivary flow rate is measured in milliliters per minute (mL/min), and the supernatant is then separated by a micropipette and stored in deep freezing (-200°C) [22] for the subsequent analyses.

Determination of salivary flow rate

By dividing the milliliter (mL) volume of collected saliva by the minute amount of time needed for collection, the salivary flow rate can be calculated (min).[23]

Flow rate (mL/min) = volume/min

Determination of salivary pH

The pH of resting saliva will be measured using a digital pH meter. The pH meter was calibrated in accordance with the manufacturer's instructions. The pH meter was checked before saliva collection by submerging it in a tube filled with distilled water to read a neutral pH of 7 and drying it with a clean piece of cotton. Saliva pH was measured by integrating the pH meter's sensor into the tube holding saliva and tilting the tube so that the saliva could cover the whole surface of the sensor after the saliva collection was finished and the froth had vanished.

Ethical approval

The protocol of this study had been approved by the ethical committee at the University of Baghdad's College of Dentistry (i.e., the ethical committee authorized this study at date 19-1-2022, no. 482). The study protocol was explained to each participant, and all participants signed written informed consents.

Statistical analysis

One-way analysis of variance, the Games–Howell *post hoc* test, and the Statistical Package for Social Science (SPSS version 22.0, Chicago, Illinois) were used to describe, analyze, and present the data (Unequal variance).

Results

Results show that males participated more than females, and the equal distribution for each caries severity and the healthy subjects are more than other categories of BMI with equal distribution of both risk over and overweight is presented in Table 1.

Descriptive and statistical test of salivary flow rate and potential of hydrogen among caries severity and nutritional status

The results of the present study are illustrated in Tables 2 and 3. Show that both salivary flow rate and salivary pH mostly decrease within nutritional status and caries severity groups but with no significant difference except in the total sample in salivary flow rate among nutritional status; its result is significant, following multiple pairwise comparisons are illustrated in Table 4. Show that only there is a significant result between healthy and overweight in salivary flow rate, while other results are not significant.

Discussion

Both obesity and tooth decay are complex, multifaceted processes that include interactions between genetic and environmental variables.[24–26] There may be a link between obesity and tooth decay in adults, but there is conflicting evidence that this is the case in teenagers.[27]

Tooth decay, also known as dental caries, is a bacterially driven, site-specific, complex, and ever-changing illness that is triggered by an imbalance between plaque fluid

Table 1: Distribution of subjects by gender, BMI, and caries severity

Gender			Caries						Total	
			Free		Mild		Severe			
			N	%	*N*	%	*N*	%	*N*	%
M	Nutrition	Healthy	9	45.00	11	52.38	10	55.56	30	50.85
		Risk over	4	20.00	5	23.81	5	27.78	14	23.73
		Overweight	7	35.00	5	23.81	3	16.67	15	25.42
		Total	20	30.77	21	32.31	18	30.51	59	65.56
F	Nutrition	Healthy	5	50.00	6	66.67	7	58.33	18	58.06
		Risk over	1	10.00	3	33.33	3	25.00	7	22.58
		Overweight	4	40.00	0	.00	2	16.67	6	19.35
		Total	10	28.57	9	25.72	12	38.71	31	34.44
Total	Nutrition	Healthy	14	46.67	17	56.67	17	56.67	48	53.33
		Risk over	5	16.67	8	26.67	8	26.67	21	23.33
		Overweight	11	36.67	5	16.67	5	16.67	21	23.33
		Total	30	30	30	30	30	33.33	90	100

Table 2: Descriptive and statistical test of SFR among caries severity and nutritional status

Caries group	Nutritional status	SFR			
		Mean	SE	*F*	*P* value
Free	Healthy	0.725	0.126	1.949	0.162
	Risk over	0.348	0.050		
	Overweight	0.576	0.085		
Mild (1–3)	Healthy	0.649	0.075	1.493	0.243
	Risk over	0.445	0.069		
	Overweight	0.596	0.116		
Severe (DMFT > 10)	Healthy	0.590	0.066	1.358	0.270
	Risk over	0.433	0.066		
	Overweight	0.450	0.065		
Total among nutritional status groups	Healthy	0.643	0.049	4.563	**0.013***
	Risk over	0.420	0.039		
	Overweight	0.556	0.056		
Total among caries severity groups	Free	0.608	0.070	0.578	0.563
	Mild	0.586	0.051		
	Severe	0.529	0.046		
Nutrition					
Healthy		Free–mild–severe		0.615	0.544
Risk over		Free–mild–severe		0.413	0.667
Overweight		Free–mild–severe		0.437	0.653

SFR, salivary flow rate

*Bold values refer to significant results

Table 3: Descriptive and statistical test of salivary pH among caries severity and nutritional status

Caries group	Nutritional status	pH			
		Mean	SE	*F*	*P* value
Free	Healthy	6.293	0.186	2.250	0.125
	Risk over	5.800	0.200		
	Overweight	5.727	0.237		
Mild (1–3)	Healthy	6.265	0.151	0.612	0.550
	Risk over	5.975	0.268		
	Overweight	6.360	0.393		
Severe (DMFT > 10)	Healthy	6.333	0.154	0.078	0.925
	Risk over	6.258	0.198		
	Overweight	6.200	0.455		
Total among nutritional status groups	Healthy	6.302	0.093	1.832	0.166
	Risk over	6.076	0.135		
	Overweight	5.980	0.188		
Total among caries severity groups	Free	6.003	0.134	1.450	0.240
	Mild	6.203	0.127		
	Severe	6.298	0.116		
Nutrition					
Healthy		Free–mild–severe		0.049	0.952
Risk over		Free–mild–severe		0.945	0.404
Overweight		Free–mild–severe		1.170	0.334

pH: potential of hydrogen

Table 4: Multiple pairwise comparison of SFR among nutritional status using Games–Howell posthoc test

Total among nutritional status	Healthy × risk over = **0.002***
	Healthy × over weight = 0.474
	Risk over × overweight = 0.127

SFR: salivary flow rate

*Bold values refer to significant results

and tooth mineral. Treatment for this viral infection can be stopped and started again.[28,29]

Salivary flow rate was not significantly different between caries-active groups (mild and severe caries groups) and caries-free participants, according to the results of this investigation. Ahmadi-Motamayel *et al.*[30] reported no correlation between salivary secretion and decay caries active and carries free groups in the age range of 15–17 years, which was parallel with the findings of this study.

Regarding pH, the changes in salivary pH are influenced by the types of food, stimulation of salivary secretion, salivary flow rate, time, and buffering capacity. Salivary pH can be decreased due to acid production from bacteria after carbohydrate consumption. On the other hand, salivary pH will increase when the acid is washed and neutralized with minerals, such as calcium, phosphate, and ions hydroxyl.[31]

The current study shows that salivary pH decreases within nutritional status and caries severity groups with no significant difference. This result is in line with the study conducted by Daniel *et al.*,[32] where the salivary pH of normal BMI children was higher than that of obese children. It can be said that overweight and obese students were experiencing hypo salivation that decreased the salivary pH; the decreased buffering ability of saliva and the increased prevalence of caries are the result of saliva's vital role in the oral cavity. Initiation and development of carious lesions may be linked to a decrease in salivary flow and salivary pH.[33] In addition, a similar study by Tulunoglu *et al.*[34] reported no correlation between pH and caries activity in children in spite of age and gender. According to the results of a national study conducted in Sweden by Alm *et al.*,[35] there is a positive correlation between dental caries and BMI. The study also showed that adolescents who were overweight or obese had significantly higher proximal caries prevalence than those who were of normal weight. This result may have been caused by the fact that overweight participants consume sugar more frequently than persons of normal weight, according to Honne *et al.*[36] Another displays an inverse correlation.[37]

Furthermore, Cinar *et al.*[38] and Werner *et al.*[39] discovered no link between BMI and dental caries, whereas Thippeswamy *et al.*[40] and Sakeenabi *et al.*[41]

discovered a link between BMI and dental caries in children and adolescents; in the majority of these studies, dental caries were recorded orally and diagnosed at the caries level.

The limitations of the present study were that the dietary patterns could not be controlled, which might have an effect on obesity, dental caries, and salivary parameters. Furthermore, the onset of obesity could not be taken into consideration.

Conclusion

This study concluded that obesity is one of the factors responsible for deranged salivary parameters, that is, diminished stimulated salivary flow rate, buffer capacity, and salivary pH, which in turn has an adverse effect on oral health. Diet may be a secondary factor in the development of tooth decay, where Saliva production varies from person to person due to inherent differences in nutritional status.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Aziz AR, Mohammed AT. The salivary inflammatory biomarkers (interleukin-6, C-reactive protein) in relation with caries-experience among a group of 12 year old obese boys. J Bagh Coll Dent 2016;28:138-42.
2. Mohammed AI, Diab BS. Caries experience and salivary physicochemical characteristics among overweight intermediate school females aged 13–15 years in Babylon—Iraq. J Baghdad Coll Dent 2013;25:130-3.
3. Al-Khayoun JD, Diab BS. Dental caries, mutans streptococci, lactobacilli and salivary status of type 1 diabetic mellitus patients aged 18–22 years in relation to glycated haemoglobin. J Baghdad Coll Dent 2013;25:153-8.
4. Al-Moosawi RI, Qasim AA. The impact of dental environment stress on dentition status, salivary nitric oxide and flow rate. J Int Soc Prevent Communit Dent 2020;10:163-70.
5. Salih IA. A Study of the nutritional behavior and body mass indexes for students of age (17–25) years in Baghdad, Iraq. Baghdad Sci J 2009;6:480-7.
6. YakubMajid A, Diab BS, Alsaadi AA. Caries experience and salivary constituents among overweight children aged 6–11 years in Baghdad, Iraq. J Baghdad Coll Dent 2010;22.
7. Bansode PV, Pathak SD, Wavdhane MB, Birage PP. Salivary biomarkers of dental caries—A review article. IOSR J Dent Med Sci 2018;17:12-8.
8. Ali SR, Haidar A, Al Haidar MJ. Evaluation of some salivary characteristics in relation to dental caries among children with beta-thalassemia major. J Res Med Dent Sci 2022;10:115-20.
9. Wang CC, Alderman B, Wu CH, Chi L, Chen S-R, Chu I-H, *et al*. Effects of acute aerobic and resistance exercise on cognitive function and salivary cortisol responses. J Sport Exerc Psychol 2019;41:73-81.
10. Chen W, Jiang Q, Yan G, Yang D. The oral microbiome and salivary proteins influence caries in children aged 6 to 8 years. BMC Oral Health 2020;20:295.
11. Jaddoa MF, Qasim AA. Assessment of the correlation between the salivary flow rate and dental caries experience among children with? Thalassemia major. Indian J Forensic Med Toxicol 2020;14:1122-7.
12. Ali RA, Radeef SM, Mohammed NB, Diab BS. Oral health-related quality of life among dental implant patients in relation to temporomandibular joint function. Med J Babylon 2022;19:609-14.
13. Chiras, D. Human Biology. 7th ed. Barb House, London, UK: Jones and Bartlett Learning International; 2012.
14. Kadoum NA, Salih BA. Selected salivary constituents, physical properties and nutritional status in relation to dental caries among 4–5 year™ old children (comparative study). J Bagh Coll Dent 2014;26:150-6.
15. Biscaglia L, di Caccamo P, Terrenato I, Arrica MA, Seita A, Campus G; UNRWA group. Oral health status and caries trend among 12-year old Palestine refugee students: Results from the UNRWA's oral health surveys 2011 and 2016. BMC Oral Health 2019;19:157.
16. World Health Organization. Oral Health Surveys: Basic Methods. Geneva: World Health Organization; 2013.
17. World Health Organization. Sugars and Dental Caries. Geneva: World Health Organization; 2017.
18. Kazeminia M, Abdi A, Shohaimi S, Jalali R, Vaisi-Raygani A, Salari N, *et al*. Dental caries in primary and permanent teeth in children's worldwide, 1995 to 2019: A systematic review and meta-analysis. Head Face Med 2020;16:1-21.
19. Ndagire B, Kutesa A, Ssenyonga R, Kiiza HM, Nakanjako D, Rwenyonyi CM. Prevalence, severity and factors associated with dental caries among school adolescents in Uganda: A cross-sectional study. Braz Dent J 2020;31:171-8.
20. World Health Organization, International Federation of Red Cross, Red Crescent Societies, World Food Programme. The management of nutrition in major emergencies. World Health Organization; 2000.
21. Navazesh M, Kumar SK, University of Southern California School of Dentistry. Measuring salivary flow: Challenges and opportunities. J Am Dent Assoc 2008;139:35S-40S.
22. de Carvalho FK, de Queiroz AM, Bezerra da Silva RA, Sawamura R, Bachmann L, Bezerra da Silva LA, *et al*. Oral aspects in celiac disease children: Clinical and dental enamel chemical evaluation. Oral Surg Oral Med Oral Pathol Oral Radiol 2015;119:636-43.
23. Jensen PM, Saunders RL, Thierer T, Friedman B. Factors associated with oral health-related quality of life in community-dwelling elderly persons with disabilities. J Am Geriatr Soc 2008;56:711-7.
24. Rahmani A, Sayehmiri K, Asadollahi K, Sarokhani D, Islami F, Sarokhani M. Investigation of the prevalence of obesity in Iran: A systematic review and meta-analysis study. Acta Med Iran 2015;53:596-607.
25. Kalaf DK, AbdAl-Azeez EA, Dawood A. Metabolic syndrome among overweight and obese children attending central pediatric teaching hospital in Baghdad. Med J Babylon 2015;12:455-62.
26. Al-yasiry RZ, Jwad MA, Hasan MF, Alsayigh HA. How obesity affects female fertility. Med J Babylon 2022;19:111-4.
27. Sadeghi M, Lynch CD, Arsalan A. Is there a correlation between dental caries and body mass index-for-age among adolescents in Iran? Commun Dent Health 2011;28:174-7.
28. Fejerskov O, Nyvad B, Kidd E, Editors. Dental Caries: The Disease and its Clinical Management. Oxford: John Wiley & Sons; 2015.
29. Al-Ali GM, Jafar ZJ, AL-Ghurabi BH. The relation of salivary cathelicidin and beta-defensin with dental caries of school children. J Res Med Dent Sci 2021;9:30-5.
30. Ahmadi-Motamayel F, Goodarzi MT, Hendi SS, Kasraei S, Moghimbeigi A. Total antioxidant capacity of saliva and dental caries. Med Oral Patol Oral Cir Bucal 2013;18:e553-6.
31. Baliga S, Muglikar S, Kale R. Salivary pH: A diagnostic biomarker. J Indian Soc Periodontol 2013;17:461-5.
32. Daniel U, Anamaria D, Sebarchievicia I, Miclau M. Photovoltaic performance of Co-doped $CuCrO_2$ for p-type dye-sensitized solar cells application. Energy Proc 2017;112:497-503.

33. Bud A, Bud E, Esian D, Pop S, Bechir A, Pacurar M, *et al*. Interrelation between salivary pH, buffer capacity and dental caries in underweight, normal weight and overweight children. Rev Chim 2017;68:1255-8.
34. Tulunoglu O, Demirtas S, Tulunoglu I. Total antioxidant levels of saliva in children related to caries, age, and gender. Int J Paediatr Dent 2006;16:186-91.
35. Alm A, Fåhraeus C, Wendt LK, Koch G, Andersson-Gäre B, Birkhed D. Body adiposity status in teenagers and snacking habits in early childhood in relation to approximal caries at 15 years of age. Int J Paediatr Dent 2008;18:189-96.
36. Honne T, Pentapati K, Kumar N, Acharya S. Relationship between obesity/overweight status, sugar consumption and dental caries among adolescents in South India. Int J Dent Hyg 2012;10:240-4.
37. Sánchez-Pérez L, Irigoyen ME, Zepeda M. Dental caries, tooth eruption timing and obesity: A longitudinal study in a group of Mexican schoolchildren. Acta Odontol Scand 2010;68:57-64.
38. Cinar AB, Christensen LB, Hede B. Clustering of obesity and dental caries with lifestyle factors among Danish adolescents. Oral Health Prev Dent 2011;9:123-30.
39. Werner SL, Phillips C, Koroluk LD. Association between childhood obesity and dental caries. Pediatr Dent 2012;34:23-7.
40. Thippeswamy HM, Kumar N, Acharya S, Pentapati KC. Relationship between body mass index and dental caries among adolescent children in South India. West Indian Med J 2011;60:581-6.
41. Sakeenabi B, Swamy HS, Mohammed RN. Association between obesity, dental caries and socioeconomic status in 6- and 13-year-old school children. Oral Health Prev Dent 2012;10:231-41.