Salivary characteristics of children and its relation to oral microorganism and lip mucosa dryness

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The aim of this paper was to present baseline data on various saliva properties among a group of Saudi children aged 5 to 11 years and to study the relationship of these properties to some oral micro-organisms as well as to lip and oral mucosa dryness. The results showed a mean of resting and stimulated flow rate of 0.54+ 0.40 and 1.23±0.59 respectively and mean pH value of 7.27±0.38 and 7.5±.035 respectively. Fluoride concentration was estimated to be 0.151±0.07 and 0.145±0.06 in resting and stimulated saliva respectively. Children with dry lip represented 33.9% of the sample population, whereas, those with dry mucosa represented only 0.8%. No significant sex difference was evident in all parameters. 59.1% of children showed medium buffering capacity in the resting saliva, whereas, the majority of children (73.7%) showed high stimulated buffering capacity. Children showed generally high Lactobacillus counts (Lb) in the resting and stimulated saliva (57.9% and 60.5% of children). The presence of yeast also in resting and stimulated saliva seemed high in general (40% and 53% of children had high count). However, Streptococcus mutans (S. mutans) *counts showed no discriminating trend in both types of saliva. The data showed no significant association between flow rate and Lb counts in both resting and stimulated saliva although there was a trend toward higher counts associated with low flow rate. The same trend was observed in resting saliva although not significant. Similarly, low resting buffering capacity was associated with high counts of Lb among a high proportion of children (68.6% of children) although not significant. A significant reverse relation was evident between* S. mutans *counts and stimulated flow rate (p=0.049). The majority of children with normal level of saliva pH showed no yeast colonization (62.1%). The association was significant (p=.024). Similarly, the same association was observed in the medium and high buffering group (66.2%) (p=.040). It was concluded that salivary Lb count seems to be primarily affected by some local factors other than salivary properties, such as diet. Significant inverse relationship was found between* S. mutans *and stimulated salivary flow. Children in general showed high percentage of yeast reflecting the affect of poor diet among the studied population group. Buffering capacity and pH had an important role in yeast colonization.*

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INTRODUCTION

Saliva performs a range of function within the oral cavity, which includes lubrication of food, mastering good oral hygiene and the maintenance and protection of the tooth hard tissues by providing a source of pH ions. The importance of saliva in the maintenance of oral health is not trivial. The magnitude of the contribution can be clearly demonstrated when the effects of a reduced supply are studied. Rampant caries, difficulties with speech mastication and swallowing and super infection by organisms normally regarded as oral commensals that can occur.[1-3]

The flow rate of saliva changes as a function of stimulation. It has been reported that there are large differences in the flow rate between individuals.[4] For example, resting parotid flows range between 0.01 and .03 ml/min in normal healthy young adult.[5] Stimulated flows have a wide range of values between 0.8 and 3.0

ml/min in response to acid gustatory stimulus.[6] It is almost recognized that the rate of salivary secretion with an individual also varies considerably throughout the day. The most important cessation of secretion takes place during sleep. (<.01 ml/min) to the very generous flow (> 3 ml/min) in response to feeding.[7]

A common perception is that saliva drains into the mouth and is distributed over the various surfaces to fulfill the main function. Evidence published in recent years however, concluded that saliva in adults is not evenly distributed nevertheless, tends to stay on the side of the mouth or where it was secreted. This phenomenon holds true when dealing with resting[8-9] or stimulated secretions[10-19]. Various methods have been used to determine the distribution of saliva under stimulated and unstimulated conditions.[8,9,10-19]

A study in Tanzania, which examined flow rate and composition of whole saliva in both rural and urban areas, suggested that the difference in the composition of saliva in rural and urban areas of this country were closely associated with difference in absolute and selective amounts of nutrients rather than with the everyday content of the diet.[20] Mazengo *et al*.[20,21] studied salivary counts of SM, Lb and yeast as well as the salivary flow rate and reported them quantitatively in selected age groups.

The dental literature, which contains few analytical studies on the suggested relationship of salivary properties to microorganisms and oral dryness in children, triggered the present study.

The purpose of this paper was to present a baseline data on the various property of saliva among Saudi Arabian children aged 5 to 11 years residing in Western region of Saudi Arabia. The study also aimed at investigating the relationship of salivary properties to oral microorganisms; mainly SM, Lb and yeast. It also aimed at studying lip and oral mucosa dryness and the relationship to saliva flow rate.

MATERIALS AND METHODS

Subjects

The present study is considered a part of a larger investigation comprising different age groups.[5-11,12-17,18-48] It consisted of clinical examination and a questionnaire. In this paper, we are presenting the clinical part of the study for the age group 5 to 11 years.

One hundred and fourteen children aged 5 to 11 years participated in the study. The volunteers were examined orally to make sure that there were no signs of overt inflammatory disease or infection. Subjects with orthodontic appliances or history of regular use of any medication for systemic disorders such as diabetes, hypertension or sleep disorders were excluded from the study.

Saliva was collected from each subject for determination of pH, flow rate, buffering capacity, fluoride content as well as the microbiology assay counts of the SM, Lb and yeast.

METHODS

Flow rate

Both stimulated and unstimulated saliva were collected from children between 9:00 to 12:00 noon each day of the study and processed immediately. The unstimulated saliva was collected first by requesting the subject to sit in a quiet environment and expectorate into a calibrated cylinder through a funnel tube. This was done over a 5 minute period. For the stimulated saliva, the subjects were given a paraffin wax to chew and saliva was collected. Similarly, all saliva that accumulated within the oral cavity for a total of 5 minutes was collected into a funnel shape cylinder. The amount was measured and the flow rate for the stimulated saliva was calculated. Resting saliva below normal was <.2 ml/min. Stimulated flow rate below normal was < 1.0 ml/min.[22]

pH of saliva

The pH of the collected unstimulated and stimulated saliva was measured by a bench top pH meter immediately after collecting using an EC 40 pH/ISE meter (Huch company model 50265).

Fluoride content

Fluoride was determined on the collected samples with the use of fluoride EC40 pH/ISE meter (Huch company model 50265).

Fluoride ions were selectively absorbed by ions selective electrode (ISC) and the potential voltage established was proportional to the concentration of fluoride in the sample. This potential was compared to the constant potential of a reference electrode. By measuring the potential of known standard a calibration curve was constructed for determining the concentration of fluoride in the unknown samples. The result were recorded in part per million (ppm).

Buffering capacity

This was determined with the use of the Dento-buffer strip method CRT buffer vivadent.

Microbiological assay

(i) Bacterial assay

This was done by determining the proportion of SM and Lb content for each sample of both resting and stimulated saliva samples using bacterial kit. Microbiological assay of SM and Lb were determined using the dentocult method *(CRT Bacteria, Ivoclar, Vivadent, AG, fl-9494 Shaan / Liechtenstein). Since these organisms are considered acidogenic, their presence should suggest an acidic environment in the oral cavity.

(ii) Yeast assay

Swab from resting and stimulated saliva were collected over a sabouroud dextrose agar with chloramphinicol

Table 1. Distribution of salivary properties in stimulated and unstimulated saliva in children.

Salivary properties	All sample N=114 (M+SD) mean±SD	Male n=46 mean±SD	Female n=68 mean±SD
Salivary flow / min Resting	.5465±(0.40)	.5317± (.358)	.556±(.4360)
Salivary flow /min Stimulated	1.239±(0.59)	1.2667±(.5951)	1.2207±(.6035)
pH resting	7.27±(.38)	7.328±(.4788)	7.236±(.30321)
pH stimulated	7.546±(.359)	7.54±(.355)	7.5444±(.3650)
Fluoride resting	0.151±(0.07)	.1502±(.05)	.1524±(.09)
Fluoride stimulated	0.145±(0.066)	.1465±(.05)	.1453±(.07)
Buffering Capacity	n (%↓)	(%↓) (%→)	(%↓) (%→)
Resting			
Low	35 (30.7%)	14 (30.0) (40.0)	21 (30.9) (60)
Medium	68 (59.1%)	26 (56.5) (38.2)	42 (61.8) (61.8)
High	11 (9.6%)	6 (13.0) (54.5)	5 (7.4) (45.5)
Total	**114**	**46**	**68**
Stimulated			
Low	1 (.9)	1 (2.2) (100)	0 (0) (0)
Medium	24 (25.4)	10 (21.7) (34.5)	19 (27.9) (65.5)
High	84 (73.7)	35 (76.1) (41.7)	49 (72.1) (58.3)
Total	**114 (100)**	**46**	**68**

(SDA). The plate was incubated at 35˚ for 3 days. The sabouroud dextrose agar was examined daily for the presence of growth of white creamy colony. The colony was stained by gram stain and examined under the oil emerged microscopic for the presence of candida species.

Dryness of lip oral mucosa

Signs of xerostamia were registered clinically by clinical observation of lip and oral mucosa dryness.

Oral mucosa dryness was recorded when the investigator noticed the absence of a saliva coating over most of the dorsum of the tongue, the buccal and lingual mucosa as well as the absence of pooled saliva in the floor of the mouth.[23-25] Lip dryness was recorded when the lips lacked the characteristic shiny appearance and or in the presence of chapped lips.

STATISTICAL ANALYSIS

The collected data were entered in a database file using D Base IV and cleaned and checked for outliners. Statistical analysis was done using SPSS. Data comparison was done using t-test Pearson chi square. When the expected value was less than 5, Fisher and exact test was complemented. Inter and intra observe relation between the two examiners were 0.97, 0.94 respectively. The level of significant was set at $p<0.05$.

RESULTS

Results of salivary properties

The results of saliva properties were obtained from a sample of 114 children aged 5 to 11 years (46 males and 67 females). The mean and standard deviation of various salivary properties are presented in Table 1. The mean resting and stimulated flow rate was found to be 0.546±0.40 and 1.239±.59 respectively, whereas the pH of resting and stimulated saliva were 7.27±0.38, 7.5 ±0.35 respectively. Fluoride concentration was estimated to be 0.151±0.07 in resting saliva and 0.145 ±0.06 in the stimulated one. No significant difference was seen between males and females.

The buffering capacity data in resting and stimulated saliva are also reported in Table 1. Results showed low, medium and high values of buffering capacity in both resting and stimulated saliva. Considering resting saliva, the highest proportion of children demonstrated

Table 2. Distribution of microbial content in resting and stimulated saliva according to gender

	Resting saliva			Stimulated saliva		
	Male	**Female**	**Total**	**Male**	**Female%**	**Total**
***Lactobacillus* count**	**n (%↓) (%→)**	**n (%↓) (%→)**	**n (%↓) (%→)**	**n (%↓) (%→)**	**n (%↓) (%→)**	**n (%↓) (%→)**
$< 10^5$	20 (43.5) (41.7)	28 (41.2) (58.3)	48 (42.1) (100)	17 (37) (37.8)	28 (41.2) 62.2)	45 (39.5) (100)
$>10^5$	26 (56.5) (39.4)	40 (58.8) (60.6)	66 (57.9) (100)	29 (63) (42)	40 (58.8) 58.0)	69 (60.5) (100)
Total	46 (100) (40.4)	68 (100) (59.6)	114 (100) (100)	46 (100) (40.4)	68 (100) (59.6)	114 (100) (100)
***Strep mutans* count**	**n (%↓) (%→)**	**n (%↓) (%→)**	**n (%↓) (%→)**	**n (%↓) (%→)**	**n (%↓) (%→)**	**n (%↓) (%→)**
$<10^5$	22 (47.8) (38.6)	35 (51.5) (61.4)	57 (50.0) (100)	23 (50.0) (40.4)	34 (50.0) (59.6)	57 (50) (100)
$>10^5$	24 (52.2) (42.1)	33 (48.5) (57.9)	57 (50) (100)	23 (50.0) (40.4)	34 (50.0) (59.6)	57 (50) (100)
Total	46 (100) (40.4)	68 (100) (59.6)	114 (100) (100)	46 (100) (40.4)	68 (100) (59.6)	114 (100) (100)
Yeast	**n (%↓) (%→)**	**n (%↓) (%→)**	**n (%↓) (%→)**	**n (%↓) (%→)**	**n (%↓) (%→)**	**n (%↓) (%→)**
Yes	13 (31.7) (32.5)	27 (46.6) (67.5)	40 (40.4) (100)	21 (51.2) (39.6)	32 (55.2) (60.4)	53 (53.5) (100)
No	28 (68.3) (47.5)	31 (53.4) (52.5)	59 (59.6) (100)	20 (48.8) (43.5)	26 (44.8) (56.5)	46 (46.5) (100)
Total	41 (100) (41.4)	58 (100) (58.6)	99 (100) (100)	41 (100) (41.4)	58 (100) (58.6)	99 (100) (100)

Table 3. Distribution of lip and oral mucosa dryness according to gender.

	Dryness of lip			Dryness of oral mucosa		
	Male	**Female**	**Total**	**Male**	**Female%**	**Total**
	n (%↓) (%→)	**n (%↓) (%→)**	**n (%↓) (%→)**	**n (%↓) (%→)**	**n (%↓) (%→)**	**n (%↓) (%→)**
Yes	18 (39.1) (47.4)	20 (30.3) (52.6)	38 (33.9) (100)	0 (0) (0)	2 (3)) (100)	2 (.8) (100)
No	28 (60.9) (37.8)	46 (69.7) (62.2)	74 (66.1) (100)	46 (100) (41.8)	64 (97) (58.2)	110 (98.2) (100)
Total	46 (100) (41.4)	66 (100) (58.9)	112 (100)	46 (100) (41.1)	66 (100) (58.9)	112 (60)

medium buffering capacity (59.1%), whereas in the stimulated saliva the highest percentage of children showed higher buffering capacity (73.7%).

There were no significant differences between males and females concerning the buffer capacity at the different levels.

Oral microorganism counts

The study showed that, the proportions of children with Lb count $<10^5$ in resting and stimulated saliva were similar, 42.1% and 39.5% respectively. Also the percentages of children with Lb count $>10^5$ in resting and stimulated were very close (57.9% and 60.5% respectively). Interestingly, children generally showed high Lb counts in both resting and stimulated saliva ($>10^5$) (Table 2), however, the differences were not significant statistically.

The proportions of children with low and high counts of SM in the resting and stimulated saliva were similar (50%), and no significant sex difference was found (Table 2). Considering the yeast data, 15 samples were excluded from the yeast analysis because of the small amount of the saliva collected in these samples to run all the tests of salivary properties. The presence of yeast in resting and stimulated saliva seemed to be high in general, especially in stimulated saliva, where the proportion of children with +ve yeast colonization were 40% and 53.5% respectively. The difference was not significant. Also no significant sex difference was evident. (Table 2)

Dryness of lip and oral mucosa in children based on clinical examination

Two (2) samples were excluded from the clinical examination due to lack of cooperation of the children.

The number of children with dry lip was 38 (33.9%) whereas those with dryness of mucosa were only 2

Table 4. Salivary properties and lactobacillus count in resting and stimulated saliva.

	***Lactobacillus* count in resting saliva**		
	< 10^5 48 n (%↓) (%→)	**> 10^5 66 n (%↓) (%→)**	**Total 114 n (%↓) (%→)**
Resting salivary flow			
<.2	4(8.3) (33.3)	8(12.1) (66.7)	12 (10.5) (100)
≥.2	44 (91.7) (43.1)	58 (87.9) (56.9)	102 (89.5) (100)
Buffering capacity			
Low	11 (22.9) (31.4)	24 (36.4) (68.6)	35 (30.7) (100)
Medium & high	37 (77.1) (46.8)	42 (63.3) (53.2)	79 (69.3) (100)
Saliva pH rest			
<6.5	2 (4.2) (50.0)	2 (3) (50)	4 (3.5) (100)
≥ 6.5	46 (95.8) (41.8)	64 (96) (58.2)	110 (96.5) (100)
	***Lactobacillus* count in stimulated saliva**		
	< 10^5 45 n (%↓) (%→)	**> 10^5 69 n (%↓) (%→)**	**Total 114 n (%↓) (%→)**
Stimulated flow rate			
<1.0 ml/min	12 (26.7) (32.4)	25 (36.2) (67.6)	37 (32.5) (100)
≥ 1.0 ml/min	33 (73.3) (42.9)	44 (63.8) (57.1)	77 (67.5) (100)
Buffer stimulated			
Low	0	1 (1.4) (100)	1 (.9) (100)
Medium & high	45 (100) (39.8)	68 (98.6) (60.2)	113 (99.1) (100)
PH stimulated			
<6.5	0	0	0
>6.5	45 (100) (39.5)	69 (100) (60.5)	114 (100)

Table 5. Salivary properties and Strep mutans counts in resting and stimulated saliva.

	***Strep mutans* count resting**			
	< 10^5 57 n (%↓) (%→)	**> 10^5 57 n (%↓) (%→)**	**Total 114 n (%↓) (%→)**	**P value**
Resting flow rate				
<.2	3 (5.3) (25.0)	9 (15.8) (75.0)*	12 (10.5) (100)	
>.2	54 (94.7) (52.9)	48 (82.2) (47.1)	102 (89.5) (100)	0.06
PH resting				
<6.5	2 (3.5) (50)	2 (3.5) (96.5)	4 (3.5) (100)	NS
>6.5	55 (96.5) (50)	55 (96.5) (50)	110 (96.5) (100)	
Buffer resting				
Low	16 (28.1) (45.7)	19 (33.3) (54.3)	35 (30.7) (100)	NS
Medium & high	41 (71.9) (51.9)	38 (66.7) (48.1)	79 (69.3) (100)	
	***Strep mutans* count stimulated**			
Stimulated flow rate				
<1.0 ml/min	14 (24.6) (37.8)	23 (40.4) (62.2)	37 (32.5) (100)	
≥ 1.0 ml/min	43 (75.4)* (55.8)	34 (59.6) (44.2)	77 (67.5) (100)	.049
PH stimulated				
<6.5	0	0	0	NS
>6.5	57 (100) (50)	57 (100) (50)	114 (100) (100)	
Buffering stimulated				
Low	1 (1.8) (100)	0	1 (.9) (100)	NS
Medium & high	56 (98.2) (49)	57 (100) (50.4)	113 (99.1) (100)	

Table 6. Salivary properties and yeast colonization in resting and stimulated saliva.

	YES 40 n (%↓) (%→)	NO 59 n (%↓) (%→)	Total 99 n (%↓) (%→)	P value
Resting flow rate				
<.2	6 (15) (54.5)	5 (8.5) (45.5)	11 (11.1) (100)	NS
≥.2	34 (85.0) (38.6)	54 (91.5) (61.4)	85 (88.9) (100)	
PH resting				
<6.5	4 (10.0) (100)	0 (0) (0)	4 (4.0) (100)	
>6.5	36 (90.0) (37.9) *	59 (100) (62.1)	95 (96.0) (100)	.024
Buffer resting				
Low	17 (49.5) (54.8)	14 (23.7) (45.2)	31 (31.3) (100)	
Medium & high	23 (57.5) (33.8) *	45 (76.3) (66.2)	68 (68.7) (100)	.040
	Yeast stimulated			
	YES 53 n (%↓) (%→)	**NO 46 n (%↓) (%→)**	**Total 99 n (%↓) (%→)**	**P value**
Stimulated pH				
<6.5	0 (0) (0)	0 (0) (0)	0 (0) (0)	
>16.5	53 (100) (53.5)	46 (100) (46.5)	99 (100) (100)	
Stimulated flow rate				
<1	21 (39.6) (60.0)	14 (30.4) (40)	35 (35.4) (100)	
>1	32 (60.4) (50.0)	32 (69.6) (50)	64 (64.5) (100)	
Buffering stimulated				
Low	0 (0)	1 (2.2)	1 (1.0) (100)	
Medium /high	53 (100) (54.1)	45 (97.8) (45.9)	98 (99) (100)	

(0.8%) out of the total sample (Table 3). Again, no difference between males and females was reported. The analysis of data of lip and mucosa dryness in relation to saliva flow rate failed to show any significant association.

Salivary properties in relation to oral microorganism

Table 4 presents the effect of salivary properties on Lb count in resting and stimulated saliva. No significant relationship was found between flow rate and Lb count in both resting and stimulated saliva. Considering the low flow rate of resting (<.2ml/min) and stimulated saliva, (<1 ml/min), the results showed that higher proportions of children (66.7%) and (67.6%) respectively had higher count of Lb ($>10^5$). However, the differences were not significant to demonstrate a solid relationship.

Similarly, children with low resting buffering had higher Lb count ($>10^5$), this was not also significant. The same trend was also evident in the stimulated saliva with no significant differences. The effect of resting and stimulated pH on Lb count was not statistically significant also.

The results of Table 5 demonstrates the high proportions of children with high stimulated flow rate and low SM count (75.4%). It also showed high proportion of children with low stimulated saliva flow rate and high SM count (62.2%). The results were statistically significant indicating an inverse relationship between flow rate and SM counts (.049). The same trend was observed in the resting saliva, although not significant (p = 0.06). No association between SM on one hand and buffering capacity and pH on the other hand in both resting and stimulated saliva was evident.

Table 6 shows higher proportion of children with normal resting pH value and +ve colonization of yeast which exceeded that of children with low pH (p=.024). The number of children with no yeast in the resting medium and high buffer capacity group was higher than that of the low buffer group, and the difference was statistically significant (p=0.40).

On the other hand, no association was found between both resting and stimulated flow rate and yeast. Similarly, no association was found between yeast on one hand and stimulated pH and buffering capacity on the other hand.

DISCUSSION

The present study showed no sex difference regarding the different salivary properties; salivary flow rate, pH and fluoride concentration. Similarly, a follow up study by Tukia-Kulmala and Tenovuo[22] showed no statistical difference between males and females in the salivary flow rate. However, in a study done by Crossner[26], a higher stimulated flow rate in males versus females was reported. The boys in his study with a mean age of (14.7) showed consistent high flow rate. The stimulated flow rate ranged from 0.52 to 2.2 ml/min in the age group 5-15 years[26]. The stimulated flow rate for the age group[8-10] was found to be 1.17-1.2 ml/min, which is similar to our findings in the age group 5 to 11. The present data are lower than Ericsson,[27] which were reported 1.6 ml/min in

560 adults. This difference could be related to the age differences of subjects in both studies. Normal salivary flow rate in resting and stimulated were 0.0556±.43 and 1.227±.60 respectively. Similar results were reported by the study of Tukia-Kulmala.[22] Salivary flow rate among young teenagers proved to be increasing with age[28,29] which explains the difference in flow rate reported in our study compared to other studies on older children. During teens the salivary glands record the maximum development, the size of the glands has been shown to be the best predictor of secretary capacity.[27] This conclusion is also supported by the results of Crossner[26] who reported a range of flow rate in different age groups and the study of Erics in 1972[30] in adults. The salivary glands of adults are subjected to atrophy as well as the effect of both diseases and medication[30]. In our study the low and high flow rates in resting saliva was only reported in 10.5 % and 89.9 % of our samples respectively.

Whereas, the low stimulated flow rate was evident in 32.5% of the population and the high rate was reported among 67.5% of children. Incidence of salivary flow rate less than <0.7 was reported in another study[31] to be 2.4%. The stimulated flow rate value in the present study was considered low when it was less than 1.0 ml/minute reflecting a methodology difference in measuring the salivary flow rate.

The study of Ohrm *et al.*[31] showed a resting salivary flow rate of <.2ml/min in 35 % of healthy subjects aged 25 years. However, in our study the reported incidence was 10.5%. The age difference supports the concept that young children flow rate and saliva contents changed with age.[28,29] A study by Ohrn, *et al*.[31] showed a percentage of 35% among children with unstimulated saliva flow rate <.2 ml/min, and the proportion of children with stimulated saliva flow rate <0.7 was 2 %. Again salivary flow rate among young teenagers increased with age[28,29] which explains the difference in flow rate between our study group and older age groups, studied by Crossner and Ericsson.[26] It was reported that males have higher stimulating saliva flow rate during childhood[32] than young males[33] and adults.[34] On the other hand, equal values for both sexes have been reported for stimulated parotid, submandibular saliva[35,36] and stimulated whole saliva.

Low pH in resting saliva was present in 3.5 % of the subject while higher pH was evident in 96.5%. However, in the studied group the stimulated saliva was reported to have only high pH in contrast to other studies who reported low pH (<6.5) in 36.5% of their sample.

A study reported by Llena-PY, *et al*.[37] stated that the stimulated saliva with low PH (<6.5) was present in (36.5%) of the age group 12 to 13 years. Also, a study by Ohrn *et al.*[31] failed to show subjects with low pH stimulated saliva (pH<6.5) among healthy and subjects aged 17 to 47 years with eating disorders.

Fluoride content in our study was 0.15± 0.07 in resting saliva while stimulated saliva was 0.14±0.06 ppm in comparison to the study of Kedjarume,[38] who reported a concentration of 0.01±0.0 in males and 0.02±.01 in females.

The difference can be explained by the fact that saliva samples were collected from patients attending the dental school and who are exposed to fluoride application and continuous reinforcement of OHI including the use of fluoride dentifrices.

Considering the resting saliva, high percentage of children (59.1%) showed medium buffering capacity whereas low buffering capacity was evident in 30% of children, and the high value was reported among only 9.6% of the sample. However, in stimulated saliva 73.7% of children showed high buffer capacity, 25.4% showed medium capacity and only 0.9% showed low capacity. A study by Tukia Kulmala and Tenovuor[22] reported values similar to our study, concerning the higher prevalence of children with high buffering capacity in stimulated saliva. They also reported significant lower buffering effect in girls than boys which was not supported by our study. The author also reported that low buffering effect (pH≤ 4) was never found among subjects with the high flow rate (>2.0ml/min) and that high buffering effect (pH ≥ 6) was measured among subjects even those with salivary flow rate as low as <1.0 ml/min, which is similar to our conclusion in stimulated saliva samples. The study of Tukia-Kulmala and Tenovuo[22] used different criteria for buffering capacity than those used in our study; the low buffering effect was (pH ≤4), the intermediate ranged from 4.5 to 5.5 and the high was (>pH ≥ 6) in contrast to our values which are (<6.5) for low values and (>6.5) for high values.

The lack of any sex difference in the buffering effect of saliva in our study, could be explained by the fact that the present study comprised a younger age group (5 to 11) compared to the study of Finland[22], who reported a sex difference, a fact that was justified by the drop of buffering effect during early adolescents[28] and the effect of female sex steroid on saliva bicarbonate.[39]

Dryness of lip was present in 33.9% of children; the high prevalence can be explained on the basis of high allergic conditions reported wildly among Saudi children in the Western region.[40] No relationship was found between flow rate and dryness of lip. Similarly, the dry mucosa which was found only in 0.8% of children did not show any association with saliva flow rate. The reported result in our study might have shown significant impact if the sample was increased. Data in the dental literature on dry lip and oral mucosa in young children is nearly lacking. A study by Longman *et al*.[41] reported significant correlation between oral dryness and reduced stimulated salivary flow rate. He also added that oral dryness was a significant prediction of salivary gland hypofunction.[41] The study was limited to patients, who attended a xerostomic clinics, and were suffering originally from

xerostamia.[41] A condition that might have affected the results, which seem to be different from the present data obtained from health children.

The percentage of children with high Lb count in resting and stimulated saliva were 57.4 and 60.5 %respectively. The data are lower than what was reported by Mazengo *et al.*[21] (74% in urban Tanzania).

However, there were no significant findings between Lb count in resting and stimulated saliva and the other variables including flow rate, buffering capacity and saliva pH. As regard the flow rate in resting saliva, a trend toward higher counts of Lb in children with low flow rate was evident as a proportion of 12.1% compared to 8.3% of children with low flow rate and low Lb count. Similarly, the proportion in the low stimulated flow rate was 36.1% vs 26.7% however, it was not significant. In resting saliva, the percentage of children with low buffering capacity and high Lb count was 36.4% compared to 22.9% of children with low buffering capacity, although the difference was not statistically signification. The relationship of pH and Lb count was not significant although a higher percentage of children with normal pH showed higher Lb count in both resting and stimulated saliva. The results do not reflect the same trend seen in the buffering capacity of saliva, which indicates that salivary Lb count might be affected primarily by factors other than buffering capacity, pH and salivary flow. Among these factors is the frequent intake of sugar and caries inducing diet. Sullivan and Storvick[42] also reported no significant correlation between saliva pH and Lb counts. Whereas, Pervinen and Larmas[43] reported that low pH favored Lb count

There was a significant inverse relationship between stimulated salivary flow rate and SM counts, whenever the flow rate was low, there was an increase in the count (P =.049). On the other hand, no significant relation was found between SM count and the resting flow rate, although there was a trend toward higher counts. The present data are in favor of those reported by Tukia-Kulmala and Tenovro.[22]

Similarly, Tenovuo[22] reported that SM count displayed significant negative correlation with salivary flow rate. The inverse relationship between salivary flow rate and the levels of SM count has also been reported in earlier studies.[44,45]

Result of yeast in resting saliva showed that 59% of children had no yeast while 40% showed positive identification. A study by Jabra-Rizk[46] on the prevalence of yeast among children in Nigeria and in the United States[46] showed different species of yeast in 48.4% of Nigerian children.

The study revealed an increase in the prevalence of yeast infection among Nigerian malnourished children. The results are higher than those reported in the present study, whereas our data seems to be higher than the U.S. data. The difference could be related to the nutritional status of Nigerian children which favored yeast colonization. The U.S. findings also supports the effect of nutrition on the general health of children and the role in yeast infection. The high percentage of children with yeast, as revealed in the present study might be attributed to the poor diet of children in the western region.[47] Stimulated saliva in 53% of children showed yeast infection, whereas 46.5% of children had no yeast. A significant inverse relationship was reported between pH and yeast in resting saliva, where high percentage of children with normal pH had no yeast in their saliva sample (62.1%). The data are supported by the result of Kedjarume *et al*.[38] Parvinen[43], Alexander and Walker[48], Young *et al*.[49] and BaQai and Hafez.[50]

Similarly, the same trend was also found between buffering capacity and yeast in resting saliva. Yeast infection was evident among a larger group of children with low buffering capacity (54.8%), whereas, it was reported among a smaller percentage of children with medium and high buffering capacity (33.8%).

As regard the relationship of yeast to flow rate, no significant association was revealed in the present study. In contrast to our study, Parvinen and Larmas[43], reported an association between flow rate and yeast.

SUMMARY

1. Resting and stimulated flow rates were estimated to be 0.54±0.40 and 1.23±0.59 respectively. The pH values were 7.27±0.38 and 7.5±0.35 respectively. The fluoride level for resting and stimulated saliva were .015±0.07 and 0.14±0.06 respectively.
2. No significant sex difference was found in any of the parameters.
3. Fifty-nine percent of children had resting saliva of medium buffering capacity whereas, stimulated saliva in 73.7% of children showed high buffering capacity.
4. Children showed comparatively high Lb counts in both resting and stimulated saliva (57.9%) and (60.5%) respectively. However, the difference was not statistically significant.
5. The proportions of children with low and high SM counts in resting and stimulated saliva were similar (50%).
6. The presence of yeast in resting and stimulated saliva was high in general (40%) and (53.5%) respectively.
7. Children with dry lip presented 33.9% of the sample and those with dry mucosa presented only 0.8%.
8. High Lb counts were found to be associated with low flow rate in both resting and stimulated saliva in the majority of children (66.7% and 67.6%). However, this was not significant. The same trend was seen in the other saliva properties (buffer capacity and pH).

9. For SM, inverse significant relation existed between SM counts and stimulated flow rate (p=.049). High percentage of children (75.4%) showed low SM count. The same trend was observed in resting saliva although it was not significant (p=.06).
10. Yeast colonization had an inverse significant association with resting salivary pH (p=.024). Higher proportion of children with medium and high buffering capacity showed no +ve yeast colonization significance (p=0.04) compared to the low buffering group.

CONCLUSION

Salivary Lb count seems to be primarily affected by some local factors other than salivary properties, such as diet. Significant inverse relationship was found between *S. mutans* and stimulated salivary flow. Children in general showed high percentage of yeast reflecting the affect of poor diet among the studied population group. Buffering capacity and pH had an important role in yeast colonization.

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