

Original Article

A STUDY OF SOME SALIVARY ELEMENTS WITH RESPECT
TO SEX, AGE AND CARIES IN CHILDREN

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تم تحديد مستوى الصوديوم والبوتاسيوم والكالسيوم والمغنيسيوم والكلور في ٥٧ طفل صحيح الجسم وتم تقسيمهم إلى ثلاثة مجموعات حسب بزوغ الأسنان. تم دراسة مستوى تبدل هذه العناصر وعلاقتها بالجنس والعمر ونسبة حدوث النخر. وإن تم كيز الصوديوم والبوتاسيوم في اللعاب فيست بواسطة الجهاز الضوئي والكالسيوم والمغنيسيوم بواسطة جهاز الراندوكس. وجد زيادة ملحوظة في الصوديوم والمغنيسيوم في المجموعات الحاوية على الأسنان. وفي المجموعات السنية لم يلاحظ فرق ملحوظ في مستوى هذه العناصر بين الأطفال الذين لديهم نخور أو خالية منها وكذلك لم يشاهد فرق في هذه المواد باختلاف جنس الأطفال. كذلك تم قياس محتوى اللعاب من العناصر اللاعضوية ومدى علاقته بعمر الأطفال. ولوحظ انخفاض في المغنيسيوم في حين العناصر الأخرى زادت مع ازدياد سطوح النخر.

Salivary Na, K, Ca, Mg, Cl and P levels were determined in 57 healthy children who were divided into 3 groups according to dentition. The changes in the levels of these elements were studied with respect to sex, age and caries incidence. Salivary Na and K concentrations were measured by a flame photometer. Ca, Mg, Cl and P were measured colorimetrically using Randox diagnostic kits. Significant increases were found between dentition groups for Mg and Na. None of the dentition groups showed significant differences in the levels of any of the parameters between the children with and without caries. There was no significant differences between any of the parameters in any dentition groups with respect to sex. The salivary composition of all the inorganic elements measured rose linearly with age. Except for Mg which decreased, other elements increased with total caries surface area.

Introduction

Saliva is the least known and the least appreciated of all body fluids. Yet this

lowly secretion plays a vital role in the integrity of oral tissues and in the selection, ingestion and preparation of food for digestion.

Saliva is about 99% water, the remaining 1% consists of large organic molecules which are mainly proteins, glycoproteins and lipids and of small organic molecules such as glucose, urea and

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electrolytes.¹ The main electrolytes in saliva are sodium, calcium, chloride, bicarbonate, phosphate and potassium. Quantitative differences in the relative proportion of these electrolytes in each of the major salivary gland secretions have been shown. The composition is markedly altered as the saliva passes along the duct system, mainly due to reabsorption of Na and Cl and secretion of K and inorganic phosphate.¹ The concentrations of both cations and anions are affected by factors such as flow rate, the duration of stimulation and the time of day when saliva is collected.^{4,5,6,7} A positive correlation exists between the concentration of most inorganic elements in plasma and saliva. The concentrations of Ca and K, however, in human saliva are relatively independent of their concentrations in plasma.⁸ The presence of Ca and phosphate and other inorganic ions play important protective roles in maintaining the integrity of dental tissues. Calcium and phosphate maintain the saturation of saliva. Ca is also important in calculus formation and in the development of caries.

As the salts of K are generally very soluble, it would be surprising if K by itself had any effect on caries.⁹

There have been few studies on salivary composition of healthy children, and most of them have measured inorganic components only in a narrow age range. The authors have therefore aimed to examine certain inorganic elements in the saliva of healthy children.

Materials and Methods

Unstimulated whole (mixed) resting saliva specimens were collected from 57 healthy children. The children had no systemic diseases, ages 3 - 13 years. The

specimens were studied for inorganic elements. The children, who comprised 32 girls and 25 boys were of similar socio-economic groups and randomly selected from nursery, primary and secondary schools. The children were divided into the following three dentition groups: 1. Primary (20 children, mean age: 4.2 years ranging from 3 to 5); 2. Mixed (17 children, mean age: 8.6 years ranging from 6 to 10); and 3. Permanent (20 children, mean age: 11.9 years ranging from 11 to 13).

The collection of saliva samples was done in the morning at least one hour after a standard breakfast. The children were asked to rinse their mouth with distilled water before saliva collection. The numbers of decayed, filled and missing teeth and total caries surfaces were recorded.

The saliva samples were then centrifuged* at 6,000 rpm and 4°C. Supernatants were taken and kept at -20°C. Salivary Na and K concentrations were measured by a flame photometer.⁵ Ca, Mg, Cl and P were measured colorimetrically using Randox diagnostic kits (CA 590, MG 573, Cl 552, PH 575).

The results were evaluated using unpaired "t" tests, and one way analysis of variance and correlation analysis using the NCSS statistical computer package.

Results

Comparing between the primary, mixed and permanent dentition groups, salivary sodium and magnesium concentrations were found significantly higher in the mixed dentition group than in the others ($p < 0.01$, Table 1). There was no significant difference in the levels of any

*Sorvall RT 6000
⁵Carl Zeiss PF5 27971

group than in the other groups (Table 4).

Discussion

A number of physiological factors influence the composition of whole saliva.

Table 2. Correlation analysis (only significant correlations, i.e. $p < 0.05$) are shown.

Variables	Correlation Coefficient r
P-K	0.06665
Mg-Na	0.5096
Na-T. Protein	0.5176
P-T. Protein	0.5676

These are the source of saliva, the method of collection and the degree of stimulation. Because it is difficult to use a collecting device with children, unstimulated whole saliva was collected in this research.

Since unpracticed subjects frequently experience difficulty in collecting resting saliva, dentally related research often involves saliva secreted in response to the mastication of paraffin wax or rubber bands. However, wax is known to take up some organic constituents of saliva and rubber bands often have a higher froth content than wax.

The salivary components change with the type and duration of stimulation. The time of collection is also important. In this study, saliva was collected between 8 and

Table 3. Mean levels of all parameters of children with caries according to dentition and the significance of differences (p values).

	Primary Dentition n = 11		Mixed Dentition n = 9		Permanent Dentition n = 10		P
	Mean	SD	Mean	SD	Mean	SD	
Ca mg/dl	2.15	0.58	2.78	0.64	2.14	0.60	$p > 0.05$
Mg mmol/L	0.14	0.21	1.31	0.24	0.22	0.22	$p < 0.01$
Na mEq/L	32.18	1.14	45.56	1.26	35.20	1.20	$p < 0.01$
P mmol/L	3.85	0.58	4.64	0.64	4.52	0.60	$p > 0.05$
Cl mEq/L	9.51	1.27	10.91	1.41	11.70	1.33	$p > 0.05$
K mEq/L	9.01	0.60	10.89	0.67	9.03	0.63	$p > 0.05$

Table 4. Mean levels of all parameters of children without caries according to dentition and the significance of differences (p values).

	Primary Dentition n = 9		Mixed Dentition n = 11		Permanent Dentition n = 7		P
	Mean	SD	Mean	SD	Mean	SD	
Ca mg/dl	1.56	0.73	3.07	1.12	2.70	1.44	$p < 0.05$
Mg mmol/L	0.13	8.70	1.12	0.78	0.53	0.49	$p < 0.01$
P mmol/L	4.61	1.36	4.82	2.14	5.97	3.00	$p > 0.05$
Na mEq/L	34.33	5.15	45.00	3.38	36.86	5.15	$p < 0.01$
K mEq/L	8.08	2.17	9.21	1.76	9.03	2.12	$p > 0.05$
Cl mEq/L	9.82	2.79	12.54	2.80	12.70	1.65	$p < 0.05$

10 am. The flow rate of saliva peaks during the afternoon (acrophase) and drops to almost zero during sleep.^{b1}

The most important elements in saliva are Ca and P. No significant differences were found in levels of Ca and P between dentition groups in this study. The salivary Ca concentration was lower than in adults and that of phosphate which was similar in each group was similar to that in adults. Ca and P concentration increased with age.

Ben Aryeh et al observed the salivary concentration of Ca to be higher and of phosphates to be lower in the saliva of infants than in adults. This may have been due to relative deactivation at the time of collection. On the other hand, these authors found no significant difference between young and old for Ca concentration in whole saliva.

Akyuz et al found the salivary concentration of Ca to be lower in children than in adults and that of phosphate to be similar to that of adults.

In this study, no sex related differences were observed. This observation is supported in the findings of Akyuz et al.¹²

There was no significant difference in Ca and P between subjects with and without caries. However, there was a positive linear correlation between both Ca and P and total caries surface. Other researchers also have not found significant differences.^{10, 12, 14}

On the other hand, Koray reported that the salivary concentration of P in caries-free subjects tends to be higher than in caries susceptible subjects.¹ Phosphorous has also been reported to have caries prevention effects. A number of investigators have demonstrated no relation between Ca and caries.¹⁴ This has led to the belief that it is the saturation of saliva by calcium phosphate which is

important in dental caries and calculus formation.'

The authors found no significant changes in salivary K levels between dentition groups, but Na was significantly higher in the mixed dentition group. Na and K increased linearly with age. Ben Aryeh et al found a positive linear correlation of salivary Na with age, but no change in K.

The present study found salivary concentration of K to be lower than normal adult levels and of Na higher than in adults. Ben Aryeh et al, however, found no significant differences in Na or K between young and adults. Accordingly, inspite of the reported extensive morphological changes with age in salivary glands, the functional alterations appear to be very mild. Ben Aryeh et al found that the high salivary Na concentration in newborns might be due to the leakage via the immature junctions between cells. Salivary Na level also changes with the degree of stimulation. '

Shammon and Prigmore found that salivary Na levels changed according to the time of day which in turn varies over a 3 day cycle. There is no detailed information on these changes. However, the changes in Na and K in saliva might be a result of hormonal development as the salivary Na/K ratio is known to be regulated by aldosterone.

In this study, K increased with caries surface. Other studies have found K to be significantly higher in teeth with low caries than of high caries individuals. On the other hand, K has been found not to have a relationship to dental caries nor to have any significant interactions with other trace elements. ' Certainly, its presence in enamel would be unlikely to reduce enamel solubility. As the salts of K are generally very soluble, it would be

surprising if K by itself had any effect on caries.

The authors found Na to rise only slightly with dental caries, appearing not to have any major effect. Although the literature gives no indication of any research that has specifically focused on the action of Na, the action of NaF on caries is well known.

Although no significant differences were found in salivary Cl levels between groups, Cl positively correlated with age. Ben Aryeh, however, found Cl to decrease with age which might be due to the leakage of the immature junctions between cells as the possibility of a relationship between morphology and the permeability of the barriers has been suggested.⁹ The most regular of the changes in Na, K, Cl could arise from rhythms in aldosterone secretion (related to posture and sleep wakefulness) acting directly on the salivary gland.

Mg rose linearly with age in this study. Ben Aryeh found the concentration of Mg to be higher in the saliva of infants maintaining that the morphological development of permeability barriers between cells change the activity of enzymes and maturation of the autonomic nervous system.

Ben Aryeh et al, however, found whole saliva Mg concentration not to differ significantly between young and old in the study. The difference in these results might be due to factors such as temperature and humidity.

There was no relation between caries and Mg in this study. Kirzioglu et al came across the same finding. However, others have found Mg to decrease with increasing caries surface. Most surveys have found a negative correlation between Mg in drinking water and caries prevalence and high Mg to be usually present with high Ca. The known anticaries effect of the

phosphate, perhaps, washes away any effect of Mg.⁹ The literature reports very low levels of cariogenic streptococci in the presence of Mg. It is difficult to identify any possible effect of Mg alone in the presence of Ca and/or other alkaline earth trace elements.⁹ The composition of saliva is potentially of great importance to the prevention of caries.^{2, 21}

Saliva has been recommended by Mendel as a diagnostic tool. However, the main advantages of saliva in this regard are its variability in its composition changing with flow rate, nature and duration of stimulation, plasma composition, and the time of day at which samples are collected. In many studies, these variables have not been adequately taken into account. Consequently, the need for standardization of normal values becomes increasingly apparent when saliva is used for diagnosis. This study has demonstrated the importance of having normal values in different age groups.

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