Nutritional Status among a Group of Preschool Children in Relation to Concentration of Selected Elements in Saliva and Caries Severity (A Comparative Study)

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ABSTRACT

Background: Nutritional status during childhood is very important for individual development and growth. Nutrition has local and systemic effect on the oral health by affecting dental health and salivary composition. This study was aimed to determine effect of iron, sodium and potassium ions in saliva on the nutritional status and to determine the effect of nutritional status on caries severity among preschool children.

Material and Methods: The sample consists of 90 children aged 4 and 5 years of both genders, selected from 6 kindergartens in Al-Resafa aspect of Baghdad province. Children classified according to their nutritional status into three groups (normalweight, underweight and overweight). Nutritional status was determined by using body mass index BMI that achieved from height and weight (weight (Kg)/height (m)^2). Assessment and recording of caries experience was done by the application of decayed, missing, filled index (dmfs for primary teeth). The diagnosis of dental caries was done according to (d$_{1-4}$ mfs) criteria for primary teeth. Stimulated saliva was collected from children between 9-11 AM under standardized conditions and chemically analyzed to determine the concentration of iron, sodium and potassium calorimetrically by using ready-made kits and spectrophotometer machine. Data were analyzed using SPSS version 19.

Results: Concentration of sodium, potassium and iron ions were (46.64 mg/dl ± 18.00, 31.22 mg/dl ± 9.84, 17.76µg/dl ± 3.17) respectively. From the elements measured in saliva only sodium ions recorded statistically significant difference among the three groups of nutritional status. By application of LSD, the significant difference was found to be between normal weight and overweight groups (46.33 mg/dl ± 17.18, 40.64 mg/dl ± 14.79) respectively (P<0.05). Furthermore, positive and statistically significant correlations were recorded between sodium ions with BMI mean of overweight group on one hand (r=- 0.125, P<0.05) and iron ions and normal weight group on other hand (r=0.362, P<0.05). Recording and diagnosis of dental caries showed that means of ds, ms, dmfs, d$_2$s and d$_4$s were significantly higher among children aged 5 years than those aged 4 years. In addition to that means of ds, ms, dmfs and d$_2$s were significantly differ among the three groups of nutrition. Application of LSD test showed that those means were higher among underweight group than others.

Conclusion: Concentration of sodium ions in saliva changed according to nutritional status. On the other hand nutritional status may affect caries severity, where underweight children suffering from dental caries more than normalweight and overweight children.

Key words: Nutritional status, concentration of iron, sodium and potassium in saliva, Severity of caries. (J Bagh Coll Dentistry 2016; 28(1):147-152).

INTRODUCTION

Nutritional status is an assessment of level of nutrients in the body of a patient or subject and their ability to maintain normal metabolic integrity [1,2]. Excess or deficiency of one or more of the essential nutrients may result in deleterious effects on the subject health [3,4]. Oral and dental health reflects the nutritional status of the body, where there is a complex relationship among oral health, general health and nutritional status with many interrelating factors [5,6].

Dental caries remain the most public oral health disease especially among children [7]. Nutritional status has local and systemic effect in the etiology and pathogenesis of dental caries [8,9]. On the other hand inorganic composition of saliva including major and trace elements plays an important role in caries process and mineralization of teeth [10,11].

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There is an interrelationship between elements in saliva and nutritional status, where some of these elements as zinc were changed with alteration in nutritional status [6, 12, 13]. There is a limitation in the studies concerning these aspects. For all of the above and in order to increase knowledge about the Effect of certain element in saliva on the nutritional status on one hand and the effect of nutritional status on caries severity on the other hand, this study was conducted.

MATERIALS AND METHODS

The Study Group

Sample involved in this study consisted of 90 children aged 4 and 5 years of both genders selected from 6 kindergartens in Al-Resafa Aspect of Baghdad province. Those children were selected according to their body mass index to determine their nutritional status, in order to be classified into three groups (normal weight group, underweight group and overweight group), each group was consist of 30 children to compare

between them. For each volunteers parents the objectives of the study were explained to, and they approved to participate.

Assessment of Nutritional Status

Nutritional status of each child was assessed by using body mass index BMI that represents a number calculated from weight and height according to the following formula:

$$\text{BMI} = \frac{\text{Weight [Kg]}}{\text{Height [meter] 2}}$$

There was no BMI database available for Iraqis to compare results so, the reference population defined by the National Centre for Health Statistics, in collaboration with the National Centre for Chronic Disease Prevention and Health promotion was used. BMI value crossed against age on special charts one prepared for boys and the other prepared for girls, to determine the nutritional status of each child involved in this study.

Collection of Saliva and Recoding of Caries

Stimulated saliva was collected from children between 9-11 AM. Each child was asked not to eat or drink (except water) 1 hour before collection, then each child was sited in relaxed position without any heavy physical stress and was asked to chew apiece of Arabic gum (0.35-0.4 gm.) for one minute then to remove all saliva by expectoration. Chewing was continued for five minutes, with the same piece of gum and saliva collected in sterile screw capped bottle [14].

Each salivary sample was then centrifuged by centrifugater at 3000 r.p.m. (revolution per minute) for 10 minutes. Salivary supernatant was stored at (-20ºC) in polyethylene tubes for subsequent chemical analysis. Clinical examination of teeth was conducted by using plan mouth mirror and dental explorer. Assessment and recording of caries experience was done by the application of decayed, missing, filled index (dmfs for primary teeth). The diagnosis of dental caries was according to (d_{1-4} mfs) criteria for primary teeth [15].

Analysis of Salivary Sample and Data

Concentrations of Sodium, Potassium and Iron in saliva were determined by using ready- made kits (Mg- Uranylacetat- Method, Human Biochemica, Germany) for sodium ,(Photometric Turbidimetric test, Human Biochemica, Germany) for potassium and (Lipid Clearing Factor (LCF) CAB method, Human Biochemica, Germany) for Iron, and analyzed by UV visible recording Spectrophotometry (Cecil CE 7200

UK) machine. Chemical analysis was carried out at Poisoning Consultation Center, Medical city.

Data were analyzed by using SPSS software version 19 (Statistical Package for Social Sciences) by application of both descriptive statistic including (number, percentage, mean and stander deviation) and interferential statistic including (Analysis of Variance (One Way ANOVA test), Student's t-test and Person's correlation coefficient).

RESULTS

Total number of sample was 90; 30 of them were aged 4 years and 60 of them were aged 5years. Boys represent 61.12% of total sample, while girls represent 38.88% of total sample as shown in table (1). Sample was distributed into three groups according to nutritional status (normalweight, underweight and overweight) each group consists of 30 children. Boys aged 5years were the highest in number in both normalweight and underweight groups, while girls aged 4 years were the smallest in number in these two groups. In overweight group an equal numbers of both ages and both genders were recorded as shown in table (2).

Results recorded in table (3) showed that differences in means of concentrations of iron ions (ferrous ions) and potassium ions, were not significant for the studied nutritional groups (normalweight, underweight, overweight), while significant difference was recorded for mean of concentration of sodium ions among the three groups of nutritional status (P< 0.05) with highest concentration among overweight group. Furthermore, positive weak and statistically significant correlations were recorded between concentration of Fe ions in saliva and BMI of normal weight group, and between concentration of Na ions in saliva and BMI of overweight group as recorded in table (4).

Regarding caries experience among those children, results showed that 21.11% of them were caries free, while for the other 79.99% of children involved in this study, statistically significant differences were recorded between children aged 4 years and those aged 5 years for means of ds, ms and d_4s (P < 0.05), in addition to that highly significant differences were recorded between these ages for means of dmfs and d_4s (P < 0.01). While all differences recorded between boys and girls were statistically not significant as shown in table (5).

According to the results recorded in table (6), significant differences in means of ds, fs and d_2s fractions were recorded among the three groups of nutritional status. After application of LSD

significant difference was found to be between underweight on one hand and normalweight and overweight groups on the other hand (P<0.05), furthermore; highly significant difference was recorded for means of dmfs among the same groups (P < 0.01).

Table 1: Distribution of Sample According to Age and Gender

Age of group in years	Boys		Girls		Both	
	No.	%	No.	%	No.	%
4 years	17	18.89	13	14.44	30	33.33
5 years	38	42.23	22	24.44	60	66.67
Both	55	61.12	35	38.88	90	100.00

Table 2: Distribution of Sample According to Nutritional Status (in Number and Percentage of Each Group) Described by Age and Gender

Nutritional status		Normal weight		Under weight		Over weight	
Age	Gender	No.	%	No.	%	No.	%
4 years	**Boys**	3	10.00	3	10.00	10	33.33
	Girls	4	13.33	4	13.33	5	16.67
	Both	7	23.33	7	23.33	15	50.00
5 years	**Boys**	14	46.67	15	50.00	10	33.33
	Girls	9	30.00	8	26.67	5	16.67
	Both	23	76.67	23	76.67	15	50.00
Both ages		30	100	30	100	30	100

Table 3: Concentration of Measured Elements in Saliva According to Nutritional Status (Mean and Stander Deviation) and Differences between Them

Nutritional status elements	Normal weight	Under weight	Over weight	Anova test		Total
	Mean ± SD	Mean ± SD	Mean ± SD	F	Sig.	Mean ± SD
Iron (I) µmol/L	17.40 ± 3.02	18.36 ± 3.24	17.61 ± 3.45	0.237	not	17.76 ± 3.17
Sodium (Na) mmol/l	46.33 ± 17.18	46.06 ± 18.28	40.64 ± 14.79	2.538	sig	46.64 ± 18.00
Potassium (K) mmol/l	29.25 ± 9.77	30.65 ± 9.85	31.51 ± 8.09	0.220	not	31.22 ± 9.84

SD=Stander deviation, Significance level at P < 0.05

Table 4: Correlations between (Iron, Sodium and Potassium) in Saliva and BMI in Each Nutritional tatus

Nutritional status elements	Normal weight		Under weight		Over weight	
	r	sig	R	Sig	R	sig
Iron (I) µmol/L	0.362	sig	- 0.183	Not	- 0.114	not
Sodium (Na) mmol/l	0.016	not	0.003	Not	0.125	sig
Potassium (K) mmol/l	0.145	not	0.187	Not	- 0.368	not

Significance level at P < 0.05

DISCUSSION

Nutritional status during childhood is very important for subsequent growth and development of individuals [2,3], so this study was conducted among preschool children aged 4 and 5 years. By studying the effect of elements in saliva on the nutritional status of children, results showed that the difference in concentrations of Fe and K ions in saliva were statistically not significant among the studied nutritional groups.

There is a controversy among Iraqi studies regarding salivary level of these two elements. Iraqi study conducted on school aged children found that salivary iron level was lower among overweight than that of normal weight [12]. On the other hand potassium level was lower among malnourished than well-nourished kindergarten children [16].

Table 5: Caries Experience among Children by Age and Gender

Fraction	Age Gender	4 years Mean ± SD	5 years Mean ± SD	Both ages Mean ± SD	t-test for ages t	Sig	t-test for gender t	sig
ds	Boys	3.87 ± 5.29	6.10 ± 5.23	5.45 ± 5.30	2.36	Sig	1.05	not
	Girls	4.00 ± 3.70	8.41 ± 7.20	6.77 ± 6.44				
	Both	3.93 ± 4.57	6.93 ± 6.06	5.97 ± 5.77				
ms	Boys	0.00 ± 0.00	0.95 ± 2.11	0.67 ± 1.82	2.44	Sig	0.26	not
	Girls	0.00 ± 0.00	0.91 ± 1.97	0.57 ± 1.61				
	Both	0.00 ± 0.00	6.93 ± 2.04	0.63 ± 1.73				
fs	Boys	0.75 ± 2.49	0.82 ± 1.98	0.80 ± 2.12	1.07	Not	0.00	not
	Girls	0.08 ± 0.27	1.23 ± 2.74	0.80 ± 2.23				
	Both	0.45 ± 1.86	0.97 ± 2.27	0.80 ± 2.15				
dmfs	Boys	4.63 ± 7.48	7.87 ± 5.96	6.93 ± 6.54	3.25	highly	0.64	not
	Girls	3.38 ± 3.82	10.55 ± 7.64	7.89 ± 7.31				
	Both	4.07 ± 6.05	8.84 ± 6.64	7.30 ± 6.83				
d_1s	Boys	1.56 ± 1.99	1.38 ± 1.54	1.44 ± 1.67	1.14	Not	0.50	not
	Girls	1.77 ± 1.96	0.95 ± 1.32	1.26 ± 1.61				
	Both	1.66 ± 1.95	1.23 ± 1.47	1.37 ± 1.64				
d_2s	Boys	0.75 ± 1.39	3.23 ± 2.96	2.51 ± 2.82	2.98	highly	1.56	not
	Girls	1.92 ± 2.01	5.00 ± 6.32	3.86 ± 5.33				
	Both	1.28 ± 1.77	3.87 ± 4.50	3.03 ± 4.01				
d_3s	Boys	0.56 ± 1.36	0.59 ± 1.42	0.58 ± 1.39	1.36	Not	1.43	not
	Girls	0.31 ± 0.63	1.50 ± 1.99	1.06 ± 1.71				
	Both	0.45 ± 1.08	0.92 ± 1.69	0.77 ± 1.53				
d_4s	Boys	0.00 ± 0.00	0.90 ± 2.28	0.64 ± 1.95	2.16	Sig	0.08	not
	Girls	0.00 ± 0.00	0.95 ± 2.34	0.60 ± 1.89				
	Both	0.00 ± 0.00	0.92 ± 2.28	0.62 ± 1.92				

Significance level at P < 0.05
Highly significance level at P < 0.01

Table 6: Caries-experience among children in relation to nutritional status (in mean and standard deviation) and differences between means

Nutritional Status / Fraction of caries	Nutritional status				
	Normal weight Mean ± SD	Under weight Mean ± SD	Over weight Mean ± SD	Anova F	Sig.
ds	4.70 ± 4.62	8.53 ± 7.60	4.67 ± 3.60	4.249	sig
ms	0.47 ± 1.43	1.10 ± 2.29	0.33 ± 1.26	2.360	not
fs	0.77 ± 1.94	1.43 ± 3.05	0.20 ± 0.55	2.950	sig
dmfs	5.63 ± 5.79	11.07 ± 8.55	5.20 ± 3.78	7.664	Highly sig
d_1s	1.23 ± 1.59	1.07 ± 1.59	1.80 ± 1.71	0.572	not
d_2s	2.60 ± 2.60	4.97 ± 5.74	1.53 ± 1.83	4.790	sig
d_3s	0.57 ± 1.22	0.87 ± 1.59	0.87 ± 1.77	0.220	not
d_4s	0.30 ± 1.14	1.10 ± 2.51	0.47 ± 1.77	0.883	not

Significance level at P <0.05
Highly significance level at P <0.01

So to understand the role of these tow ions further studies may be indicated. The concentration of Na ions in saliva of overweight group was significantly higher than that of normalweight. On the other hand sodium level in saliva recorded no significant difference between malnourished and well-nourished children as mentioned by other Iraqi study [16]. This result was agreed with result achieved in this study. In addition to that, by application of Person's correlation coefficient between BMI of each nutritional group and concentration of these elements in saliva, Na ions showed positive correlation that was statistically significant with BMI of overweight group. Although this correlation was weak, but this result in addition to that achieved by Analysis of Variance (ANOVA) gave an indication that Na ions in saliva may be increase with increase in BMI.

No previous study had been conducted regarding the relation between sodium ions in saliva and nutritional status particularly overweight condition, to compare the result with. However, it had been found that, increase in serum sodium level, result in further uptake of water to maintain a balance between sodium and water level in serum and this may increase body weight [17,18]. This fact may support result achieved in this study. The concentration of Fe ions in saliva of normalweight group recorded positive and statistically significant correlation with BMI of this group. This result was agreed with fact that, iron deficiency may result in malnutrition condition and lose of body weight[19]. This result may indicate that when iron present in sufficient amount; healthy weight could achieve as reflected by salivary picture.

Regarding caries severity among those children, the means of (ds) that represent the present disease, (ms) that represent the accumulative effect of dental caries and (dmfs) that represent the caries experience; were significantly higher among children aged 5 years than these of 4 years. On the other hand means of (d_2s) that represent initiation of caries, and (d_4s) that represent progression of caries to the deeper tooth layers, were also significantly higher among children aged 5 years than these of 4 years. All of these results could explained by that, teeth of children aged 5 years exposed to oral environment and cariogenic factors for longer period of time than teeth of children aged 4 years that no longer had been erupted. It was well established that caries severity increase with age due to accumulative and irreversible nature of dental caries [20].

Concerning the effect of nutritional status on caries severity, results showed that caries experience and severity were significantly higher among underweight children than that of both normal weight and overweight. The same results were achieved by other Iraqi studies [16, 21]. Underweight children may take inadequate amount of essential nutrient that may affect composition of teeth as accumulative effect (if this problem is previous) or affect composition of outer enamel surface and composition and properties of saliva that continually affect by availability of essential nutrient in diet [22].

In conclusion from the three elements measured in saliva, sodium ions only were found to be changed with nutritional status. On the other hand it had been found that caries severity affected by nutritional status of children, where caries severity increase among underweight children. However, epidemiological study on larger population of children regarding this aspect is recommended.

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