Salivary antioxidants in relation to dental caries among a group of lead-acid batteries factory workers

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ABSTRACT

Background: Lead-acid battery workers are at higher risk for systemic diseases as well as oral diseases like dental caries. The aim of this study was to assess selected salivary antioxidants and their relation with dental caries among lead acid battery factory workers in comparison with non-exposed group.

Materials and methods: The sample consisted of 35 subjects aged 35-45 year-old who worked in Babylon lead acid battery factory in Baghdad city and matching group that not exposed to lead were selected as a control. Dental caries severity was recorded by using DMFS index, stimulated salivary samples were collected and analyzed for the measurement of salivary antioxidants (uric acid, total protein, catalase and glutathione peroxidase enzymes).

Results: The antioxidants levels (uric acid, catalase and glutathione peroxidase enzymes) were higher among the study group than the control group with non-significant difference for uric acid, highly significant difference for catalaseenzyme and significant for glutathione peroxidaseenzymes, whereas total protein level was significantly lower among the study group than the control. Regarding dental cariesseverity, DMFS values were significantly higher among study group compared to that among control group. All the correlations between salivary antioxidants and dental carries found to be weak non-significant for both groups.

Conclusions: Selected salivary antioxidants were found to have little effects dental caries of the study group, although dental caries revealed higher percentage of occurrence among lead exposed workers. Therefore, special oral health preventive and educational programs are needed for them.

Key words: lead exposure, lead acid battery workers, antioxidants, oral health status. (J Bagh Coll Dentistry 2015; 27(1):159-163).

INTRODUCTION

Air-pollution is a major public health problem affecting everyone in developed and developing countries alike [(1)], it can be define as an introduction of physico-chemical or biological materials into the earth's atmosphere that may cause harm or discomfort to humans or other living organism or deterioration of natural environment [(2)].

One of the most familiar of the particulates in air pollutants is lead [(3)]. The manufacturing of lead acid batteries can result in lead exposures sufficient to cause chronic and acute health effects [(4,5)], it effects almost all the body systemsespecially red blood cells, liver, nervous system, gonads andkidneys [(1)]. Air pollutants give rise to oxidative stress and reactive oxygen species production occurs in the mitochondria, cell membranes, phagosomes, and the endoplasmic reticulum[(6)].

Dental caries is the localized destruction of susceptible dental hard tissues by acids produced by bacterial fermentation of dietary carbohydrates [(7)]. It is a multifactorial disease involving the presence of microorganisms, the host, the substrate and alteration of the immunological system [(8)].Studies found an increased in the caries prevalence among lead exposed people [(9, 10)].

Saliva was found to affect oral health through various defense mechanisms such assalivary flow rate, buffer capacity,electrolytes, total protein, Antimicrobial activities etc[(11)], in addition to its antioxidant system [(12)]. The specific role of antioxidants is to neutralize rampaging free radical and thus reducing its capacity to damage [(13)].

MATERIALS AND METHODS

The sample consisted of 35 subjects aged 35-45 year-old at Babylon lead acid battery factory in Baghdad city. They should be non-smoker, with no medical history, shouldn't take any medications, and shouldn't wear any fixed or removable dental prostheses. The collection of stimulated salivary samples was performed according to the instructions cited by Tenovuo and Lagerlöf [(14)].Then salivary samples were taken to the laboratory for biochemical analysis at the Poisoning Consultation Center/ medical city. Salivary antioxidants were determined colorimetrically by using the spectrophotometer for uric acid (UA) a ready kit was used (Human, Germany). This method enables to determination of uric acid by reaction with uricase.

The formed H_2O_2 reacts under catalysis of peroxidase with 3.5-dichloro-2-hydroxybenzene-sulfonic acid (DCHBS) and 4-aminophenazone (PAP) to give a red-violet quinoneimine dye as indicator. For total protein (TP) (SYBRIO-FRACE) kit was used, proteins modify spectrum

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of absorption of the complex pyrogallol red molybdate. Globins together with albumin react.

The optical density read at 598nm is proportional to concentration in proteins. Determination of catalase enzyme (CAT) according to Beers and Sizer [15] modified by Aebi [16] using phosphate buffer (50 mM) andhydrogen peroxide (30 Mm). Whileglutathione peroxidase enzyme (GpX) according to Flohe and Gunzler [17] using Phosphate buffer (0.1 M), Glutathione reduced (2 mM), Sodium azide (10 mM), Hydrogen peroxide (1 mM), Trichloroacetic acid (TCA) 5 %, DTNB (0.4 mg/ml). Dental caries severity was recorded by using DMFS index by WHO [18].

RESULTS

Sample distribution according to age is shown inTable-1.The means and standard deviations of DMFS in study and control groups are demonstrated in Table-2 which revealed that DMFS, DS, MS, FSwere higher among study group with statistically highly significant difference for DMFS, DS and no significant for MS, FS components.

Table-3 demonstrates comparison of salivary antioxidant concentration between the study and control groups, all the selected antioxidant except the total protein showed higher mean values among study groupwith non-significant difference for UA, significant for GpX and highly significant difference concerning CAT enzyme, while TP was significantly lower amongstudy group than the control group.

Pearson's correlation coefficient between caries experience and salivary elements concentrations are clarified in Table-4, all salivary antioxidants showed weak and statistically not significant correlations with caries experience, in positive direction concerning UA with MS, also TP with DS, MS, FS, DMFS and CAT enzyme with FS for the study group, while the positive relation in control group was recorded between TP with DS and CAT enzyme with FS, concerning GpX enzyme positive relation was found with all DMFS components, where all the other relations was negative.

Table 1: Distribution of subjects' sample by age

Groups	Age group (years)	No.	%
Study	35-40	22	62.86
	41-45	13	37.14
	Total	35	100
Control	35-40	22	62.86
	41-45	13	37.14
	Total	35	100

Tables 2: Caries experience among study and control groups

Variables	Age group (years)	Study group		Control group		Statistic test		
		Mean	± SD	Mean	± SD	t-test	P-value	df
DS	35-40	10.41	6.53	3.23	3.07	4.67	0.00**	42
	41-45	12.00	7.34	6.15	6.37	2.16	0.04*	24
	Total	11.00	6.78	4.31	4.71	4.79	0.00**	68
MS	35-40	12.68	9.87	8.82	8.95	1.36	0.18	42
	41-45	13.31	9.21	8.00	9.68	1.43	0.17	24
	Total	12.91	9.5	8.51	9.01	1.98	0.05	68
FS	35-40	2.41	2.80	2.73	4.07	-0.30	0.76	42
	41-45	4.77	8.74	2.69	5.69	0.71	0.48	24
	Total	3.29	5.76	2.71	4.65	0.45	0.65	68
DMFS	35-40	25.50	12.14	15.00	11.05	2.98	0.005**	42
	41-45	29.31	16.01	15.31	11.98	2.52	0.02*	24
	Total	26.91	13.64	15.11	11.33	3.94	0.00**	68

***Significant (P<0.05), **Highly significant (<0.01).**

Table 3: Salivary antioxidants among study and control groups

Variables	Age group (years)	Study group		Control group		Statistic test		
		Mean	± SD	Mean	± SD	t-test	P-value	df
UA (mg/dl)	35-40	2.59	0.88	2.58	0.96	0.06	0.95	42
	41-45	2.81	0.88	2.48	0.89	0.95	0.35	24
	Total	2.67	0.87	2.54	0.92	0.61	0.54	68
TP (mg/dl)	35-40	59.62	12.18	65.17	15.20	-1.33	0.19	42
	41-45	58.66	11.29	69.88	8.22	-2.89	0.01*	24
	Total	59.26	11.70	66.92	13.11	-2.57	0.01*	68
CAT (U/ml)	35-40	21.30	0.69	19.98	0.98	5.13	0.00**	42
	41-45	21.79	0.45	19.70	1.22	5.76	0.00**	24
	Total	21.48	0.65	19.87	1.07	7.56	0.00**	68
GpX (U/ml)	35-40	0.30	0.19	0.21	0.15	1.76	0.09	42
	41-45	0.28	0.17	0.22	0.08	1.06	0.30	24
	Total	0.29	0.18	0.21	0.13	2.07	0.04*	68

***Significant (P<0.05), **Highly significant (P<0.01).**

Table 4: Salivary antioxidant in relation tocaries experience among study and control groups

Variables		Study group				Control group			
		DS	MS	FS	DMFS	DS	MS	FS	DMFS
UA	r	-0.12	0.02	-0.08	-0.06	-0.18	-0.04	-0.29	-0.18
	P	0.48	0.91	0.64	0.72	0.29	0.84	0.09	0.29
TP	r	0.04	0.04	-0.07	0.02	0.05	-0.02	-0.06	-0.06
	P	0.80	0.79	0.68	0.89	0.76	0.88	0.73	0.72
CAT	r	-0.07	0.01	0.05	0.01	-0.05	-0.21	0.10	-0.18
	P	0.68	0.95	0.76	0.97	0.77	0.23	0.57	0.28
GpX	r	-0.05	0.01	-0.11	-0.06	0.14	0.14	0.10	0.21
	P	0.76	0.94	0.53	0.74	0.41	0.43	0.56	0.22

DISCUSSION

Lead is a ubiquitous environmental toxin that induces abroad range of physiological, biochemical, and behavioraldysfunctions [19]. Results of the current study revealed thatUAwas slightly higher among study group than the control group, The same result was also reported by other studies [20-22], this elevation in UA level may be due to adverse effects of lead on renal function that may cause hyperuricemia [22] or may be explained as a defense mechanism against pollutants, since UA is a dominant antioxidant in the body [23], while TP was significantly lower in the study group than the control group, the decrease in TP level may be due to proteinuria that occur as a result of kidney impairment in lead toxicityand may be a cause of protein loss [24],or could be attributed to lower intake of protein-rich due to low socio-economic level and lacking knowledge about the importance of healthy diet [25], same result was reported by other studies [26, 27].

Also the results revealed signifigantly higher levels of both CAT and GPx enzymes were found among the study group than the control group, this may be explained as a defense mechanism against oxidative stress as results of pollution [28]. Also data showed that dental caries (DMFS, DS, MS, FS) were significantly higher among study group than the control group, this may be due to poor oral hygiene among the study or may be attributed to the lead exposure effect, as lead ions considered as a cariogenic element [29,30]. Also the result of this study revealed a weak negative non-significant correlation between dental caries and salivary antioxidants (UA, CAT, GpX enzyme) among study group, this confirmed the protective role of salivary antioxidants and this effect is non-significant or limited in this study may be due to the fact that dental caries is a multi-factorial disease [31].

The present research also give a positive relations of DMFS index and DS fraction with the total protein although statistically were not significant, this may be due to the fact that total salivary proteins may have both protective and detrimental properties. Some proteins such as antimicrobial and pH modulating proteins play a protective role in the oral cavity, while adhesins and agglutinins play a detrimental role by increasing the colonization of microorganisms [32].From the present study, workers exposed to lead showed an elevated risk of achieving caries, missed teeth due to caries and high DMFT index, Thus it is recommended that this group should

receive a special preventive program and specialized care centers should be offered.

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الخلاصة

المقدمة يتعرض العاملون في معامل البطاريات إلى مشاكل في الصحة العامة بالاضافة الى صحة الفم والاسنان من ضمنها تسوس الاسنان. الهدف من هذه الدراسة هو لتقييم مستوى مضادات الأكسدة اللعابية ومدى تأثيرها على تسوس الأسنان لعينة من العاملين في معمل بطاريات بابل ومن ثم مقارنتها مع عينة ضابطة.

المواد والطرق تكونت مجموعة الدراسة من (35) عامل في معمل بطاريات بابل في مدينة بغداد واللذين تتراوح أعمارهم بين 35-45 وكذلك (35) شخصا مطابقين بالجنس والعمر وغير معرضين لمادة الرصاص تم اختيارهم كمجموعة ضابطة. تم حساب شدة التسوس من خلال تطبيق مؤشر دالة تسوس سطح الاسنان لمنظمة الصحة العالمية وبعدها تم تحليل عينات اللعاب كيميائيا لغرض إيجاد مستوي تركيز مضادات الأكسدة (البروتين الكلي , حامض اليوريك, أنزيمي الكاتاليز و الكلوتاثيون بيروكسيدايز).

النتائج وجد إن مستوى تركيز مضادات الأكسدة(حامض الفوليك, أنزيمي الكاتاليز و الكلوتاثيون بيروكسيدايز) اعلى في مجموعة الدراسة مقارنة بالمجموعة الضابطة مع وجود فرق معنوي بالنسبة لأنزيم الكاتاليز و الكلوتاثيون بيروكسيدايز وعدم وجود فرق معنوي بالنسبة لحامض الفوليك, بينما كان مستوى البروتين الكلي اقل في مجموعة الدراسة مقارنة بالمجموعة الضابطة مع وجود فرق معنوي. كذلك وجد ان دالة تسوس سطح الأسنان اعلى لدى مجموعة الدراسة مقارنة بالمجموعة الضابطة مع وجود فرق معنوي عالي. أظهرت مضادات الأكسدة ارتباطا ضعيف غير معنوي مع دالة تسوس الأسنان بالاتجاه الإيجابي بالنسبة للبروتين الكلي و أنزيم الكاتاليز لمجموعة الدراسة و أنزيم الكلوتاثيون بيروكسيدايز للمجموعة الضابطة وبقية العلاقات بالاتجاه السالب.

الاستنتاج وجد إن مضادات الأكسدة اللعابية المختارة لها تأثير ضعيف على تسوس الاسنان الذي اظهر نسبة حدوث وشدة عالية لدى مجموعة الدراسة ولهذا يتطلب الأمر برامج وقائية و تثقيفية خاصة بصحة الفم و الأسنان لعمال معمل البطاريات .

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