Oral health status in relation to selected salivary elements among a group of gasoline stations workers

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ABSTRACT

Background: Gasoline constituents and its derivatives had many hazardous effects on the general health of humans. Thus, gasoline stations workers may be affected by different types of related diseases.This study was conducted to assess selected salivary elements and their relation with dental caries, oral hygiene status and periodontal diseases among gasoline stations workers in comparison with individuals have no regular exposure to gasoline.

Materials and methods: The study group consists of thirty male subjects with an age range (33-39) years who worked in different gasoline stations in different areas of Baghdad city and thirty persons that matching in age and gender and not exposed to gasoline were selected as a control group. Dental caries was recorded by lesion severity through the application of D1-4 MFS index of (Manji et al). Plaque index of Silness and Loe and calculus index of Ramfjord were used for recording oral hygiene status. Periodontal diseases were evaluated by using the gingival index of Loe and Silness and periodontal pocket depth of Carranza. Stimulated salivary samples were collected and chemically analyzed to determine the concentration of salivary calcium, phosphorous, iron, copper and lead ions.

Results: Caries experience (DMFS) was higher among the study group compared with the control group with significant difference (P<0.05) for DS and highly significant difference (P<0.01) for D_2. The mean values of plaque, calculus and gingival indices were significantly higher (P<0.01) among the study group than the control group and the mean value of periodontal pocket depth was significantly higher (P<0.05) among the study group. The levels of salivary calcium and phosphorous were lower among the study group compared with the control group with no significant difference between them; whereas iron, copper and lead levels were higher among the study group than the control group with highly significant differences (P<0.01) for both copper and lead.

Conclusion: Dental caries and periodontal diseases revealed higher percentage of occurrence among the study group and salivary elements were found to have little effects on the oral health status. Therefore, special oral health preventive and educational programs are needed for them.

Key words: Gasoline, Salivary Elements,dental caries, oral hygiene status and periodontal diseases. (J Bagh Coll Dentistry 2013; 25(3):125-129).

INTRODUCTION

Gasoline is the generic term for petroleum fuel used mainly for internal combustion engines. It is complex, volatile and flammable and contains over 500 saturated and unsaturated hydrocarbons. The variable mixture characteristics depend on crude oil origin, differences in process techniques and blades, season to season changes and the additives required meeting particular performance specifications. Generally, a common gasoline formulation contains approximately (80-90%) hydrocarbons in addition to alcohols, ethers and additives [(1)].

Gasoline has many negative effects on the general health of humans depending upon both the amount and duration of the exposure. The major toxic risk of gasoline comes from breathing exhaust fumes, evaporative and refueling emissions rather than from occasional skin contact from spills [(2)], also personal habits and lack of protective measures at the workplace and lack of awareness about the effects of gasoline were reported to contribute in facilitating exposure to gasoline [(3,4)].

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Saliva is an important fluid and plays an essential role in maintaining the integrity of the oral structure [(5)]. Recently saliva is a promising option for diagnosis of many systemic diseases through the evaluation of certain substances for each type of disease [(6)].

As there are no available studies that investigate the relation between the exposure to gasoline constituents and its additives with the oral health status among the gasoline stations workers, so this study was conducted to increase the knowledge and to improve human oral health.

MATERIALS AND METHODS

The study group includes 30 males who work at least five years in different gasoline stations in Baghdad city. Their ages were between 33-39 years and the age was recorded according to the last birthday [(7)]. They were non-smokers with no history of serious medical problems, not received any medicaments in the last two weeks before examination and not wear any fixed, removal dental prosthesis or orthodontic appliance and their permanent residence were in Baghdad city. The control group also includes 30 males that matching the study group in everything except they were not in contact with gasoline.

Dental examination and oral health assessments were performed after the collection of the stimulated saliva and according to the basic method of oral survey of the WHO [8].

Caries experience was recorded using plane mouth mirror and dental explorer according to Decayed, Missing and Filled Surfaces index (DMFS). The diagnosis of the severity of dental caries was according to the criteria of Manji et al [9]. Radiographs were not taken because of the technical difficulties.

Dental plaque was assessed by using plaque index (PlI) of Silness and Loe [10]. Gingival inflammation was assessed by using the gingival index by Loe and Silness [11]. Dental calculus was assessed according to criteria of Ramfjord [12].

The probing pocket depth was measured with calibrated periodontal probe (William's probe) according to criteria of Carranza [13].

The collection of stimulated salivary sample was performed following instruction cited by Tenovuo and Lagerlof [14]. Chemical analyses of the elements were carried out at the Poisoning Consultation Center / Specialized Surgeries Hospital. Ca, Cu and Pb ions were determined using air-acetylene atomic absorption spectrophotometer (Buck scientific, 210 VGP, USA) according to instrumental manufacturer's specification [15]. While inorganic phosphorous and iron were determined colorimetrically by the Molybdenum-Vanadata method [16] and by using readymade kit (Biomaghreb, Tunisia) for phosphorous and a readymade kit (Biolabo, France) for iron .

Analysis of data was carried out using SPSS(version16). Statistical tests used were Student's t-test and Pearson's correlation coefficient. The confidence limit was accepted at 95% , P< 0.05 was regarded as statistically significant and P< 0.01 were regarded as highly significant.

RESULTS

Result revealed that caries experience represented by DMFS index was higher among study group compared with control group, but the difference was statistically not significant (P>0.05). In both groups missing component of DMFS index represented the highest proportion. Decayed surfaces value was significantly higher among the study group (P<0.05). Although missing surfaces value was higher among study group compared with control group, but the difference was statistically not significant (P>0.05).While filled surfaces value was higher among control group compared with study group, but the difference was statistically not significant (P>0.05) Table (1). Results also showed that only D_2 value was highly significant higher among study group compared with control group (P<0.01), while for the other grades, study group D_1, D_3 and D_4 were higher than control group D_1, D_3 and D_4 respectively, but the differences were statistically not significant (P>0.05) Table (2).

Oral examination revealed higher mean values of plaque index, calculus index ,gingival index and periodontal pocket depth among the study group than the control group with statistically highly significant difference (P<0.01) except for PPD the difference was significant (P<0.05) Table (3).

Table (4) showed that salivary calcium and phosphorous ions levels were higher among control group compared with study group, but the difference were statistically not significant (P>0.05). While iron ions concentration was higher among study group compared with control group, but the difference was statistically not significant (P>0.05). For copper and lead ions concentrations they were higher in study group than control group with statistically highly significant different between them (P<0.01). Pearson's correlation coefficient between caries experience and salivary elements concentrations showed that both groups have weak and statistically not significant correlations with caries experience where some of these correlations were positive while the others were negative Table (5).

Table 1. Caries experience among study and control groups.

Variable	Study group		Control group		Statistical test	
	Mean	± SD	Mean	± SD	t-test	P-value
DS	10.43	5.53	7.00	5.81	2.34	0.023 *
MS	14.50	12.75	10.30	8.78	1.48	0.143
FS	5.13	9.73	7.80	9.29	-1.1	0.282
DMFS	30.07	18.52	25.10	14.21	1.16	0.249

***Significant (P<0.05), d.f =58**

Table 2. Caries severity among study and control groups

Variables	Study group		Control group		Statistical test	
	Mean	+ SD	Mean	+ SD	t-test	P-value
D_1	2.67	2.64	2.2	2.83	0.66	0.512
D_2	5.1	3.91	2.67	3.04	2.68	0.009 **
D_3	1.5	2.54	1.47	2.12	0.05	0.956
D_4	1.17	2.84	0.67	2.85	0.68	0.499

****Highly significant (P<0.01), d.f = 58**

Table 3. Oral hygiene and periodontal indices among study and control groups.

Variables	Study group		Control group		Statistical test	
	Mean	+ SD	Mean	+ SD	t-test	P-value
PlI	1.27	0.61	0.88	0.45	2.75	0.008 **
CalI	0.54	0.51	0.14	0.17	4.03	0.000 **
GI	0.94	0.53	0.6	0.39	2.78	0.007 **
PPD	1.88	0.75	1.5	0.35	2.54	0.014 *

***Significant (P<0.05), **Highly significant (P<0.01), d.f = 58**

Table 4. Salivary elements among study and control group

Variable	Study Group		Control Group		Statistical test	
	Mean	+ SD	Mean	+ SD	t-test	P-value
Ca (mg/dl)	3.86	2.13	4.12	0.9	-0.62	0.537
PO4 (mg/dl)	4.89	1.77	5.18	2.69	-0.49	0.626
Fe (µg/dl)	41.41	16.06	38.41	11.43	0.83	0.408
Cu (µg/dl)	13.86	3.08	5.8	1.8	12.36	0.000 **
Pb (µg/dl)	15.9	3.26	7.23	1.16	13.7	0.000 **

****Highly significant (P<0.01), d.f = 58**

Table 5. Correlation coefficients between salivary elements with caries experience

Variable	Study group				Control group			
	DS		DMFS		DS		DMFS	
	r	P	r	P	r	P	r	P
Ca	-0.079	0.680	0.129	0.496	-0.176	0.352	0.001	0.998
PO_4	-0.122	0.521	0.231	0.220	0.052	0.784	0.137	0.472
Fe	0.025	0.895	0.244	0.195	-0.356	0.053	-0.140	0.460
Cu	-0.015	0.937	0.002	0.990	0.105	0.582	-0.152	0.422
Pb	0.060	0.754	0.101	0.595	-0.112	0.556	-0.097	0.609

DISCUSSION

Gasoline constituents and its additives had many effects on the general health of humans and as gasoline stations workers who pump gasoline are liable to exposed to the products present in the gasoline so they may have an increase in the risk for the development of many health disorders [17]. As there is no previous Iraqi studies concerning the effect of gasoline constituents and its additives on the oral health status, so this study was conducted.

The sample consist of 30 males who worked at least five years at different gasoline stations in Baghdad city to determine the effect of gasoline exposure on the oral health status. Their ages were between 33-39 years to exclude the systemic effects which occur as a result of aging. They were non smokers and looking healthy and not take any medication in the last two weeks to exclude any effect on the oral health status except the effect of gasoline.

Regarding the difference in the caries susceptibility, finding of this study found that missing surface fraction in the current study was the highest proportion of the DMFS index in the both groups. DS fraction was higher than the FS fraction in the study group, while FS fraction higher than the DS fraction in the control group. This finding indicates that the study group did not received an optimal dental care and have poor dental health knowledge , in addition to the that, the study group showed higher caries experience compared with the control group which indicated by the higher D_2 grade with highly significant difference and a significantly higher difference in the DS fraction. This could be explained by the poor oral hygiene among the study group as in the present study the study group had higher plaque and calculus deposits compared with the control group, since dental plaque plays an essential role in caries pathogenesis [18].

The other important factor that may affect caries experience is saliva through its constituents (19). Electrolytes in the saliva especially calcium and phosphorous are necessary to maintain the integrity of the teeth and considered to be an important variable explaining the difference in caries experience (20). As high concentration of calcium and phosphorous in the saliva guarantee the ionic exchange that directed towards the tooth surfaces and resulting in post-eruptive maturation. Remineralization of carious tooth before cavitation is then possible, mainly due to the availability of calcium and phosphorous in the oral cavity (21).

Iron ions in the present study showed inverse correlation with dental caries indicated by DMFS, DS and all grades of dental caries in the control group this in agreement with other study (22). This indicated that when iron increased in saliva, dental caries decreased, so it act as cariostatic element in the saliva by the inhibition of GTFs enzyme produced by Mutants streptococci, so it affect the growth and metabolism of microorganism on the teeth (23).

Lead ions considered a cariogenic element as its concentration increase in carious teeth compared with its concentration in the sound teeth with a highly significant difference between them (24). This is confirmed in the present study by a positive correlation with dental caries represented by DMFS, DS; however, the correlation was not reach the significance. It is essential to know that dental caries is a multi-factorial disease of which salivary composition represent only a fraction of all contributing factors, furthermore, salivary composition showed considerable variation since it depend on their present in the systemic environment which affected by the type of food, water, air and even drugs, also affected by the salivary flow rate, (25). In addition caries experience affected by other factors that is not involved in this study which include the diet and the cariogenic bacteria (26).

In this study results shown that the study group have higher mean value of gingival inflammation with highly significant difference and higher periodontal pocket depth mean value with significant difference compared with the control group. This could be attributed to the poor oral hygiene which plays an important role in the etiology and progression of periodontal disease (27)as indicated by the higher plaque and calculus mean values among the study group compared with the control group with highly significant difference between them and since plaque and calculus is the causative factors for the development of gingival inflammation(28) so they are also the causative factors for the increase in the periodontal pocket depth as previous study find that the gingival inflammation plays an important role in the occurrence of periodontal pocketing (29).

Saliva may affect periodontal diseases as any changes in the salivary constituents will affect the pathogenicity of dental plaque; this in turn will affect the periodontal response. The results of this study revealed that both salivary calcium and phosphorous ions were higher among the control group compared with the study group, although the difference failed to reach the significance. This could be attributed to the absence of both calcium and phosphorous ions in the composition of gasoline (30) since calcium and phosphorous ions were found to be essential for the health of the bone including the alveolar bone (31).

Iron ions in this study was higher among the study group compared with the control group, but with no significant difference between them, this may be due to the addition of iron carboxyl to gasoline as anti-knock agent, but it added in very small amount because it increases the engine wear due to its abrasive combustion product (32), so there is an exposure to small amount of iron ions. Beside this effect, the study group also had a higher iron level because they had higher gingival inflammation than the control group with a highly significant difference between the two groups, this is in agreement with the study done by Petrovich et al (33) who found that the salivary iron level was higher among persons with gingivitis than persons with normal gingival.

Regarding the copper ions, the present study revealed that the study group has higher salivary copper level compared with the control group, with highly significant difference between them. This could be attributed to the presence of copper ions in the gasoline as it is used as a metal deactivator which is effectively catalyze the oxidization of gasoline (32). Other reason could be due to subjects exposed to gasoline may had liver dysfunction which lead to an increase in the plasma level of copper (34), and as salivary composition resembles to that of serum (35), so this will lead to an increase in the salivary copper level.

Lead ions also was evaluated in this study and found that the study group had higher salivary lead level compared with the control group, with highly significant difference between them. This may be due to the addition of tetraethyl lead as anti-knock agent to the gasoline (36).

The higher level of both copper and lead ions may be attributed to that gasoline stations workers spend large part of the day exposed to gasoline, beside these workers did not use the preventive measures which include the using of proper personal protection which include the use of masks and gloves, use of ointment which reduce dermal exposure to gasoline and drinking of milk which retard the absorption of heavy metals, beside the poor health knowledge about the harmful effects of gasoline (37).

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