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Periodontal Health Status and Antioxidant Levels Among a Group of Diesel Generator Workers

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ABSTRACT

Background: The highly use of generators creating an alarming level of pollution (air and noise) in all regions of the world. One of the dangerous pollutant that emitted into environment during combustion process of diesel engines is The soot which is impure carbon particles known for their direct and broad impact on the respiratory organs and some polycyclic aromatic hydrocarbons which responsible for their cancer properties are associated with it. As Environmental conditions have many serious impacts on the general health of humans, it has also on oral status.

Aim: The aim of the study was to evaluate periodontal health status, salivary antioxidants (catalase, total antioxidant capacity and zinc) and protein carbonyl as oxidative stress marker in relation to periodontal disease among a group of diesel generator workers.

Materials and methods: The sample for this study included 94 workers in diesel generators, their ages were between 20 and 49 years. Collection of stimulated salivary samples was carried out under standardized conditions to determine the levels of antioxidants by using spectrophotometer while protein carbonyl by ELLISA technique, and periodontal health was determined by the CPI that modified by WHO in 1997.

Results: The result revealed that exposure of healthy subjects to occupational hazards for long period produces different changes in the oxidative stress markers as revealed by excessive production of the protein carbonyl (PC) and depletion in the activity of catalase (CAT) as antioxidant, according periodontal health : all categories of CPI approximately inclined within duration, and the most predominant score recorded is the score 2(calculus) and score 1 (bleeding) respectively with following mean ± SE (1.83 ± 0.15) and (1.81± 0.16) followed by score 3(shallow pocket) (1.74 ± 0.16) then score 4 (0.319 ± 0.06) while the least one was the score 0 or healthy (0.298 ± 0.08).

Conclusion: the work duration in diesel generator field affect the oxidative status and oral health condition of workers in that field, So, the workers in generators need special preventive programs to be designed for them.

Key words: Periodontal health, Antioxidants, Bloodstream, Radioactive hazards, Dentistry.

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INTRODUCTION

Pollution It is "the release of physical, chemical, biological or radioactive hazards or contaminants into the environment which cause adverse change". Among the most common forms of pollution are air, noise, and water pollutions [1]. Air pollution is the contamination of air by different particles of solids and gasses that change its normal characteristics [2]. Air pollution ranks among the top risk factors that causing death and disability worldwide as appear in Figure 1 [3]. The main health impacts of air pollution depend on the duration of exposure, either short (e.g. 8 or 24 hours) or long (e.g. annual) and the level of exposure (frequently expressed in ug/m^3) [2]. Diesel fuel produced by fractions of crude oil distillates mixed with different brand-specific additives, have many uses, as a fuel for road vehicles, or other forms of transport and electricity generators, incomplete combustion, of diesel fuel resulting in formation of diesel Exhaust, which is a complex mixture

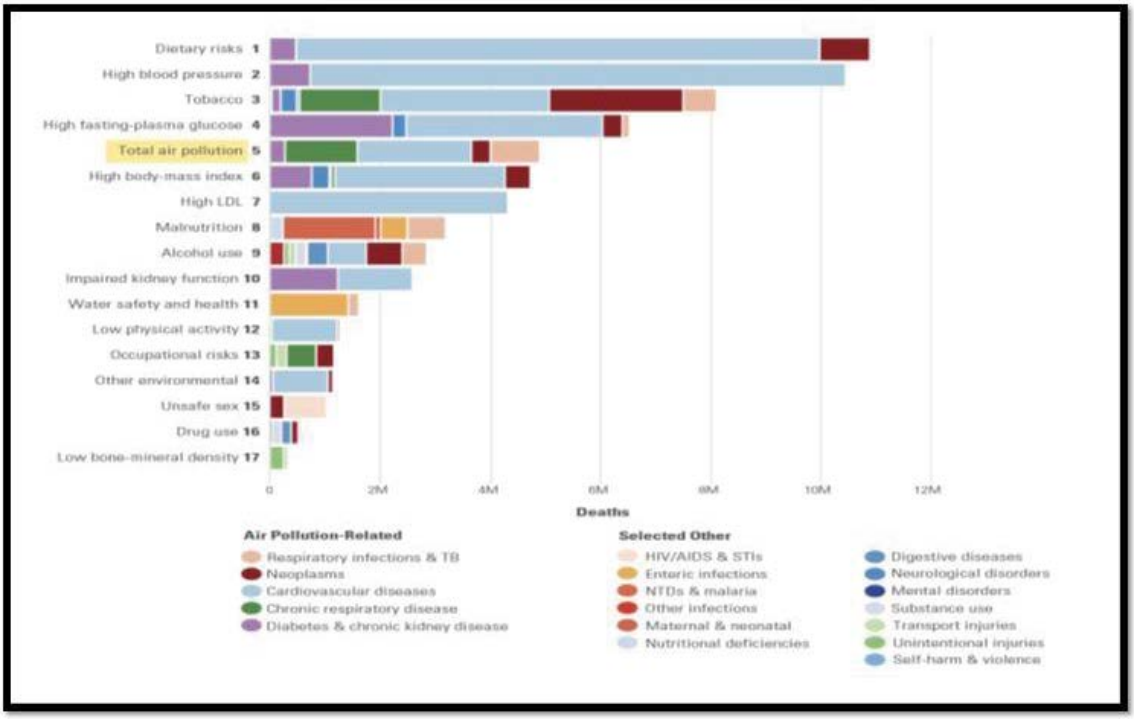

Figure 1: Global ranking of risk factors by total number of deaths from all causes for all ages and both sexes in 2017.

of gaseous and particulate components . Diesel particulate matter consists of fine particles these particles makes them highly respirable, and able to reach the deep lung and enter the bloodstream [4]. Generators are the machines that burning gas or diesel as fuels for generating electricity. In Iraq and other developing countries where there is no or little supply of power, they are a good and useful alternative source for electricity generation. Generator sets have a large cumulative effect on the ecosystem as it causes a threat to both humans as well as the environment [5]. The exact causative relation between diesel exhaust or air pollution and its adverse impacts on the health, is still not completely understood, but certain cellular and molecular mechanisms are generally supposed to play the key role. The most well explained cellular responses to the exhaust of diesel are "the induction of pulmonary oxidative stress and pro inflammation", that involved in the onset and exacerbation of many diseases in the respiratory system, and also cardiovascular diseases [6]. In order to protect the cells and organ systems of the body against reactive oxygen species, humans have a highly complex antioxidant protection system, In general, these antioxidant work in the body at three different levels: Radical preventive, radical scavenging and radical induced damage repair [7]. Saliva is the biological fluid in the mouth, and the defense function considered one of most important functions of saliva which includes the specific and nonspecific antibacterial factor as well as the antioxidant defense system [8]. There was no previous study concerning periodontal health in relation to oxidative status among diesel generator workers, so, this study was conducted.

SUBJECTS, MATERIALS AND METHODS

This cross-sectional study was conducted in AL-Sewera city, Iraq, in which there was about 110 large private diesel generators and 110 workers employed on the operation of these generators were included in this study. From the total sample, (16) workers were not included in the study (1subject was with systemic disease, 2 subjects refused the diagnosis and the remaining 13 subjects were smoking). So the final sample included only 94 workers, their ages were between 20 and 49 years, which was recorded according to the last birthday [9]. They were healthy looking with no history of serious medical disease, nonsmokers, not received any medicaments or hormonal supplements in the last two weeks before examination and not wear any dental, prosthesis or orthodontic appliance. The study was reviewed and approved by the ethical committee in the College of Dentistry, University of Baghdad.

Oral health examination

Oral health examination was, done according to the basic method of the WHO in 1997. Information about workers name, duration of work in this job, age and the time duration for generator operating was taken prior to the examination. By using plain mouth mirror and WHO probe, the examination was performed and according to the community periodontal index (CPI) that modified by WHO in 1997 periodontal health was recorded. the oral cavity was divided into six parts (sextants) defined by tooth numbers (18-14 | 13-23| 24-28| 38-34| 33-43| 44-48) and only ten index teeth were examined (17, 16, 11, 26, 27, 37, 36, 31, 46, and 47), but all the remaining teeth in the sextant are examined if no index tooth was present in that sextant, and the score of the sextants was the highest score recorded [9].

Salivary analysis

Collection of stimulated saliva was done at morning (9-11 a.m.). The collection was performed according to the instruction cited by Tenovuo, et al. [10]. Each worker was asked to chew a piece of Arabic gum for about 1 minute, then by expectoration, saliva was collected in plastic disposable container. The samples were centrifuged=at 3000 r.p.m for ten minutes then the clear supernatants of saliva were separated by micropipette and stored in a deep freeze (-20^0c) till the time of biochemical analysis. By using catalase (CAT kit, French) and according to the method of Hadwan, et al. [11] catalase was analyzed, by incubating the enzymes sample in 1.0 ml substrate (65 mmol/ml hydrogen peroxide in 60 mmol/l sodium–potassium phosphate buffer, pH7.4) at 37°C for three minutes. There action was stopped with ammonium molybdate. Absorbance of the yellow complex of molybdate and hydrogen peroxide is measured at 374 nm against the blank. Catalse activity expressed in kilo unite per liter (KU/L).

Total antioxidant capacity was assessed using (TAO kit, French) and according to the method of Apak et al. [12]. The sample or standard acts to reduce copper (Cu++) to (Cu+). The reduced copper will form a 2:1 stable complex with the chromogenic reagent and has an absorption maximum at (450˜nm). A known concentration of Trolox was used. TAC expressed as micromolar per milliliter (um/ml).

Zinc was analyzed using (zinco zinc, Italian kit) and According to the manufacturer instruction, Zinc react with the chromagen present in the reagent forming a colored compound which color intensity is proportional to the zinc concentration present in the sample. Zinc measured in microgram per deciliter (µg/dl).

Protein carbonyl was analyzed using protein carbonyl assay kit (Bioassay, Chinese) using ELISA technique and according to the manufacturer instruction the assay was performed. After all reagents, standard solutions and samples were prepared, 50µl standard was add to standard well and 40µl sample was added to sample wells and then 10µl anti-PC antibody was added to sample wells, then 50µl streptavidin-HRP was added to sample wells and standard wells . The plate was covered with a sealer, incubated 60 minutes at 37°C, then sealer was removed and the plate washed 5 times with wash buffer, wells were soaked with at least 0.35 ml wash buffer for 30 seconds to 1 minute for each wash. 50µl substrate solutions were added to each well. The, plate covered with a new sealer incubated for ten minutes at, 37°C in the dark then (50µl) Stop Solution was added to each well, the blue color was changed into yellow color immediately. The, optical density (OD value) of each well, was determined immediately using a micro plate reader set to,450) nm within (10) minutes after adding the stop solution.

RESULTS

In this study 94 workers employed in the operation of large private electrical diesel generators were examined, they were male, and their ages were between 20 and 49 years old with mean ± Standard deviation (SD) (35.29 ± 6.57). The number and distribution of the sample is displayed in Table 1 according to the duration of work and their ages.

Salivary analysis

Regarding duration comparison, by each age group, there is decrease of CAT approximately with significant finding in the 1st age group, while PC increase with duration with significant results in the 2nd age group, using multiple comparisons between durations, in each age group, about CAT, the only significant finding finds between the first two durations while in

Table 1: Frequency and percentage of subjects by demographic variables.

Variables	Categories	Duration (years)							
		1-5		6-10		11-15		Total	
		*N.	%	N.	%	N.	%	N.	%
Age (years)	20-29	6	37.5	6	37.5	4	25	16	100
	30-39	10	22.73	11	25	23	52.27	44	100
	40-49	8	23.53	13	38.24	13	38.24	34	100

*N: Number

PC, all results are significant except between the last two durations, its result are not significant.

Regarding age, in all durations, both Zinc and catalase decrease approximately within age, in TAO, results showed that it decreases definitely in the 1st duration within age, while for PC in the first two duration, there is inclination approximately within age, except in the last duration, it still decreases within age, although these results but still not significant (Tables 2 and 3).

The most predominant score recorded is the score 2 and score 1 respectively with following mean±SE (1.83±0.15) and (1.81±0.16) followed by score 3 (1.74 ± 0.16) then score 4 (0.319 ± 0.06) while the least one was the score 0 or healthy (0.298 ± 0.08) (Table 4).

As appear in Table 5, subjects with CP2 (calculus) are the most predominant followed by approximately equally distributed of both CP1 (bleeding) and CP3 (shallow pocket 4-5mm) respectively then CP4 (deep pocket 6mm or more) while the least one those with healthy periodontium, (5) about duration, in all age groups, all categories of CPI will be incline within duration, about age, in each duration only CP0 decrease approximately within age but the other scores of CPI are approximately increase when age incline.

Regarding duration (Table 6), in the 1st age group (CP4) it definitely still increase with significant finding, but for (CP1), it increases approximately within duration with highly significant, in the 2nd group of age the only significant result for (CP2) which is still increase within duration.

Regarding the age, in the 1st duration, CPI scores mostly increase within age but with significant for bleeding (CP1) and highly significant result for (CP2), in the 2nd duration also most CPI scores increase with age with significant results for (CP1) and (cp4), in the last duration, most CPI scores increase approximately with age with only significant for (CP1) and (CP3) .

About multiple pairwise comparisons table (Table 7), when compared the first two groups, only in the cp1 and cp3 in the last duration, their results are highly significant, when compared 1st with 3rd age groups in cp1 for the 1st and last duration are highly significant, by the last and 2nd durations, for both cp3 and cp4, their results are highly significant and significant respectively, other results are not significant.

In the multiple pair wise comparison (Table 8) between durations, in the 1st and 2nd age groups, about cp1, the only highly significant result found between last two durations, in both cp2 and cp4, when compared 1st with last group, their results are significant as well as between the last two durations in cp4 is also significant.

Correlation between periodontal health and salivary analysis (oxidant and antioxidant)

Results show that the correlations between cp0 and salivary anti-oxidants there are ranged from either positive or negative (weak or strong) with highly significant positive result with zinc, about other scores (CP1, CP2, CP3 and CP4), the correlations are negative with either strong or weak and ranged from either not significant, significant or highly significant, although there are some positive weak correlations but their results are still not significant. Regarding the salivary PC with the first score (CP0), the correlations are ranged from either positive or negative (weak or strong) with not significant, while for other scores (CP1,CP2, CP3 and CP4), their results of correlations are mostly positive with either strong or weak ranged from either not significant, significant or highly significant, although there are some negative weak and strong correlations but their results are still not significant (Table 9).

Correlation between salivary oxidant and antioxidants

In this table, results shows the correlation between oxidant and antioxidant, all these

Table 2: Descriptive and statistical test of salivary oxidant and antioxidants by age and duration.

Age (Years)		Zinc µg/dl					TAO uM/ml					CAT KU/L					PC ng/ml				
		Duration (Year)																			
		1-5	6-10	11-15	F	p	1-5	6-10	11-15	F	p	1-5	6-10	11-15	F	p	1-5	6-10	11-15	F	p
20-29	X	255.33	246.67	210	0.72	0.506	794.6	692.13	733.5	0.96	0.407	43.08	29.4	36.36	5.49	0.019	276.87	110.3	267.6	1.49	0.262
	SE	36.79	15.41	0.58			54.58	34.3	86.49			4.24	2.01	0.62			82.8	22.28	133.83		
30-39	X	265.2	259.55	220.96	1.79	0.179	661.16	655.77	675.33	0.41	0.663	32.83	40.81	33.86	1.78	0.181	92.84	290.04	185.41	4.34	0.02
	SE	22.63	22.2	15.1			21.92	6.58	15.15			1.96	4.01	2.43			16.4	60.93	32.56		
40-49	X	229	213.92	204.62	1.14	0.333	632.1	660.58	688.19	1.35	0.274	40.77	33.81	41.23	1.08	0.353	237.18	263.37	180.66	0.59	0.561
	SE	4.15	3.38	15.46			22.26	24.18	20.22			4.08	4.13	4			64.69	67.37	41.08		
F		0.72	2.8	0.28			3.6	0.58	0.8			2.79	1.69	1.53			4.17	1.62	0.47		
p		0.499	0.079	0.757			0.063	0.568	0.456			0.084	0.203	0.23			0.055	0.217	0.631		
Df (Degree of freedom)=2, X=Mean, SE=Standard error																					

Table 3: Multiple pairwise comparisons of CAT and PC between duration groups by age using Games Howell post hoc test.

Age (years)	Variables	Duration (Years)		P-value
20-29	CAT	1-5	6-10	0.038
			11-15	0.337
		6-10	11-15	0.051
30-39	PC	1-5	6-10	0.023
			11-15	0.043
		6-10	11-15	0.311

Table 4: Total sample variables.

Variables	Mean	SE
cp0	0.298	0.083
cp1	1.809	0.16
cp2	1.83	0.153
cp3	1.745	0.162
cp4	0.319	0.065

Table 5: Community periodontal index frequency.

Age (Years)	Duration (Years)		CP				
			0	1	2	3	4
20-29	1-5	N.	0	6	6	4	0
		%	0	37.5	37.5	25	0
	6-10	N.	0	6	4	4	0
		%	0	42.86	28.57	28.57	0
	11-15	N.	0	4	4	0	2
		%	0	40	40	0	20
30-39	1-5	N.	2	4	8	8	4
		%	7.69	15.38	30.77	30.77	15.38
	6-10	N.	4	11	9	6	2
		%	12.5	34.38	28.13	18.75	6.25
	11-15	N.	3	16	17	15	4
		%	5.45	29.09	30.91	27.27	7.27
40-49	1-5	N.	0	4	8	8	2
		%	0	18.18	36.36	36.36	9.09
	6-10	N.	2	7	11	10	6
		%	5.56	19.44	30.56	27.78	16.67
	11-15	N.	3	10	11	9	2
		%	8.57	28.57	31.43	25.71	5.71
Total (N)			14	68	78	64	22
%			14.89	72.34	82.98	68.09	23.4

Table 6: Descriptive and statistical test of CPI among duration by age.

Age (Years)		CP0					CP1					CP2					CP3					CP4				
		Duration (Year)																								
		1-5	6-10	11-15	F	p	1-5	6-10	11-15	F	p	1-5	6-10	11-15	F	p	1-5	6-10	11-15	F	p	1-5	6-10	11-15	F	p
20-29	X	0	0	0			0.75	1.15	1.46	7.92	0.006	2	2.33	1.5	0.49	0.626	1	1.67	0	3.25	0.072	0	0	0.5	4.88	0.026
	SE	0	0	0			0.31	0.36	0.29			0.37	0.76	0.29			0.37	0.56	0			0	0	0.29		
30-39	X	0.4	0.73	0.13	2.38	0.105	1.6	2	1.78	0.74	0.483	0.8	1.73	1.96	3.31	0.048	2.4	0.91	1.78	2.68	0.08	0.8	0.18	0.35	1.83	0.173
	SE	0.27	0.36	0.07			0.65	0.37	0.38			0.13	0.33	0.4			0.58	0.28	0.32			0.33	0.12	0.16		
40-49	X	0	0.46	0.54	0.8	0.459	3	2.45	4	1.02	0.374	3	1.92	1.46	2.95	0.071	2	2	2.38	0.2	0.818	0.25	0.46	0.15	1.53	0.232
	SE	0	0.31	0.31			0.37	0.37	0			0.53	0.38	0.37			0.27	0.52	0.54			0.16	0.14	0.1		
F		1.53	0.94	1.72			4.82	4.14	4.34			11.001	0.37	0.41			2.03	1.62	3.32			2.59	2.772	0.57		
p		0.239	0.402	0.193			0.023	0.027	0.02			0.004	0.7	0.67			0.156	0.217	0.047			0.099	0.045	0.57		
												df=2														

Table 7: Multiple pairwise Comparisons of CPI between age groups by duration.

Dependent Variable	Duration (Year)		Age (Years)		p
cp1	1-5	Games-Howell	20-29	30-39	0.186
				40-49	0.002
			30-39	40-49	0.489
	6-10	Hochberg	20-29	30-39	0.836
				40-49	0.404
			30-39	40-49	0.038
	11-15	Games-Howell	20-29	30-39	0
				40-49	0
			30-39	40-49	0.783
cp2	1-5	Hochberg	20-29	30-39	0.092
				40-49	0.22
			30-39	40-49	0
cp3	11-15	Games-Howell	20-29	30-39	0
				40-49	0.002
			30-39	40-49	0.608
cp4	6-10	Games-Howell	20-29	30-39	0.336
				40-49	0.019
			30-39	40-49	0.318

Table 8: Multiple pairwise Comparisons of CPI between duration groups by age.

Ae (Years)	Variables		Duration (years)		P-value
20-29	cp1	Hochberg	01-May	06-Oct	0.126
				Nov-15	0.187
			06-Oct	Nov-15	0.005
	cp4	Hochberg	01-May	06-Oct	1
				Nov-15	0.043
			06-Oct	Nov-15	0.043
30-39	cp2	Games-Howell	01-May	06-Oct	0.055
				Nov-15	0.03
			06-Oct	Nov-15	0.9

results reveal that the correlations are negative, in the first duration within the age groups, only the Zinc and CAT have the strong negative highly significant correlation except in the first age group with Zinc, it has significant correlation, in the 2nd duration within the last age group, only TAO has significant strong negative correlation, in the last duration, all anti-oxidants have strong negative highly significant correlations within the first age group, in the 2nd and 3rd age groups, only the Zinc has weak and strong negative significant and highly significant correlations respectively (Table 10).

Table 9: Correlations between Salivary oxidant and antioxidants and CPI by age and duration.

Age (Years)		Zinc						TAO						CAT						PC					
	Duration (Years)																								
		1-5		6-10		11-15		1-5		6-10		11-15		1-5		6-10		11-15		1-5		6-10		11-15	
		r	p	r	p	r	p	r	p	r	p	r	p	r	p	r	p	r	p	r	p	r	p	r	p
20-29	cp0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	cp1	0.77	0.074	0.72	0.105	.	.	-0.9	0.015	-0.87	0.026	.	.	0.6	0.204	-0.65	0.158	.	.	0.4	0.434	0.03	0.948	.	.
	cp2	0.17	0.749	-1	0	-1	0	-0.83	0.041	-0.97	0.001	-1	0	0.39	0.448	-1	0	-1	0	0.6	0.213	-0.72	0.108	1	0
	cp3	-0.94	0.006	-0.89	0.018	.		-0.07	0.897	0.76	0.082	.	.	-0.99	0	-0.93	0.007	.	.	0.99	0	0.96	0.003	.	
	cp4	.	.	.	.	-1	0	.	.	.	.	-1	0	.	.	.	.	-1	0	.	.	.	.	1	0
30-39	cp0	0.9	0	-0.19	0.572	-0.09	0.674	-0.53	0.115	-0.31	0.351	0.01	0.957	0.55	0.103	-0.03	0.921	-0.02	0.924	-0.56	0.093	-0.03	0.925	-0.39	0.063
	cp1	-0.86	0.002	-0.76	0.007	-0.03	0.886	0.27	0.446	-0.34	0.311	-0.27	0.216	0.14	0.699	0.04	0.895	-0.68	0	0.99	0	-0.04	0.915	-0.09	0.689
	cp2	-0.9	0	-0.14	0.674	-0.07	0.735	0.53	0.115	0.57	0.07	-0.74	0	-0.55	0.103	-0.76	0.006	-0.26	0.233	0.56	0.093	0.49	0.129	0.12	0.586
	cp3	-0.76	0.01	-0.42	0.196	0.22	0.31	-0.22	0.54	0.14	0.687	-0.45	0.029	-0.36	0.304	0.53	0.095	-0.19	0.378	0.82	0.004	-0.34	0.302	-0.05	0.826
	cp4	-0.72	0.018	-0.33	0.328	-0.14	0.537	0.06	0.86	0.06	0.852	-0.33	0.12	0.14	0.699	-0.81	0.002	-0.57	0.005	0.75	0.012	-0.32	0.334	0.18	0.414
40-49	cp0	.	.	0.26	0.395	-0.05	0.883	.	.	-0.47	0.105	0	0.988	.	.	0.07	0.832	0.02	0.946	.	.	-0.41	0.163	0.54	0.059
	cp1	-0.93	0.001	-0.05	0.865	-0.19	0.53	-0.08	0.845	-0.5	0.082	0.44	0.131	0.59	0.127	-0.05	0.871	0.51	0.078	-0.58	0.129	0.6	0.029	0.16	0.61
	cp2	-0.93	0.001	-0.68	0.011	-0.78	0.002	0.33	0.431	0.55	0.051	0.23	0.442	-0.38	0.357	0.53	0.06	-0.48	0.094	0.29	0.49	0.07	0.817	0.47	0.106
	cp3	-0.32	0.437	-0.37	0.219	-0.63	0.021	-0.22	0.605	0.34	0.255	-0.33	0.265	-0.45	0.266	-0.36	0.231	0.09	0.774	0.59	0.125	0.69	0.009	0.67	0.012
	cp4	-0.74	0.037	-0.92	0	0.19	0.542	-0.55	0.157	-0.44	0.132	-0.35	0.237	-0.84	0.009	-0.15	0.617	-0.22	0.477	0.78	0.022	-0.3	0.327	-0.026	0.4

Table 10: Correlation between salivary oxidant and antioxidants.

Age (years)			PC		
			Duration (years)		
			1-5	6-10	11-15
20-29	Zinc	r	-0.893	-0.715	-1
		p	0.017	0.11	0
	TAO	r	-0.045	-0.53	-1
		p	0.933	0.28	0
	CAT	r	-0.971	-0.778	-1
		p	0.001	0.068	0
30-39	Zinc	r	-0.844	-0.181	-0.419
		p	0.002	0.595	0.047
	TAO	r	-0.273	-0.22	-0.29
		p	0.446	0.516	0.179
	CAT	r	-0.098	-0.008	-0.072
		p	0.787	0.98	0.743
40-49	Zinc	r	-0.268	-0.321	-0.761
		p	0.521	0.284	0.003
	TAO	r	-0.464	-0.579	-0.175
		p	0.246	0.038	0.569
	CAT	r	-0.983	-0.075	-0.114
		p	0	0.809	0.71

DISCUSSION

The biochemical analysis results of this study revealed higher oxidative stress among workers with longer duration which presented by higher mean value of PC as oxidative stress with significant difference in the second age group and by significant decrease in the antioxidant level (catalase) with duration in the first age group which may be attributed to its use in various protective roles against oxidant this go in line with Al-Helaly, et al. [13] that showed the long period of exposure to petroleum pollutants lead to increase the oxidative stress and decrease in the antioxidant level because of elevated levels of ROS and overwhelming free radicals generation [14].

Diesel exhaust particles (DEPs) have a high content of organic and elemental carbon and the ability of DEPs to generate oxidative stress was largely related to these particles [15]. These particles can interact with molecular dioxygen (O_2) by redox–cycling resulted in formation of superoxidee radicals(O_2•-) and generater ROS. This ROS can react with biomolecules and produce byproducts like proteins-carbonyl, nitrotyrosine derivatives, lipids-isoprostanes,

age pigment. Antioxidant enzymes can inhibit the ROS (in the initial stages), but then (with long period) free radical will trapping the antioxidant and prevent them from action. The cells respond with changes in the basic metabolism whenever there is cell insult, and this appear in the form of cell protective mechanisms and generation of oxidative Stress factors [16].

The duration of exposure to pollutants in the present study has significant effect on Oxidative stress rather than age, although there were an impairment in the levels of both zinc and TAC between first and third age groups but this didn't reach any statistical significance. The Community Periodontal Index 1997 have three main advantages which are (Speed, Simple, and International uniformity) [17]. In general, this study showed that subjects with calculus are the most predominant followed by approximately equally distributed of both gingivitis and shallow pocket depth then deep pocket, while the least one those with healthy periodontium, this may indicate a poor oral cleanliness by generator workers, because poor oral hygiene have a significant role in the aetiology and also progression of periodontal disease [18]. Dental calculus also plays a role in the gingival inflammation, since it is a mineralized dental plaque, and acts as a retentive factor for dental plaque [19]. Periodontitis commonly results from the extension of gingival inflammation to the periodontal tissues [20,21]. Several studies indicated that, gingivitis play a significant roleein the formation of periodontal pocketing [22,23]. Because plaque and calculus considered the causative factors for the development of gingival disease, so, they are also the causative factors for increasing depth of periodontal pocket.

Regarding duration, there were significant increase results with duration in deep pocket depth, bleeding and calculus, which may be attributed to the increase in ROS represented by PC in this study and decrease in the antioxidant levels (catalase) that may lead to worse periodontal status due to tissue destruction and protein carbonyl formation since oxidative stress can affect initiation and progression of many inflammatory and infectious diseases [24], and as chronic inflammatory disease are associated with increased oxidative stress with phagocytes (particularly neutrophils) being involved in the pathogenesis of disease because of generation of oxidative burst during phagocytosis and killing [25] . this confirmed by the positive correlation between PC and periodontal disease in this study and other studies [26] in which higher levels of protein carbonyl were associated with worse periodontal status with significant correlation, another explanation for worse periodontal status is the significant decrease in catalase level as local antioxidant status may be of importance in determining susceptibility to the periodontal disease and its progression after initial bacterial colonization [27], Which is confirmed by the negative correlation between antioxidant and periodontal disease in this study and also others [28]. the decrease in Zinc level with duration although not reach any statistically significant result but also may be involve in the worse periodontal status which confirmed by the negative correlation with gingival or periodontal disease in this study and other studies [26], because zinc play a significant role in the health status of gingival tissue and insufficient amount of zinc can increase the permeability of gingival tissue, so, allowing antigens to gain entrance more easily into the gingiva [29]. Also, zinc is a significant component of many enzymes and it involved in an early phase of collagen metabolism [30].

This study is the first study to represent information about oral health among workers of generators therefore there is no previous data to compare with the finding of this study.

According to age, this study showed higher calculus accumulations among old adults which may be related to complex plaque removal in old subjects because of: root surfaces exposure, open gingival embrasures, involvement of root furcation's, and faulty restoration; in addition to visual disturbances, deceased motivation for self-care and altered salivary flow or combination of these factors, in addition to the economic barriers that prevent them from taking care of their oral health [31].

Regarding pocket depth, the results were significantly higher among old adults for deep and shallow pocket, this may be due to that, aging cause an exaggerated response of gingival and periodontal fibroblasts to external stimuli as reactive oxygen species, bacterial lipopolysaccharides and mechanical trauma by producing an excessive amount of

proinflammatory mediators (as PGE2 and IL-ß)which play a significant role in alveolar bone resorption; however, in the absence of external stimuli the age effect is minimal [31].

Higher gingival inflammation among old workers seen by the current study may be related to Poor oral hygiene among old adults, slightly increase in the level of protein carbonyl in the first and second duration and also the impairment in the level of antioxidants (i.e. TAC and Zinc) in the third age group may be involved in the higher gingival and periodontal disease as discussed previously. However other variables affecting the periodontal health which were not included in the present study must be investigated.

The study also revealed that the mean number of sextants with healthy periodontium was decreased when the age increase while the mean number of sextants with calculus and shallow pockets were increased as the age increase, and this consistent with the results of other studies [31,32].

Also, the increase in the severity of periodontal disease with age is mostly due to the accumulative effects of the disease on the periodontium.

CONCLUSION

Results of this study revealed that Protein oxidation represented by salivary protein carbonyl was found to be higher among the workers with longer duration and this could play a role in periodontal diseases among workers with longer duration especially when there is a reduction in salivary antioxidant defense mechanism among them, and because of poor oral cleanliness, shortage of dental health education, lacking of dental health unit, So, it is recommended to design a special oral and also general health preventive program in special health care centers, also effective preventive and control measures for workplace exposure are required.

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