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Study Effect of Noise Pollution from Electric Generators on Human Health in Al - Najaf Al-Ashraf City

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Abstract

The objective of this study was to evaluate the effect of noise from electrical power generators on physiological parameters, kidney functions and oxidative stress in of workers in electrical generators in Al - Najaf Al-Ashraf city . The noise levels measurements were conducted by using sound level meter in south and north sectors which were chosen in Najaf city center. Additionally, the study also included kidney functions, noise symptoms, antioxidants, and oxidative stress parameters in 30 workers employed on the operation of diesel generators and 30 unexposed subjects as a control group.

The results found that the average A-weighted equivalent continuous sound level (L_{Aeq}) of electrical generators 90.22±1.29 dB in the south sector during the morning period in Al-Najaf city . Furthermore , the results showed that the mean noise level (L_{Aeq}) of the electrical generator in the south sector 87.82±1.17 dB during evening period in Al-Najaf city .The study noted that all the quarters selected in the southern sector during the morning period have decibel levels above the recommended limits set by the Iraqi-standards and WHO.

The results also showed no significant change in the average of serum creatininein and serum urea electrical generators workers being compared with the control group. The study recorded a significant decrement ($P \leq 0.05$) in glutathione (GSH) level of electrical generators workers in comparison with the control. In addition, the study indicated that headache (50 %) and discomfort (39 %) were the most common types of symptoms caused by the noise among in electric generators workers. Conclusion: The results found exposure to air pollutants had adverse effects on kidney functions and cause oxidative stress in electrical generators workers.

Keywords: Noise pollution., Electric generators, Human health

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دراسة تأثير التلوث الضوضائي الصادر عن مولدات الكهربائية على صحة الإنسان في مدينة النجف الاشرف

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الخلاصة

هدفت هذه الدراسة إلى تقييم تأثير الضوضاء الصادر عن مولدات الطاقة الكهربائية على المعايير الفسيولوجية ووظائف الكلى والاجهاد التأكسدي للعاملين في المولدات الكهربائية في مدينة النجف الأشرف. أجريت قياسات مستويات الضوضاء باستخدام جهاز قياس مستوى الضوضاء في قطاعين الجنوبي والشمالي لمولدات مركز مدينة النجف الاشرف بالإضافة إلى ذلك ، شملت الدراسة أيضًا وقياس

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[1] **المؤلف المراسل**

معلومات البحث
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وظائف الكلى وأعراض الضوضاء ومضادات الأكسدة ومعايير الإجهاد التأكسدي الى 30 عاملاً يعملون في تشغيل مولدات الديزل و 30 شخصًا غير معرضين للإجهاد كمجموعة سيطرة للمقارنة.

ووجدت النتائج أن متوسط مستوى الضوضاء المستمر (LAeq) للمولدات الكهربائية 90.22 ± 1.29 ديسيبل في القطاع الجنوبي خلال الفترة الصباحية في مدينة النجف . كما أظهرت النتائج أن متوسط مستوى الضوضاء (LAeq) للمولد الكهربائي في القطاع الجنوبي 87.82 ± 1.17 ديسيبل خلال فترة المساء في مدينة النجف ، وأشارت الدراسة إلى أن جميع الأحياء المختارة في القطاع الجنوبي خلال الفترة الصباحية أعلى من الحدود الموصي بها من قبل المعايير العراقية ومنظمة الصحة العالمية.

كما أظهرت النتائج عدم وجود تغير معنوي في متوسط الكرياتين في الدم و اليوريا في الدم مقارنة مع مجموعة السيطرة. كما سجلت الدراسة انخفاضاً معنوياً ($P\geq0.05$) في مستوى الجلوتاثيون (GSH) لعمال المولدات الكهربائية بالمقارنة مع مجموعة السيطرة. بالإضافة إلى ذلك أشارت الدراسة إلى أن الصداع (50٪) وعدم الراحة (39٪) كانا أكثر أنواع الأعراض شيوعاً التي تسببها الضوضاء بين العاملين في المولدات الكهربائية.

الكلمات المفتاحية : التلوث الضوضائي ، مولدات الكهرباء ، صحة الأنسان

Introduction

Air pollution is now one of the biggest bioenvironmental problems in the world. A huge amount of pollutants, especially carbon monoxide exhausted from vehicles, is released into the air every day [1].Also, they reported that diesel exhaust fumes responsible for symptoms of respiratory allergies, eye irritation, shortness of breath, especially when starting generators without using protective devices such as plastic mask [2].

Noise from diesel-fueled generators is considered a health hazard due to the high-stress factor and extreme noise exposure linked to its usage, which negatively affects some facets of human life. According to World Health Organization (WHO), the long- and short-term health effects of human exposure to noise include sleep disturbance, stress, speech interference, hearing loss, annoyance, lack of concentration and cardiovascular problems [3].

The pathological link between air pollution and disease has been attributed to oxidative stress [4].Moreover, an important source of the metal is air pollution caused by the gasoline power generators and industrial activities which of large number distributed in most areas of Najaf city. Most previous studies focused on the evaluation of noise pollution of electric generators. However, few studies have investigated the effect noise produced by generators on workers.

The Aim of the study is

1. to evaluate the effect of noise from electrical power generators on physiological parameters , kidney functions and oxidative stress in of workers in electrical generators in Al - Najaf Al-Ashraf city.

Materials and Method

1.1 Study Area

Al-Najaf al-Ashraf city, the study area, is one of the most important cities in Iraq in terms of religious and historical issues. It is located on the edge of the western plateau of Iraq, at southwest of Baghdad, the capital city of Iraq, with 160 kms far from the capital. Its high population density estimated population 1.500.522 people and area 28,824 km^2 .

1.2. Noise level evaluation

The sound levels measurements were recorded by using sound level meter (SLM), model: UNI-T; UT352, with the ranging of 30 dB – 130 dB. generated by diesel generators was measured in Najaf city center. More than sixty generators sites were investigated in this study; they were distributed in north and south sectors in Najaf city. In each sector, several high population density quarters were chosen to measure various noise parameters at different time intervals. Measurements were done at selected distances ranging from two meters (2 ms) up to five meters (5 ms). Noise level A-weighted equivalent continuous level (L_{Aeq}) assessments were performed at two time periods including morning time and evening time respectively .

1.3.Study population

The study consisted of 30 workers employed on the operation of diesel electrical power generators and 30 healthy individuals as control group for the comparison in Najaf city . The characteristics of workers in large private electrical generators include mean duration of work (6.23±0.68 years), age (30.73±1.33 years), height (1.6.60±1.21 m), weight (75.90±1.73 Kg) and body mass index BMI (22.34±0.43 Kg/m^2) as shown in Table (1) below.

Table 1: Electrical generators workers and control characteristics.

Characteristics	Electrical generators workers	Healthy control
	Mean± SE	Mean± SE
Age (years)	30.73±1.33	30.01±8.17
Height (m)	1.6 ±1.21	1.7±0.02
Weight (kg)	75.90±1.73	74.36±10.74
BMI (Kg/$m^{2)}$	22.34±0.43	22.03±3.46

Mean ±SE: mean ± standard error

2.Methods

2.1.Survey questionnaire

The questionnaire has been applied to 30 workers selected from different quarters. Data were collected through direct interview in the workplace by using prepared questionnaire in large private electrical generators in Al-najaf AL-Ashraf city, Iraq.

2.2. Blood sampling

Five milliliters of venous blood samples were collected from each electrical power generators and control placed in serum tubes for the evaluation of the biochemical parameters kidney tests and antioxidants markers, these tubes centrifuged at 3000 rpm for 5 minutes to separate the serum which kept was in new tubes, then divided into portions in epindroff tubes and kept at deep freeze (-10 C˚) until measured.

2.3. Determination of kidney functions tests

To assess the state of the kidney, biochemical studies involved analysis of kidney functions tests such as creatinine and urea were analyzed by using clinical fully automatic blood chemistry analyzer biochemistry analyzer Ds-261

(Sinnowa medical sciences & technology Co. Ltd., Jiangsu, China) in Al-Safeer Lab for Analytics .

2.4. Antioxidants and oxidative stress analysis

2.4.1. Determination of glutathione in serum (GSH)

Estimation of glutathione by biochemical assay [5].

2.4.2. Determination of Malondialdehyde Activity in serum (MDA)

Measurement of total antioxidative capacity in serum by biochemical assay [6].

Statistical Analysis

The data were statistically analyzed by using SPSS (statistical package for social sciences). The independent sample t-test, ANOVA (analysis of variance). All values were expressed as mean ± Standard Error of Mean. P-value less than 0.05 and 0.01 were considered statistically significant [7].

Results

The results found that the average A-weighted equivalent continuous sound level (L_{Aeq}) of electrical generators 90.22±1.29 dB in the south sector during the morning period in Al-Najaf city (Table 2). Furthermore , the results showed that the mean noise level (L_{Aeq}) of the electrical generator in the south sector 87.82±1.17 dB during evening period in Al-Najaf city (Table 2).

Moreover, The results mentioned that mean A-weighted equivalent continuous sound level (L_{Aeq}) of electrical generators 89.338±0.886 dB in the north sector during the morning period in Al-Najaf city (Table 2). Furthermore , the results showed that the mean noise level (L_{Aeq}) of the electrical generator in the north sector 87.855±0.783 dB during evening period in Al-Najaf city (Table 2) below:

In the present study, the mean equivalent noise levels of electrical generator observed in in south sector during evening period exceeded the recommended limits set by Iraqi-standard.

Table (2): Average A-weighted equivalent continuous sound levels (L_{Aeq}), of electrical generators in south sector and north sector in morning and Evening times in Al-Najaf city:

Time	Sound levels (dB) (L_{Aeq})	
	South sector	North sector
	Mean ± SE	Mean ± SE
Morning	90.22±1.29	89.338±0.886
Evening	87.82±1.17	87.855±0.783

Note: Morning period (09.00-12.00 hours a.m.).

Note: Evening period (3:00-6:00 hours p.m.).

Maximum permissible noise level (L_{Aeq}) for housing quarters in the morning: 60 dB.

Maximum permissible noise level (L_{Aeq}) for housing quarters in the evening : 50 dB.

Source: Iraqi Standards.

The results in table (3) below showed no significant change in the average of serum creatininein electrical generators workers compared with the control group (Table 3). Also, the result for current study recorded that no significant difference in serum urea in electric generators workers compared with the control group (Table 3).

Table (3): Mean values of kidney function test (KFT) indices of electrical generators workers and control group Kidney function

Parameters	Control subjects (n=30)	Electric generators workers (n=30)	p-values for differences	Significance level
	Mean±SEM	Mean±SEM		
Serum creatinine (mg/dl)	0.946±0.048	0.965±0.059	0.09	NS
Serum urea (mg/dl)	32.05±1.87	32.53±1.58	0.1	NS

Note :NS = No significant . SEM = Standard Error of the Mean .

The study recorded a significant decrement (P≥0.05) in glutathione (GSH) level of electrical generators workers in comparison with the control (Table 4). However, the statistical analysis revealed that significant increment (p≥0.05) in serum malondialdehyde (MDA) for electrical generators workers comparison with control group (Table 4).

Table (4): Mean values of glutathione and malondialdehyde in electrical generators workers and control group.

Parameters	Control subjects (n=30)	Electric generators workers (n=30)	p-values for differences	Significance level
	Mean±SEM	Mean±SEM		
Glutathione (GSH) (µmol/L)	46.42±0.15	43.93±0.66	P≥0.05	S
Malondialdehyde (MDA) (µmol/L)	17.89±0.41	22.13±1.08	P≥0.05	S

Note : S = significant . SEM = Standard Error of the Mean .

According to the data, the study indicated that headache (50 %) and discomfort (39 %) were the most common types of symptoms caused by noise among in electric generators workers. However, the statistical analysis revealed that ear pains (16%) and tinnitus (14 %) were the lowest percentage of symptoms caused by the noise in electric generators workers (Figure 1) below:

Moreover, the result also showed increment in percentages of symptoms caused by noise such as dizziness (34%), sleeplessness (30 %) and tiredness (29%) in electric generators workers (Figure 1).

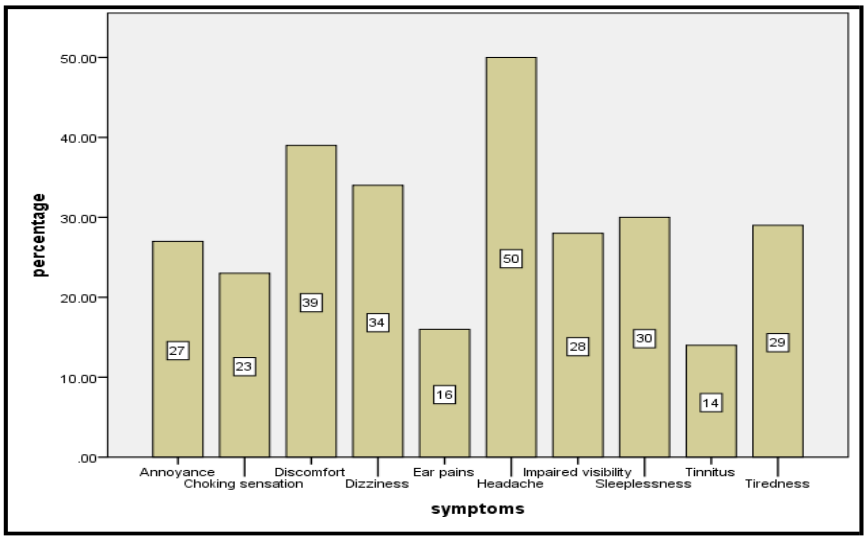

Figure (1) Frequency distribution of symptoms caused by noise of electric generators workers in Al-Najaf city

Discussion

The findings of the present study reported that average noise levels of electrical generator in all quarters selected in the south and north sectors during both morning and evening times in Al-Najaf city exceeded the recommended limits set by the Iraqi-standard. Similar findings were reported by [8] investigated noise level in residential, commercial and industrial areas. Measurements implemented in 51 selected locations. Noise measurements were taken at different day and night times, calculations conducted to obtain the equivalent and average representative noise level. The measured noise level exceeded the recommended standards limits for good health and environment especially in locations that supposed to have a silence zone such as parks and hospitals. Noise level at the industrial areas was as higher as 102 dB. Continuous exposure at these locations (8 daily working hours) without any precautions or occupational safety actions will certainly leads to adverse health effects to workers and individuals.

Moreover, The results mentioned that mean A-weighted equivalent continuous sound

level (L_{Aeq}) of electrical generators 89.338±0.886 dB in the north sector during the morning period in Al-Najaf city (Table 2). Furthermore , the results showed that the mean noise level (L_{Aeq}) of the electrical generator in north sector 87.855±0.783 dB during evening period in Al-Najaf city (Table 2).Similar findings were recorded by [9] estimated diesel generators noise pollution in Duhok city. They found that the measured mean noise level at 50 m from the generator sites was 74.86 dB(A) which is higher than the permissible noise level for residential area that is 55 dB(A), while it is near the industrial areas which equals 75 dB(A).[10] showed highest values of noise levels in the morning in period in Najaf city because this period represents a large number of vehicles passing through the main street well as the high noise of the diesel generators.

In addition the high sounds of traffic police whistles with excessive use of cars horns rise in the average noises pollution indicators in this period of time. It is also attributed to the raises the voices of street vendors and their use of loudspeakers in the local markets. The average noises pollution indicators decrease for a while and rise slightly in the evening period. [11] measured noise pollution from private electrical generators in Kirkuk city by choosing determined regions. The results found that noise pollution from generators higher value 102.55 dBA in some regions exceeding the limits from EPA standards in the residential regions, and also exceeding WHO standards which determined higher limits of noise 50-55dBA, while lower value of L_{Aeq} in other regions such as Tisin region 91.02dBA because the generators, in this region, have cover absorbent to noise as compared to other generators in the study.

Increased sound levels in the south and north sectors probably are due to the increasing in the number of populations with the significant increment in economical facilities, the south sector has been grown and it was extended towards the east along Kufa-Najaf road in the north direction. This leads to a developing a residential area away from the city Centre.

The findings of the present study reported that there was no significant change in the average of serum creatininein electrical generators workers compared with the control group (Table 3). Also, the result study recorded that there was no significant difference in serum urea in electric generators workers compared with the control group (Table 3). This indicates might be caused by the exposure to air pollutants and cause adverse effects on several organs and organ systems, including the hematopoietic, nervous, renal, cardiovascular, reproductive, and immune system. mentioned occupational exposure to heavy metals might cause toxic effects on vital organs such as respiratory, renal and liver [12].[13] who found significantly increased of kidney function tests such as blood urea , serum uric acid and serum creatinine in workers exposed heavy metals. The results from the study indicated that lead can cause slight nephrotoxicity. [14] revealed that extended exposure to noise pollution may cause vertigo, agitation, weariness, hypertension, gastrointestinal system problems (including gastric and duodenal ulcer), cardiac arrhythmia, nervous and psychic disorders.

The study recorded a significant decrement ($P \leq 0.05$) in glutathione (GSH) level of electrical generators workers in comparison with the control (Table 4). However, the statistical analysis revealed that significant increment

($p \leq 0.05$) in serum malondialdehyde (MDA) for electrical generators workers comparison with control group (Table 4). These results agreed with [15] reported that exposure to gases rising from electric generators on workers employed on the operation of diesel generators causes significant increase in malondialdehyde (MDA) , oxidation protein products AOPP and serum lead. This result suggests that elevated serum lead has a significant correlation with oxidative stress, and biochemical markers that may help to detect impairment in the body function in lead exposed workers.[16] showed that acute and chronic loud noise contact generates extreme free radicals and reason disorders that involve extra- auditory body part such as neural cells, endocrine functions and cardiovascular homeostasis. Also, the study suggested that the alterations in glutathione as well as antioxidant enzyme activities implicate oxidative stress in the toxicity of lead.

[17] lead also have been badly affects the antioxidant pathway obtainable evidences indicate that metal induce toxicity may cause derangement of antioxidant mechanisms in living tissues; as a consequence highly reactive oxygen species (ROS) are generated. This antioxidant imbalance might lead to the degradation of proteins, nucleic acids and lipid per oxidation. An oxidative assault of cellular components by ROS is concerned in the pathogenesis of several human diseases.

The result found higher prevalence of symptoms such as headache (50 %) and discomfort (39 %) in workers of electric generators workers. Moreover, the result also showed increment in percentages of symptoms caused by noise such as dizziness (34%) , sleeplessness (30 %) and tiredness (29%) in electric generators workers. This finding agreed with [18] studied association between environmental hazards (noise and air pollution) from electric power and health hazards by using questionnaire survey. They found higher prevalence of health hazards such as impaired hearing 67.2%, sleeplessness 60.5%, choking sensation 55.4%, deafness 35.5%, dizziness 31.9% and impaired visibility 13.4%).

[19] that found exposure to excessive noise is associated with sleep disturbance, and symptoms such as dizziness, confusion, fatigue, high blood pressure, digestive problems, heart arrhythmias and neuropsychological disturbances. Moreover, noise is considered as the most common cause of discomfort, imposes stress and disrupts communication. [20] demonstrated that disturbance is the most prevalent community response in a population exposed to environmental noise. Noise disturbance can result from noise interfering with daily activities, feelings, thought, sleep or rest, and might be accompanied by negative responses, such as anger, displeasure, exhaustion, and stress-related symptoms.

Conclusion:

1. The results found exposure to air pollutants had adverse effects on kidney functions.
2. This study revealed that values of glutathione (GSH) was significantly decreased and significant increment in malondialdehyde (MDA) in blood electrical generators workers.

Recommendations:

1- Electrical generators workers should be advised to use personal protective devices such as mask ,safety goggles, and ear

plugs while working in electric generators , also periodic medical surveillance .these measures would help to identify susceptible workers in due time.

2- More studies are required to evaluate harmful effects of gaseous air pollutants and noise stress in workplace on cytogenetic changes , circulatory systems , digestive system and nervous system and other biological systems. in subjects occupationally exposed to noise.

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