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Study Effect Exposure of Air Pollutants on Physiological Blood Parameters and Liver Functions in Electric Generators Workers in Al - Najaf Al-Ashraf city

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Abstract

The objective of this study was to evaluate effect of noise and gases rising from electrical power generators on physiological blood parameters, liver functions in of workers in electrical generators in Al - Najaf Al-Ashraf city. The noise levels and gaseous pollutants emissions from electrical power generators were measured in Najaf city center. In each quartier, several generators were chosen to measure various noise and gaseous pollutants parameters at different time intervals. Additionally, the study also included determines blood parameters and liver functions in 30 electrical generators workers selected from two sectors and 30 unexposed subjects as control group. The results indicated that estimated average noise level (L_{Aeq}) from the electrical generator in Al-Ansar quarter was 95.350±0.750 dB(A) and Al-Shorta quarter was 93.35±1.35 from the electrical generator during morning and evening periods in south sector in Al-Najaf city. The study noted in this study is that all the quarters visited in southern sector during morning period have decibel levels above the recommended limits set by WHO. Furthermore, The results recorded that there was elevation in carbon monoxide (Co) concentration emitted by electrical generators in south sectors compared with permissible limits of gaseous air pollutants emission from electrical power generators in Iraq. In addition, the results showed that there was a significant elevation ($P \leq 0.01$) in total white blood cells of electrical generators workers comparison with control group. Also, the study elucidated that significant increment ($P \leq 0.01$) in serum aspartate aminotransferase (AST) in workers of electrical generators comparison with control.

Keywords: Electrical power generators, Noise , Gaseous pollutants Blood parameters , Liver functions

1. Introduction

Electric generators used widely in all places in Iraq which producing some chemical pollutants to environment. Diesel generators emitted several gases and compounds, which cause air pollution and harmful effect on the health of workers in generators (Mehde et al., 2015). The major air pollutants raised from site electrical generators are: "Carbon dioxide (CO_2), CO, SOx , nitrogen oxides (NOx), carbon black (CB), and mass particulate (MP)" (Gorman et al.,2003).

The biggest bioenvironmental problems now is air pollution in the world. A large amount of pollutants, such as carbon monoxide exhausted from cars, is released into the air every day (Poursafa and Kelishadi, 2010). Al-Fartusie and Mohssan (2017) illustrated that long-period exposure to releases from diesel generators has been reported to cause "dizziness, cardiovascular and respiratory problems, eyes' irritation, nausea, drowsiness, headache, dizziness, drowsiness, death, unconsciousness, chronic obstructive pulmonary diseases and cancer". Al_Saadi et al., (2021) stated that increment of cadmium and copper in serum of workers in private electrical generators comparison with control. The results of the study showed elevated the risk of oxidative stress. Also, they recorded that diesel exhaust gases cause eye irritation , respiratory allergies and shortness of breath.

Electrical generators using in living quarters when electricity is cut off, is a significant source releases of air pollutants. Electricity generating plants are characteristically associated with noise and vibration which are unfriendly to human health and the environment (Alani et al., (2020) Noise emanates from different sources such as automobiles, machines, household devices, industrial, commercial and residential generators (Azodo and Adejuyigbe, 2013).Most previous studies concentrated on evaluation of noise pollution. However, there are few studies had the investigated effect of the noise and air pollution produced by generators on workers. T This

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study was conducted to determine effect of noise and gases which release from electrical power generators on physiological blood parameters , liver and kidney functions in of diesel generators workers .

2.Materails and Methods

2.1.Study Area:

Al-Najaf al-Ashraf city is one of the most important governorates 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 km far from the capital. Its high population density estimated population 1.500.522 people and area 28,824 km2 ".

2.2. Noise level evaluation:

The noise level generated by diesel generators was measured in Najaf city center by using sound level meter (SLM), model: UNI-T; UT352, China Picture (3.1), with the ranging of 30 dB – 130 dB. More than sixty generators sites were investigated in this study ."Measurement were done at selected distances ranging from two meters (2 m) up to five meters (5 m)". It is generators were work for 12 h daily. Noise level assessments were performed at two time periods include morning time (09:00 am–12:00 am hours) and evening time (04:00 pm–06:00 pm hours).

2.3. Gaseous air pollutants measurement:

The carbon monoxide and sulphur dioxide emissions from electrical power generators was measured in Najaf city center by using carbon monoxide meter BENETECH GM8805 handheld digital (Shenzhen Liweihui Technology Co., Ltd, China) and BX 170 portable Sulphur dioxide gas detector (World Marine Supply Co., Ltd, China).The study included different sites of electrical generators were selected covering Najaf city. The distances of measurement were done at distances ranging from "two meters (2 m) up to five meters (5 m)".

2.4.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. The medical history was taken. 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/m2). (Table 1).

4.5. Blood sampling:

Eight milliliters of venous blood samples were collected from each electrical power generators and control : "2 milliliters placed in EDTA tubes for measurement of hematological parameters, however other 6 milliliters put in serum tubes for evaluation biochemical parameters liver , kidney tests and antioxidants markers, these tubes centrifuged at 3000 rpm for 5 minutes to separate the serum which kept in new tubes, then divided into portions in epindroff tubes and kept at deep freeze (-20 C˚) until measured".

Table 1. Demographic characteristics of electrical generators workers and healthy unexposed control.

Characteristics	Electrical generators workers	Healthy control
	Mean± SD	Mean± SD
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 ±SD: mean ± standard deviation

3.Result and discussion

The results found that the average A-weighted equivalent continuous sound level (L_{Aeq}) from the electrical generators ranges between (95.4±0.7 - 82.40±3.9) dB during morning period in Al-Najaf city (Table 2).Similar findings were recorded by Mahammed *et al.*, (2013) estimated diesel generators noise pollution in Duhok city. They observed that the estimated noise level at 50 m from sites of generator was 74.86 dB(A) which is above the recommended limits of noise level for residential area that is 55 dB(A), however it is near the industrial areas 75 dB(A).

Abdulkareem (2018) 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 evening period.

Table 2. Average A-weighted equivalent continuous sound levels (L_{Aeq}), minimum (L_{min}) and maximum) (L_{max}) sound levels in (dB) from electrical generators at different quarters during morning period in Al-Najaf city.

Locations	Sound levels (dB)		
	L_{Aeq}	L_{min}	L_{max}
	Mean ± SD	Mean ± SD	Mean ± SD
Al-Muthanna Quarter	95.4±0.7	91.750±0.850	97.45±1.55
Al-Muallimeen Quarter	88.6±2.8	87.2±2.8	91±3.2
Al-Zahraa Quarter	90±5.6	87.55±5.15	93.3±4.2
Al-Ameer Quarter	82.6±4.10	79.7±5.3	91.65±7.45
Al-Ansar Quarter	95.350±0.750	92.3±0.3	98.6±0.4
Al-Ashtarqee Quarter	93.9±4.5	90.85±2.55	95.15±4.55
Al-Quds Quarter	92.75±3.35	90.4±2.1	94.3±3.7
Al-Shorta Quarter	93.35±1.35	91.3±0.4	94.75±1.15
Al-Askan Quarter	87.85±1.55	84.85±3.45	89.75±0.85
Al-Saad Quarter	82.40±3.9	79.2±1.7	86.45±2.45
All	90.22±1.29	87.51±1.26	93.24±1.14

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

. The noise level of the at the five distances from the commercial user indicated average values of 109.86, 85.95, 83.09, 80.68 and 81.69 dB taken at the exhaust, in different distances and closest distance of the generator from the business enterprises user. The study revealed that distances of one, two, three meters were very loud at noise from generators 9.1, 100, 96.6 and 90.9 percent respectively.

Onwuka *et.al.,* (2017) measured of noise level from power generating sites in Nnewi in Anambra State of Nigeria. The study included different sites were randomly selected from the several quarters. Noise level estimates was collected for (3) days during mooring time (11 am – 1 pm) and evening time (7 pm – 8 pm) during three months. The study results

indicated during evening hours are generally noisier comparison the permissible noise level. The rapidity of urbanization and increasing population in the area , it therefore environmental managers and government should calls for quick steps, retrofitted and energy-efficient building strategies such as the use of solar energy and other more environmentally friendly options .

The results showed that there was increment in carbon monoxide (Co) and sulphur dioxide (So_2) concentrations emission from electric power generators in Najaf city compared with permissible limits of gaseous air pollutants emission from electrical power generators in Iraq (Table 4). The findings agreed with results of previous study by Khalaf *et al.,* (2009) who measured gaseous air pollutants releases from electrical generators in of Kut government during winter and summer. The study results observed emissions from electric diesel generators were nearly 189-515 ton from nitrogen oxides NOx, 25-68 ton from carbon monoxide CO ,10428- 28335 ton from carbon dioxide CO2 , 66-180 ton from sulfur oxides SOx and 23-64 ton from particulate matter PM.

Jassim *et. al.,* (2016) reported that the high use electricity power production in Iraq will due to major difficult in the environmental problems lead to the big increase in the production of different types of pollutants. About 50% of amount produced systems are gas stations, while 15% are diesel stations , 28% are steam stations which are fuelled by heavy oils. The main gases pollutants from electrical stations are, CO2, CO, NO, SO and mass particles. The results showed the every year amount of CO2 pollutant from all Iraqi cities except Kurdistan has doubled during the period from 2005 to 2014, from 7.33 to 14.54 million tons.

Table 3. Average A-weighted equivalent continuous sound levels (L_{Aeq}), minimum (L_{min}) and maximum) (L_{max}) sound levels in (dB) from electrical generators at different quarters during evening period in Al-Najaf city.

Locations	Sound levels (dB)		
	L_{Aeq}	L_{min}	L_{max}
	Mean ± SD	Mean ± SD	Mean ± SD
Al-Muthanna Quarter	91.65±2.05	89.25±1.05	95.65±1.35
Al-Muallimeen Quarter	90.95±0.05	89.35±1.35	91.05±0.650
Al-Zahraa Quarter	88.1±1.5	87.25±0.95	89.3±1.1
Al-Ameer Quarter	85±5.9	81.55±9.15	90.5±6.5

Al-Ashtarqee Quarter	86.8±7.7	84.25±8.05	90.05±6.95
Al-Ansar Quarter	90.6±4	88.65±2.35	91.75±3.55
Al-Quds Quarter	89.6±5	85.75±5.25	91.7±3.6
Al-Shorta Quarter	86.6±2.6	83.55±1.05	88±0.3
Al-Askan Quarter	87.8±3.2	84.25±3.75	91.2±3.1
Al-Saad Quarter	81.15±3.45	77.55±2.95	86.2±1.9
All	87.82±1.17	85.14±1.33	90.54±0.99

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

Table 4. Average carbon monoxide (Co) and sulphur dioxide (So_2) concentrations (ppm) emitted from steam power generators in Al-Najaf city.

Locations Gas Pollutants	Electrical generators in southern sector	Electrical generators in northern sector	Permissible limits of gaseous air pollutants emission from electrical power generators in Iraq
	Mean±SEM	Mean±SEM	
Carbon monoxide (Co) ppm	1.365±0.136	1.448±0.196	0.26
Sulphur dioxide (So_2) ppm	1.01±0.117	0.84±0.112	0.14 (24h)

SEM = Standard Error of the Mean .

The results indicated that there was a significant elevation (P≤0.01) in total leukocyte count of electrical generators workers comparison with control group (Table 5).). Similar findings were recorded by Lorenzo *et al.,* (2006) who demonstrated significant leukocytosis in lead exposed worker with respect to non-exposed worker. In addition , electrical generators workers suffer from occupational stresses because of excessive noise at work place. Wankhar et al.,(2014) showed that different physical and mental stressors could increase the secretion of stress hormones, such as "cortisol, corticosterone, adrenaline and noradrenaline". Therefore, total white blood cells increased in employees of mills probably due tolong-period of facing to occupational exposure to noise stress.

Concerning , differential leukocytes count , the statistical analysis showed that no significant elevation in percentage of neutrophils and lymphocytes count of electrical generators workers in comparison with control subjects (Table 5). This finding could be explained by effect of inhalation to gaseous air pollutants cause difference in the level of toxicity and duration of exposure and extent of lead induced inflammation. Almissari *et al.,* (2012) found human hematopoietic system is extremely sensitive to environmental pollution influences due to rapid synthesis of cells with resultant metabolic demands.

The present study found that significant increment (P≤0.01) in serum aspartate aminotransferase (AST) , alkaline phosphatase (ALP) and alanine aminotransferase catalase (ALT)for electrical generators workers as compared to the control group (Table 6). This finding agreed with results of previous study by Fadhel *et al.,* (2013) found serum alkaline phosphatase (ALP) and alanine aminotransferase catalase (ALT) were significantly higher in workers exposed to heavy metals (P<0.01) than control group. They concluded that elevation of (ALP) (ALT) response to exposure to diesel components is associated with many toxicities effect on blood, hepatic, immunologic and chromosomal functions and an increased risk of carcinogenesis.

Table 5. Total and differential counts of leukocytes of electrical generators workers and control group.

Groups Parameters	Control subjects (n=30)	Electric generators workers (n=30)	P-values for differences	Significance level
	Mean±SEM	Mean±SEM		
Total leukocytes count (cell/mm^3)	5.61±0.03	7.18±0.22	P≤0.01	HS
Neutrophils (%)	50.91±2.4	56.96±1.69	0.064	NS

Lymphocytes (%)	24.82±3.93	30.56±1.9	0.21	NS
Monocytes (%)	5.28±0.33	5.2±0.32	0.86	NS
Eosinophils (%)	3.89±0.467	3.5±0.42	0.64	NS
Basophils (%)	0.935±0.054	0.606±0.047	P≤0.01	HS

Notes: HS = Highly significant . NS= Non-significant . SEM = Standard Error of the Mean

Table 6. Mean values of liver function test (LFT) indices of electrical generators workers and control group.

Groups / Parameters	Control subjects (n=30)	Electric generators workers (n=30)	p-values for differences	Significance level
	Mean±SEM	Mean±SEM		
Aspartate aminotransferase (AST) (Units/L)	23.73±0.86	41.48±1.83	P≤0.01	HS
Alkaline phosphatase ALP (Units/L)	88.37±1.56	147±6.2	P≤0.01	HS
Alanine aminotransferase catalase (ALT) (Units/L)	23.14±1.08	43.18±1.68	P≤0.01	HS
Serum Total Protein (g/dl)	7.6±0.11	6.24±0.14	P≤0.01	HS
Serum Albumin (g/dl)	4.52±0.03	3.97±0.09	P≤0.01	HS
Total serum Bilirubin (mg/dl)	1.77±0.15	0.7±0.02	P≤0.01	HS

Note : HS = Highly significant . SEM = Standard Error of the Mean .

Gorman *et al.*, (2003) complex compounds and many gases are released from electrical power generators that lead to air pollution and the hazards of human health, especially for workers in electrical generators .The decline in plasma total protein due to exposed to air pollution was primarily cause decrement in albumin and globulin fraction . The decrement in plasma protein in workers exposed to environmental pollutants could be attributed to changes in metabolism of protein and free amino acid and their synthesis in the liver (Oluwayernis, 2012).

The study elucidated that a significant (P≤0.05) decrement in mean serum total protein for electrical generators workers compared with control group (Table 4.6). Moreover , it was observed that there was significant decrement (P≤0.01) in serum albumin for electrical generators workers compared with the control group (Table 4.9). The finding agreed with the outcomes of Resan Ibraheem et al. (2006) investigated effect of chemical pollutants in some biochemical parameter in the workers of electric generators. The results of the study showed that significant differences in the concentration of total protein in the workers in comparison with control group . Abed et al., (2006) found that a non-significant decrease in the average of total serum protein and albumin of workers employed in large private electrical generators in comparison with control. The study also, indicated decrement in total protein only occurs as a because of conditions causing decrease values of the main components, i.e. albumin and the immunoglobulin (particularly IgG).

4.Conclusion

This study revealed that exposure to gases and noise are released from electrical generators adverse effects on blood parameters and liver function of workers in electrical generators as a result might be effects the blood and liver functions.

5.Refernces

Mehdi, W. A. (2014). Study the Effect of Gases Rising From Electric Generators on Sera Protein, Iron, Transferrin and other Biochemical Parameters... *Australian Journal of Basic and Applied Sciences*, *8*(3), 521-526.

Gorman, D., Drewry, A., Huang, Y. L., & Sames, C. (2003). The clinical toxicology of carbon monoxide. *Toxicology*, *187*(1), 25-38.

Poursafa, P., & Kelishadi, R. (2010). Air pollution, platelet activation and atherosclerosis. *Inflammation & Allergy-Drug Targets (Formerly Current Drug Targets-Inflammation & Allergy)(Discontinued)*, *9*(5), 387-392.

Al-Fartusie, F. S., & Mohssan, S. N. (2017). Essential trace elements and their vital roles in human body. *Indian J Adv Chem Sci*, *5*(3), 127-136.

Al_Saadi, M. R., Al-Fartusie, F. S., & Thani, M. Z. (2021). Evaluation of lead, cadmium, copper and zinc levels and studying their toxic effect in sera of private electrical generator workers. In *Journal of Physics: Conference Series* (Vol. 1853, No. 1, p. 012044). IOP Publishing.

Alani, R. A., Ogunmoyela, O. M., Okolie, C. J., & Daramola, O. E. (2020). Geospatial analysis of environmental noise levels in a residential area in Lagos, Nigeria. ***Noise Mapping*****, *7*(1), 223-238.**

Azodo AP, Adejuyigbe SB. (2013). Examination of noise pollution from generators on the residents of Obantoko, Ogun State, Nigeria. Asian J. Eng. Sci. Technol. 3(1): 31-41.

Mahammed, M. A. , Kochery, F. A. , & Abdulkhaliq, M. S. (2013). Investigation of noise pollution of electrical diesel generators in Duhok city / Kurdistan of Iraq. *Science Journal of University of Zakho*, *1*(1), 319-324.

Abdulkareem, H. K. (2018). Evaluation of noise pollution indicators in Najaf city. Kufa Journal Of Engineering,9(4).

Azodo, A. P., Omokaro, I., Mezue, T. C., & Owoeye, F. (2018). Evaluation and analysis of environmental noise from petrol fuelled portable power generators used in commercial areas. *Journal of Experimental Research*, *6*(1).

Onwuka, S. U., Ezigbo, C. M., & Eneche, P. S. U. (2017). Assessment of noise pollution from power generating sets: a case study of Nnewi-North LGA, Nigeria. *Journal of Scientific Research & Report*, *16*(3), 1-12.

Khalaf,K.A.; Jubeir,A.J. & Kazem,S.K.(2009).estimating study for calculating electrical diesel generators emissions in the center of kut city.. *Journal Of Wassit For Science & Medicine*, *2*(2).

Jassim, H. M., Fakhri, H. I., & Hayfaa, A. J. (2016). Environmental impact of electrical power generators in Iraq. *International Journal of Engineering Technology, Management and Applied Sciences*, *4*(3), 122-134.

Lorenzo, Ó., Urbé, S., & Clague, M. J. (2006). Systematic analysis of myotubularins: heteromeric interactions, subcellular localisation and endosomerelated functions. *Journal of cell science*, *119*(14), 2953-2959.

Wankhar, D.; Sheela Devi, R. and Ashok, I.(2014). Emblica officinalis outcome on noise stress induced behavioural changes in Wistar albino rats. Biomed Prev Nutr. ,4(2):219-24.

Almissari, A. M. A., Rashid, B. A., Abd, A. Q., & Aldelaimy, R. A. (2012). The Effects of Lead exposure to workers in electric generator and car mending. ***Diyala Journal For Pure Science*****, *8*(4).**

Oluwayernis B. (2012). Antioxidant status and hepatic lipid peroxidation in albino rats exposed to cement Dust. Trans J Sci Tec , 2:50-9.

Fadhil,S.H.,AL-Kafour,K.F.A., & Almehemdi,A.F.(2013). Determination the concentrations of some heavy metals and studying the blood variables for the diesel generators workers blood in Ramadi city. *Journal of university of Anbar for Pure science*, *7*(1).

Resan Ibraheem, I., Fateehallah, F., & Furoon, B. (2006). Effect of the pollution produced by generators in som biochemical parameters in workers. *journal of al-qadisiyah for pure science (quarterly)*, *6*(1), 30-39.

Abed, B. F., Karaam, F. F., & Sagban, L. A. (2006). Pollution of plants by lead from power generators in Diwaniah City-Iraq. *journal of al-qadisiyah for pure science (quarterly)*, *6*(1), 110-118.