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# Comparative Studies on the Effect of Noise and Electromagnetic Fields on Rabbit Blood

Khitam Elwasife<sup>1</sup>, Ismail Abdel Aziz<sup>2</sup>, Mohammad Shabat<sup>1</sup>

<sup>1</sup>Department of Physics, College of Science, Islamic University of Gaza, Gaza, Palestinian Territory

<sup>2</sup>Department of Biology, College of Science, Islamic University of Gaza, Gaza, Palestinian Territory

## Email address:

kelwasife@iugaza.edu.ps (K. Elwasife)

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**Abstract:** This study have shown the comparison between the effect exposure to the noise and electromagnetic waves radiation on rabbit. Environmental noise and electromagnetic fields are a known stressful factor that induces alterations of various physiological responses in the exposed individuals. The electromagnetic field applied was generated by using an antenna installed at the laboratory of Islamic University of Gaza. The mobile system used in Gaza is GSM with frequency equals 900 MHz. The antenna place at 20 cm away from the animals such that the whole body exposed to the electromagnetic field on the days of the test the rabbits were brought to the laboratory. The experiment was conducted at Gaza strip laboratory. Twenty two adult male rabbit were used throughout the study. Rabbits were randomly divided into three groups. The first group consists of ten rabbits (w1000-1200gm) served as the control group. During the course of the study the animals were housed in pairs in the animal house with food and water and kept under standard environmental conditions for light (12: 12 h light: dark cycle) temperature (27°C). The second group was subjected to the noise levels (60-70 dB) for 18 days. The animals were exposed to noise product from generator with 1KW and dimension of 1200 mmx1100 mmx1300 mm. They exposure for 3-4 hour in each day. The third one of animals were exposed to split dose of electromagnetic field with constant power in the range from (1.4-4.7) mw/cm<sup>2</sup> and electric field with the range (60-130) V/m. The treated animals were subjected to electromagnetic field for eight hours then rest eight hours without exposure. The process of exposure and rest for the same time interval were repeated for two weeks. Animals from both control and experimental groups were decapitated at the end of the experiment. Blood samples were collected in 10 ml plain tubes for serum preparation. The effect of electromagnetic exposure is greater than noise one in urea, uric acid, creatinine, Alpha., AST, ALT and PLT. Exposure to noise caused increase triglycerides, white blood cell counts, mean corpuscular volume, mean corpuscular hemoglobin and mean corpuscular hemoglobin concentration. It was found to be directly related to the duration of exposure, the intensity and the characteristics of the noise with loud intermittent noise and longer duration of exposure producing more analgesia.

**Keywords:** Electromagnetic Fields Radiation, Global System Mobile Frequency, Noise Exposure

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## 1. Introduction

Many reports on the effects of electromagnetic radiation in various cellular base stations are still increasing. Until now no satisfactory mechanism has been proposed to explain the biological effects of this radiation. Another Electronic contamination as a noise which damaging effects particularly the productions of free radicals are not limited to the auditory organ. The response to noise may depend on characteristics of the sound, including intensity, frequency, and complexity

of sound, duration and the meaning of the noise, The effect of noise on oxidative stress parameters in rat sera has been investigated [1]. The biological systems get more affected due to deep penetration of the electromagnetic waves in living tissues. The effects such as, cancer. It also causes displacement of electrolytes and ions within the body [2]. C. K. Firoz et al were explained and discussed the epidemiological studies, that designed to verify whether electromagnetic wave exposure may be a potential risk factor for health, have led to controversial results. The possible association between electromagnetic fields and an increased

incidence of childhood leukemia, brain tumors or neurodegenerative diseases was not fully elucidated. On the other hand, they cleared that the electromagnetic radiation are widely used, in neurology, psychiatry, rheumatology, orthopedics and dermatology, both in diagnosis and in therapy [3]. Some studies are being conducted on causation of exposure to noise near airports to the higher risk of developing hypertension, cardiovascular diseases and incidence of cancer [4-5]. Several studies have shown that noise in animal care facilities can reach as high as 90 – 100 dB [6]. The long term effect of prenatal chronic intermittent noise stress on active avoidance learning in rats has been determined [7]. also the effect of prenatal chronic intermittent noise stress on learning in rats was determined by exposed fifteen rats chronically to intermittent white noise (90-120dB, 350Hz) during the last two weeks of their pregnancy periods which are in (dark cycle, 07:00Pm-07:00Am) during the experiment. Stressed and no stressed puppies bred under normal condition up to 3 months of age. Both stressed and no stressed adult male and female rats were trained in an equal 3 arms Y-maze with 20-25 Volts D. C. electrical foot shock and a 12 Watts light stimuli as an active avoidance learning. Animals were trained one session daily and criterion condition response (CCR) was 90 percent of last session of training. Noise not only affects the nervous system of man, but also causes some psychological and psychosomatic problems [8]. The effects of electromagnetic radiation from a mobile phone on the oxidant and antioxidant levels in rabbits studied [9]. Oxygen free radicals can attack protein, nucleic acids and lipid membranes thereby disrupting normal cellular functions and integrity [10]. In this study a comparison between the effect of noise and electromagnetic fields exposure on rabbit blood Parameters.

## 2. Materials and Methods

Twenty two adult male rabbit were used throughout the study, It was divided into three groups that the first group consists of ten rabbits (w1000-1200gm) served as the control group, where commercial balanced diet and water were continuously and regularly supplied to animals all over the experimental period. During the course of the study the animals were housed in pairs in the animal house with food and water and kept under standard environmental conditions for light (12: 12 h light: dark cycle) temperature (27°C). The second group was subjected to the noise levels (60-70 dB) for 18 days. They were exposed to noise product from generator with 1kW and dimension of 1200 mmx1100 mmx1300 mm and exposure for 3-4 hour in each day. The third one of animals were exposed to split dose of electromagnetic field with constant power in the range from (1.4–4.7) mW/cm<sup>2</sup> and electric field with the range (60-130) V/m. The treated animals were subjected to electromagnetic field for eight hours then rest eight hours without exposure. The process of exposure and rest for the same time interval were repeated for two weeks. The electromagnetic field applied was generated by using an antenna installed at the laboratory at

Islamic University of Gaza. The antenna received the signal from mobile base station. The mobile system used in Gaza is GSM with frequency equals 900 MHz. The antenna place at 20 cm away from the animals such that the whole body exposed to the electromagnetic field, on the days of the test the rabbits were brought to the laboratory. The experiment was conducted at Gaza strip laboratory. The use of these experimental animals was approved by Veterinary Service of the Municipality of Gaza-Palestine. Animals from both control and experimental groups were decapitated at the end of the experiment. Blood samples were collected in 10 ml plain tubes for serum preparation. Clear serum samples were separated by centrifugation at 3000 r.p.m for 20 min. Serum glucose was determined according to the method of Trinder [10]. The kits were purchased from Randox lab LTD, UK. Serum triglyceride concentration was determined enzymatically according to the method of Fossati *et al.* [11]. Serum total cholesterol levels were determined following instruction manuals of Randox reagent kit [12]. Serum total protein was determined according to the Biuret reaction as described by Bellossi *et al* [13]. The kits were purchased from Biotech laboratories, U. K. Serum albumin was determined using Randox reagent kits and following their instruction manual according to the method of Dumas *et al.* [14]. The concentrations of globulin were calculated by the following equation:

Concentration of globulins (gm/dl)=Total protein-Albumin.

Urea determination is based upon the cleavage of urea with urea's (Berthelot's reactions) according to Fawcett [15]. The kit was purchased from Boehringer Mannheim GmbH Diagnostica. Serum uric acid was determined using the spin react reagent kits and following their instruction manual and as described by Fossati *et al.*[16-24], For the hematological tests, approximately 2–3 mL of blood sample was received at a tube containing dipotassium ethylene diaminetetra acetate (EDTA) Serum creatinine was determined without protein precipitation. The third group was exposure to the noise for 18 days respectively. At the end of the experiment, animals from both control and experimental groups were decapitated. After wards, the blood samples were collected between 6–7 mL from each rabbit depending on the rabbit body weight.

### *Data Analysis*

Data were analyzed using SPSS program (statistical package for the social sciences Inc. Chicago, Illinois). Means were compared by independent sample t-test. All values are expressed as mean + SE. Significance are taken as follows: P> 0.05 is non-significant, P≤0.05 is significant, P < 0.001 is highly significant.

## 3. Results and Discussion

Protein and non-protein nitrogenous constitutions concentration in rabbit serum after electromagnetic field exposure and the noise action were tabulated in table 1. In general, the electromagnetic field exposure significantly increase urea, uric acid and creatinine compared to control

level. The effect of electromagnetic field was more pronounced on uric acid and creatinine. The data presented in table 2 summarize the effect of electromagnetic field and noise on rabbit serum glucose, triglycerides and total cholesterol. Electromagnetic field exposure decreased serum

glucose level by 12.59% compared to the control level. While the exposure to the noise decreased serum glucose level by 15.83% compared to the control group. By exposure to the noise our results indicate non significant decrease of total protein, albumin and globulin levels table 3.

**Table 1.** Distribution of urea, uric acid and creatinine in two groups of rabbits Exposed to noise and electromagnetic field.

parameter	Control N=10	18 days (noise) N=6	Electromagnetic field N=6
Urea (mg/dl)		29.99 ± 0.32	35.67±0.19
%change	28.10± 0.6	19.48	26.94
P value		<0.01	< 0.01
Uric acid (mg/dl)		3.13 ± 0.18	6.20±0.13
%change	3.11± 0.11	0.64	99.36
P value		>0.05	< 0.01
Creatinine (mg/dl)		0.86± 0.08	1.70±0.05
%change	0.80± 0.04	7.5	112.5
P value		0.05>	< 0.01

**Table 2.** Distribution of glucose, triglycerides and cholesterol in the two groups of rabbits exposed to noise and electromagnetic field.

parameter	Control N=10	18 days (noise) N=6	Electromagnetic field N=6
Glucose(mg/dl)		80.21 ± 0.39	83.30 ±.39
%change	95.30± 0.50	-15.83	-12.59%
P value		<0.01	<0.05
Triglycerides(mg/dl)		155.00 ± 0.36	95.90 ± 0.41
%change	100.20 ± 0.28	15.27	-4.29%
P value		<0.01	>0.05
Cholesterol (mg/dl)		175.0± 0.36	135.6 ± 0.65
%change	171.90 ± 0.55	1.8	-21.12%
P value		0.05>	< 0.01

In table 3, It was noticed that total protein for rabbits decreased non significantly when subjected to electromagnetic field with percentage of decreased by 2.26% compared to the control group. In table 3 the effect of noise exposure on Total Globulin is decrease by 1.49% while in electromagnetic exposure is decrease by 0.75. Furthermore, as shown in table 4, Serum transaminases (AST& ALT) and alkaline phosphatase (ALP) exhibited significant increase in electromagnetic field treated rabbits compared to the control group, it is shown that the effect of noise on three parameters above is less than electromagnetic fields exposure

**Table 3.** Distribution of total protein, albumin and globulin in the three groups of rabbits exposed to electromagnetic field and noise.

Parameter	Control N=10	18 days (noise) N=6	Electromagnetic field N=6
Total protein(mg/dl)		7.87 ± 0.25	7.90±0.018
%change	7.98± 0.28	-1.38	-2.26
P value		0.05>	0.05>
Total Albumin(mg/dl)		3.91 ± 0.11	3.85±0.04
%change	3.96 ± 0.41	-1.26	-2.78
P value		0.05>	0.05>
Total Globulin(mg/dl)		3.96± 0.13	4.05±0.12
%change	4.02 ± 0.10	-1.49	-0.75
P value		0.05>	0.05>

**Table 4.** Distribution of A phosphates ALP, AST and ALT in the three groups of rabbits exposed to electromagnetic field and noise.

Parameter	Control N=10	18 days (noise)	Electromagnetic field
A phosphates ALP (mg/dl)		41.93 ± 0.79	47.30±0.88
%change	40.11± 0.95	4.54	17.93
P value		0.05>	< 0.01
AST (mg/dl)		35.16 ± 0.73	45.70±0.77
%change	31.79± 0.22	10.6	43.76
P value		0.05>	< 0.01
ALT(mg/dl)		39.96± 0.20	60.10±0.30
%change	35.10± 0.17	13.85	71.23
P value		0.05>	< 0.01

**Table 5.** Distribution of *A* WBC, RBC, HB, HCT and MCV in the two groups of rabbits exposed to noise and electromagnetic field.

parameter	Control N=10	18 days N=6(noise)	Electromagnetic field
WBC count(mg/d)		8.6 ± 0.41	8.50±0.14
%change	7.5 1± 0.2	13.61	13.18
P value		0.05>	< 0.01
RBC (mg/dl)		3.5 ± 0.19	4.80±0.27
%change	5.60 ± 0.21	-37.5	-15.04
P value		<0.01	< 0.01
Hb (mg/dl)		11.51± 0.30	9.60±0.21
%change	11.89 ± 0.16	-3.20	-19.26
P value		0.05>	< 0.01
HCT (mg/dl)		34.11 ± 0.25	31.40±0.29
%change	37.50± 0.22	-9.04	16.27
P value		0.05>	< 0.01
MCV(mg/dl)		97.46 ± 0.26	65.42±0.38
%change	66.4± 0.32	46.78	-1.48
P value		<0.01	>0.05
MCH(mg/dl)		32.89± 0.22	20.0±0.17
%change	21.04± 0.20	56.32	-1.48
P value		<0.01	0.05>
MCHC(mg/dl)		33.74± 0.21	30.57±0.19
%change	37.53± 0.24	6.40	18.55
P value		0.05>	< 0.01
PLT(mg/dl)		250.0± 21.79	654±20.15
%change	388.0± 25.66	-35.57	68.56
P value		<0.01	< 0.01

The present findings also showed significant increase of total WBCs count and lymphocyte as illustrated in table 5. It shows that the blood indices in rabbits after exposure to noise or electromagnetic fields. The more obvious changes that resulted from noise exposure were an increase in WBC count, MCV and MCH but there was a decrease in RBC count, hemoglobin (HB), hematocrit, MCHC and platelets, while in electromagnetic field exposure. There was an increase in WBC count and platelets but there was a decrease in RBC count, hemoglobin, hematocrit, MCV, MCH and MCHC concentration.

#### 4. Discussion

The present study is a comparative one, which performed to assess the effect of noise or electromagnetic exposure in blood parameters harmful of twelve domestic rabbits. Data revealed highly significant decrease in serum glucose levels in rabbits in response to noise exposure. Noise exposure may indirectly, play a specific role in carbohydrate metabolism probably due to enhancing gluconeogenesis and glucose mobilization to the blood [25]. The change observed in serum triglycerides and cholesterol content in response to treatment by noise exposure take place in the liver due to imbalance between the normal rabbits of lipid synthesis, utilization and secretion [26]. The increment in cholesterol and triglyceride content agreed with that reported by Parker [27-28]. The highly significant in blood urea is the principal end product of protein catabolism an accelerated amino acid deamination for gluconeogenesis is probably an acceptable postulate to interpret the elevated level of urea. The increment in blood urea, might be also due to the destruction of RBCs during the treatment. The presence of some toxic compounds might increase blood urea and decrease plasma protein [29]. On the

other hand the elevation of blood urea might suggest that animals experienced hem concentration due to mild dehydration [30]. Moreover, the serum uric acid levels exhibited an increase in the treated rabbits for the experimental duration. This may be due to high degradation of purines or an increase of uric acid level by inability of its excretion by urinary system [31]. The non significant decreased levels of total protein in noise exposure rabbits could be attributed to an increase in amino acids deamination. This decrease in serum total protein may be due to lowered synthesis of albumen and globulin in the liver in response to Noise exposure intake. It was reported that albumin levels are decreased in liver disease [32, 33]. The decrease in these blood proteins of the rabbit may be due to usage of different amino acids in the production of antibodies in response to noise exposure. Electromagnetic field influence had shown a great effect on biochemical blood parameters. However, the effect of electromagnetic fields on living organisms showed that the initial effect of an electromagnetic field is the triggering of key biochemical processes in various metabolic pathways [34]. The physicochemical action, ion, dipolar, macrostructure, electrolytic polarization, and other factors may also play a role such as molecular excitation, biochemical activation, generation of radicals, chemical bond weakening, hydration change, altered relaxation time of atom vibration, and altered spin of dipoles [35]. These physicochemical changes may affect the biochemical parameters of serum. Data revealed an decreasingly significant decrease in serum glucose levels in rabbit in response to the electromagnetic field exposure and this is in agreement with the results observed by Gorczyńska and Węgrzynowicz [34]. Albino rats treated with electromagnetic field plus vitamin C or vitamin E showed a decreased in serum glucose level. Vitamin C or E may

potentiate insulin effects by increasing insulin secretion [35]. Concerning lipid metabolism, results demonstrated that the triglycerides and total cholesterol levels were decreased in response to electromagnetic field exposure as previously reported by Kula et al. [36]. The decreased level of total protein in rabbits subjected to electromagnetic field compared to control is also in agreement with the results of Kula [37]. The decrease in the level of protein, cholesterol, and Glucose can be explained due to malfunction of the absorption process as a result to the exposure of the rabbits to the electromagnetic field. In our study, we observed a decrease in globulins. The decrease may have resulted from disturbed protein synthesis in the liver, which is controlled by steroid hormones. The availability of tissue proteins release of amino acids and their metabolism in the liver are triggered by the catabolic action of glucocorticoids [38]. The elevation of blood urea is a good indicator for kidney disorders. Additionally, the presence of some toxic compounds might increase blood urea and decrease plasma protein. Uric acid is the end product of the catabolism of tissue nucleic acid, i.e. purine bases metabolism [39]. The highly significant increase in uric acid concentrations may be due to degradation of purines or to increase uric acid levels by either overproduction or inability of excretion. Creatinine is the last variable of non nitrogenous protein blood constituents; it appears in serum in amounts proportional to body's muscles mass and is more readily excreted by the kidneys than urea and uric acid. Elevated creatinine concentration is associated with abnormal renal function, especially as it relates to glomerular function [40]. Kaczmarek and Adey [41], reported that electromagnetic field causes changes in the activity of the oxidative enzymes due to some mitochondrial changes and disturbance in the mechanism of mitochondrial membrane permeability. After one day of exposure to electromagnetic field, the tubular epithelial cells were much swollen and a pronounced swelling in the glomeruli and glomerular adhesions with Bowman's capsule, in albino rats was observed by Zaghoul [42]. The present data of liver enzymes activities also showed the harmful effect of electromagnetic field exposure than noise exposure. There was a significant increase of ALT, AST and ALP value after electromagnetic fields exposure. These alterations were fewer servers in rabbit's noise exposure. These results were supported by [43]. The obtained results indicate that exposure to electromagnetic fields and noise produced clear increment of WBCs count indicated the activation of defense mechanism and This significant increase in WBCs count indicated the activation of defense mechanism and immune system of rabbit [44]. It was found that exposure to electromagnetic field produced a highly significant decrease in red blood cells, hemoglobin, hematocrit and MCHC which less reflected also by noise exposure. This findings may be exposure on the basis of inhibitory effects of these treatments on histogenesis. The decreased in RBC count and hemoglobin (HB) lowered the oxygen supply to different tissues thus resulting in low energy production. Decrease in Hb contained MCH can be explained due to decreased size of

RBC or impaired biosynthesis of heme in bone marrow cells [45]. This induction of white blood cells is a positive response for survival due to cell mediated immune response of animals Leukocytosis was manifested by lymphocytosis, which were the main features of the differential leukocytic count. iT found that the noise exposure decreased the concentrations of serum glucose, total protein, globulin, and albumin [46, 47].

## 5. Conclusion

It found that the both noise and electromagnetic fields exposure decreased the concentrations of serum glucose, total protein, globulin, albumin, RBC, HB, HT, and HCHC have been decreased. The effect of electromagnetic field exposure effective more than noise. The concentration of urea, uric acid, creatinine, ALT, AST, and ALP were generally increased of noise exposure. Consequently, Also, it found that noise exposure at split dose could be harmful. The incensement in the concentration of urea, uric acid and creatinine by electromagnetic field greater than effect by noise exposure. Consequently, we found that EMF exposure at split dose could be harmful. Further research is needed to test other biological effects of noise and EMF and employing different experiment designs.

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