

Effects Of 6 Weeks Exposure Of 3.5 mT (ELF EMF) On Some Animal behaviors in White Albino Rat (Sprague Dawley) Pups

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ABSTRACT

The EMF nowadays is considered as a big source of harmful effects on our life on earth. So, the aim of this experimental study was to investigate the effect of extremely low frequency electromagnetic fields (ELF EMF) on some animal behaviors in rat pups. Laboratory animals with three different ages 2, 4, and 6 weeks were used as control and exposed groups, were placed in a Helmholtz coil electromagnetic field apparatus created for 1 hour and exposure to a 3.5mT, 50Hz. The results showed that exposure of a 50 Hz, 3.5mT electromagnetic field for 1h, has fluctuated effects on some animal behaviors like (activity, inactivity, motion, response to sound, and light, eating, and redness of limbs) in rat pups.

INTRODUCTION

Since the mid-twentieth century, electricity has been an essential part of our lives. Electricity powers our appliances, office equipment, and countless other devices that we use to make life safer, easier, and more interesting. The use of electric power is something we take for granted levels. However, some have wondered whether the electric and magnetic fields (EMF) produced through the generation, transmission, and use of electric power [power-frequency EMF, 50 or 60 hertz (Hz)] might adversely affect our health.

Undoubtedly, electricity has numerous advantages and beneficial uses; however, it can also have deleterious effects not limited to acute electrical injury. ELF magnetic fields have been classified by the International Agency for Research on Cancer (IARC) as a "possible human carcinogen" and chronic effects of ELF-EMR occur in the setting of low, continuous

doses over the course of months, years, and decades (1).

Foroozandeh et al. (2) found that when exposed mice to EMF had 50 Hz, and 8 mT for 90 min, can impair memory function in a passive avoidance learning. But no effect with 2 mT exposure of EMF on the memory (3), and animal experiments demonstrated that EMFs of 50–60 Hz affect behavior and induce neuroendocrinal changes; however, there is no clear evidence for such effects as tumor induction and prevention of reproduction (4).

The behavioral and psychological studies have shown that exposure to ELF can affect human cognitive functions and behaviors of animals. For example exposed rats to 25 or 50 Hz fields in the short term (7 days) or long term (25 days) were examined in the Y form maze. The results indicated that neither short-term, nor long term exposure did not make a change in motor activity, but 50 Hz field exposure will

decrease recognition of new arm of the mice (5).

Also, (6) concluded that based on the intense comparison of characteristics of abnormal animal behavior and seismogenic electromagnetic radiation in a wide frequency range, we came to the conclusion that lower frequency (such as ULF and ELF) electromagnetic emissions are a plausible candidate to explain abnormal animal behavior before an earthquake EQ, because EQ precursory phenomena are acting as stimuli for EM effects.

Ahlbom et al., (7) reported that Further research was focussed on the risk of central nervous system disorders including Alzheimer and Parkinson's diseases in people who were exposure to occupational electromagnetic fields and electric shock.

Kheifets et al., (8) reported that when the adults exposed to ELF electric or magnetic fields had higher internal electric-field strengths and current densities than children because of size and shape differences. However, the distributions are different, and in children some tissues have higher field strengths and current densities for the same external field. Furthermore, children have significantly higher internal field strengths and current densities from contact currents than do adults.

As compared with the above researches, this study was designed to investigate the effect of ELF EMF (50Hz) on some animal behaviors like (activity, inactivity, motion, response to sound, and light, eating, and redness of limbs) white albino rat pups.

MATERIALS AND METHODS

MATERIALS

Experimental design

From the 40 animals of each of the three age groups 2, 4, and 6 weeks, 20 were designed

as exposed group (E2W, E4W and E6W) and 20 were left as control (C2W, C4W and C6W). So in this experiment were used 120 white albino rat pups.

The exposed groups were subjected for one hour a day, 6 days a week for 6 weeks to the alternating magnetic field (alternating current AC). The exposure was at density flux of 3.5 mille tesla (mT) = 35 Gauss (G), The electric potential of the source was 140 Volt (V), frequency 50 Hertz (Hz) and electric current of 2.5 Ampere (A).

Induction and Exposure Technique Of Magnetic Fields

The Electromagnetic field (EMF) applied was generated by an artificial Helmholtz Coil constructed in the Department of Zoology, Faculty of Science, Benha University (Figure 1).

Five rats were placed in a perforated glass box placed in between two coils each coil contained 500 copper turns, connected with AC unit (varic). Horizontal magnetic induction was applied to the whole body of the animals. The field strength was monitored with a gauss-meter. Voltage and current were monitored with a voltammeter.

METHODS

The white albino rat pups were observed during the 1 hour exposure time in glass cage, and observed also after returned to the normal living cages after the end of one hour exposure time for another one hour. Finally, recorded the observations about some animal behaviors during all the exposure periods (6 weeks) as mentioned above.

The animal behaviors which studied were :

- 1- Activity.
- 2- Inactivity .
- 3- Motion.
- 4- Respond to sound.
- 5- Respond to light.
- 6- Extended of hair.
- 7- Eating.
- 8- Redness of limbs.
- 9- Protrusion of testis, and penis.

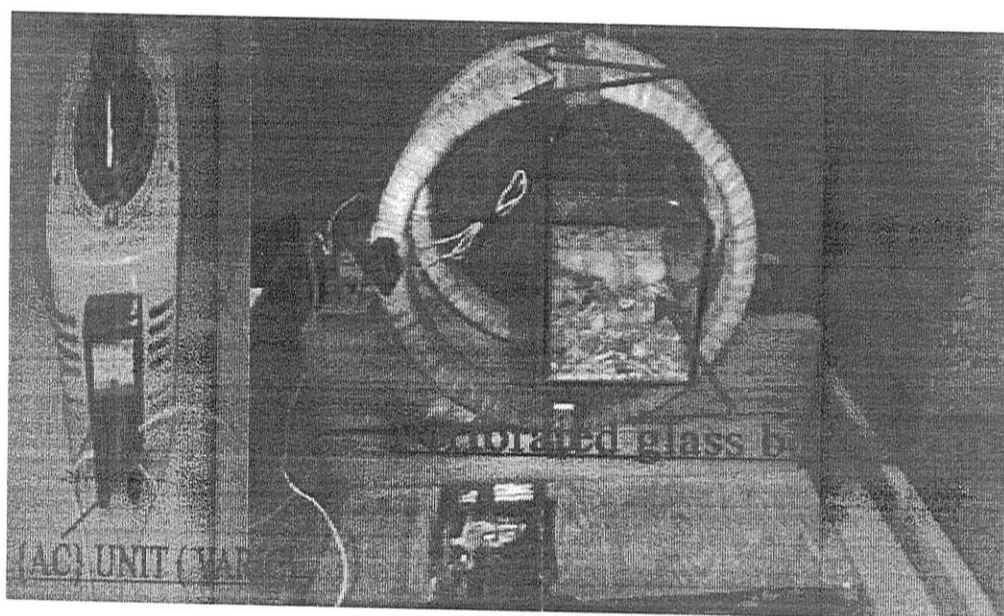


Fig. 1. A photograph of the artificial electromagnet apparatus, which generated the (AC) EMF applied with the perforated glass box of rats. (The original set up was designed by Prof.Dr.M.A.Ahmed (2008) D.Sc.in physics, royal society, England, Cairo university , Faculty of Science, Physics Department. And then the Helmholtz coil was made in the technical workshop Department of Physics, University of Cairo. R.M. Zaree (2010) modified the Helmholtz exposure apparatus in his technical workshop transformers in minya El-Kamh, Zagazig, Eastern Province, Egypt).

RESULTS

Behavioral Observations

Some changes in the behavior were observed during the exposure period in exposure time in EMF apparatus, and after the end of this time, after the animals had been returned to cages during the first hour, as shown in the (Table 1).

From the (Table 1): It was found that in all subgroups during the exposure period in cage every time the active behavior decreased, so, the motion was decreased, the response to hearing and vision were also decreased, redness of limbs, protrusion of testes and penis increased gradually as also non-eating.

While, during the first hour in cage, the animals take over all these behavioral by proceeding time as obvious in (Table 1) .

Table 1. The general behavioral changes in all subgroups

Behavior name	Behaviors during exposure time	Behaviors after exposure time ended
1- active	↓ decrease	↑ increase
2- inactive	↑ increase	↓ decrease
3- motion	↓ decrease	↑ increase but in random manner
4- response to sound	↓ decrease	↑ medium
5- response to light	↓ decrease	↑ medium
6- extended of hair	_____	↑ increase but after some time return to normal
7- eating	_____	Sometime ↑, and sometime ↓
8- redness of limbs	↑ increase gradually	↑ increase but after some time return to normal
9- protrusion of testis, and penis	↑ increase gradually	↑ increase but after some time return to normal

DISCUSSION

The results were expressed as changes in the animal behaviors over the rest of experimental period during the time of exposed animals in glass cage in Helmholtz coil apparatus, and after returned animals to cages.

In the present study, the resulted animal behaviors showed that during exposure to ELF EMF, the activity (motion) in glass cage were decreased, and increased after the end of exposure and returned to normal value gradually.

The resulted animal behaviors showed that during exposure to ELF EMF the respond to sound and vision while in glass cage were decreased, and increased after the end of exposure and reached to medium values.

While, the resulted animal behaviors showed that during exposure to ELF EMF the

eating behavior was not found in glass cage, and fluctuated after the end of exposure between decreased and increased manners.

Also, the resulted animal behaviors showed that during exposure to ELF EMF the note about the extended of hair while found in glass cage were decreased, and increased after the end of exposure and returned to normal value gradually.

In the present study, the resulted animal behaviors showed that during exposure to ELF EMF, were the redness of limbs, and protrusion of testis and penis while found in glass cage appeared to increase, which arrived at maximum values by the end of exposure period (1 hour), but after the end of exposure returned to normal value gradually.

(9) reported that during the last decade, the influence of the electromagnetic radiation on

the environment, especially the controversy on the possible adverse health effects, has gained a lot of public concern. The exposure of the human body to the electromagnetic fields result in induced currents and fields in all organs. When human is exposed to low frequency (LF) radiation (up to 30 kHz), thermal effects seem to be negligible, whereas no thermal effects could possibly be having severe effects on membrane cells. Therefore, a number of epidemiological studies have been carried out to establish possible links between extremely low frequency (ELF) exposure (fields in 50/60 Hz frequency range) and cancer risk (leukemia and nervous tissue tumor. Transduction of weak signals in ELF range involves interaction with membrane cells leading to the cytoplasmic biochemical response that cause changes in cell's behavior.

EMF firstly affects the cell membrane; some ion channels such as Na-K ATPase have been affected according the level of EMF. The alteration in the activity of these proteins causes an increasing or decreasing intracellular concentration of many ions such as Na^+ , K^+ , Mg^{+2} and Ca^{+2} which plays very important roles in cell signaling. Therefore, the biological effects of EMF expand among the cellular systems (10).

In the present study may be the behavioral results confirmed with (2) which reported that the harmful effect of EMF on cognition, learning and memory in animals have been investigated using an assortment of cognitive and behavioral tasks, tests and exposure conditions. Animal models and human designs have shown that ELF EMF can change peripheral and central nervous system activity. These changes include the increased activity of hypothalamic nuclei and intracerebral nuclei, neurotransmitter synthesis in synapses and ganglia, changes in the activity of neuronal receptors including dopamine receptor and 5-HT (1B), and such changes ultimately affect the learning and memory functions .

While, (11) reported that the mechanisms underlying the harmful effects of magnetic field on learning and memory are not known. The brain cholinergic system plays a crucial role in

learning and memory. It has shown that exposure to ELF decreased activities of cholinergic system in the frontal cortex and hippocampus, both regions are involved in memory processing. Thus, one possibility is that the impairment of cognition processing can result from decrement in transmission of cholinergic system. Also, exposure to ELF can change calcium ion, and EEG, GABA, and calcium ions in the brain and these changes may effect on cognition.

CONCLUSION

In this study, it is found that 1h exposure to a 50 Hz 3.5 mT, electromagnetic fields can affect on some animal behaviors. But the response of animals to ELF EMF gave fluctuated effects between increase and decrease, so we advice with concentrate these studies but in a spread field.

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الملخص العربي

تأثيرات التعرض للمجال الكهرومغناطيسي شديد الانخفاض بقوة $mT_{3,5}$ لمدة ٦ اسابيع على سلوكيات الحيوانات في صغار الجرذان (سبريج دولي)

فتحي مطر ، محمد حافظ باريدى ، مرفت سعد زغلول ، محمد الهادي الدسوقي ، مروة سعد

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يعتبر المجال الكهرومغناطيسي في هذه الايام مصدر كبير لتأثيرات ضارة على صحتنا على هذه الارض. لذا فان الهدف من هذه الدراسة التجريبية هو توضيح التأثير المباشر للمجال الكهرومغناطيسي ذي التردد شديد الانخفاض وذلك على بعض سلوكيات صغار الجرذان من الحيوانات.

هذا وقد تم استخدام ثلاث مجموعات من الحيوانات في اعمار ٢ و ٤ و ٦ اسابيع , تم تعريضها لجرعات مختلفة من المجال الكهرومغناطيسي ذي تردد شديد الانخفاض , هذا زيادة على استخدام مجموعة رابعة كمجموعة ضابطة .

وقد اظهرت الدراسة ان التعرض لجرعة من المجال الكهرومغناطيسي ذي تردد ٥٠ هرتز وقوة ٣,٥ ام تي لمدة ساعة يؤدي الى تأثيرات متقلبة على سلوكيات الحيوانات مثل النشاط والخمول والحركة والاستجابة للاصوات والضوء وللاكل واحمرار الاطراف لصغار الجرذان في الاعمار المختلفة.