

## Effect of Electromagnetic Waves Generated by Base Transiver Station on Liver Enzymes in Female Rats

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Article information	Abstract
<p>Article history: Received: 15 Sep 2011 Accepted: 22 Oct 2012 Available online: 7 Jan 2013 ZJRMS 2013; 15(7): 19-21</p> <p>Keywords: Electromagnetic wave liver Enzymes Rats Signal generator</p> <p>*Corresponding author at: Department of Physiology, zabol University of Medical Sciences, Zabol, Iran E-mail: simasaravani@yahoo.com</p>	<p><b>Background:</b> This study was investigating the effect of electromagnetic wave generated by mobile and base transceiver station (900 MHz) on liver enzymes in both mature and immature female age.</p> <p><b>Materials and Methods:</b> In this study, 20 rats Sprague Dawley white mature female age 8 to 9 weeks and weight 180 to 200 g and 20 rats immature age 3 to 4 weeks, weight 80 to 100 g, each age group were randomly divided in two groups (control and test). Test groups, were daily for four hours and four different times exposed to electromagnetic waves with signal generator (900 MHz), 5-meter intervals. Control groups were kept at equal condition (temperature and light) in laboratory during experiment. After at the end experimental period, blood was collected by heart puncture of all animal. Exposure to EMF generated by BTS had significant effect on liver enzymes composition in mature and immature rats.</p> <p><b>Results:</b> AST, ALT and ALP in immature-test groups decreased significantly compared with their respective control groups (<math>p&lt;0.05</math>). ALP in mature-test groups increased significantly compared with their respective control groups (<math>p&lt;0.05</math>).</p> <p><b>Conclusion:</b> These result suggest that exposure to EMF generated by BTS has a deleterious effect on liver enzymes and that this effect is more sever in immature animals.</p> <p>Copyright © 2013 Zahedan University of Medical Sciences. All rights reserved.</p>

### Introduction

Equipment's used by human are rapidly increasing and researchers try to pass the limits and save time. Users mostly are not aware of the disinfections of electromagnetism field and frequencies on the sensitive body cells and tissues as well as on their children, while these frequencies may cause disinfections on the body cells, some of which will reveal in short-term or long-term periods [1]. Living tissues have different reflects on electromagnetism fields. Some tissues will strike severe disinfections in short-time and refuse acting normally, while other may dispose the field longer, without any severe injury [2, 3].

The biologic effects caused by electromagnetism field depend on their intensity, frequency, volatility, physical characteristics and the effected tissue [1, 4]. In lower frequencies, the electromagnetism waves, called non-ionizing waves, do not have enough energy for ionization. These waves indirectly generate free radicals. Due to long-life of free radicals, DNA damage increases. As a result cancer rises [5]. Generally, cell-phone antennas, telecommunication and high-voltage power towers cause magnetic fields and people exposed to it, influence negative effects of the waves. A research made on the workers exposing electromagnetic waves reveals that these waves case impairs the function of hemoglobin, proliferation of minor cells in myeloid leukemia and reduction in blood corpuscles (due to the thermal effects

of the waves) [6, 7]. Investigating the effects of electromagnetic on topical blood flow reveals that people exposed these fields have increased brain stream to brain, especially in forehead cortex and thermal increase in occipital [8]. As a result, the telecommunication towers should be installed in a distance from residential, as living for a long time, especially children, exposed to these towers is very dangerous. Due to the increased use of wave-generator units, the biological effects studies are started and many organizations around the world, including World Health Organization, investigated the effects of the waves on human health, with special care. So, this research reviews the effects of telecommunication tower electromagnetic waves on body cells.

### Materials and Methods

This research is an experimental study which has been conducted in laboratory of Physiology Department of Shiraz University in 2009. In this research, 40 Sprague Dawley white mature female rats of 8 to 9 weeks age with 180 to 200 g weight, also immature rats of 3 to 4 weeks age with 80 to 100 g weight have been selected, which were kept in Animal Breeding Room of laboratory, in standard conditions of 60 to 70% relative humidity, near 24°C temperature and in lighting conditions of 12 hours (6 am to 6 pm) and 12 hours of darkness. The animals

were provided by Faculty of Medicine. Drinking water was supplied from tap water throughout the experiment with no limitations for all groups, and feeding of control and experimental groups was provided as a special feed (plate). Each age group of the rats was categorized randomly into 2 groups, including 10 numbers of control and experimental rats which were all kept in separated plastic cages. Experimental groups (mature and immature) were exposed to 900 Megahertz-waves emitted from a signal generator device in the same laboratory environment as control group throughout the experiment. A simulated device, named "signal generator" or "oscillator" was used to generate electromagnetic waves of 900 MHz. This simulated device which has been designed based on B.T.S (Base Transceiver Station) urban telecommunication antennas, was engineered and produced by the department of electronic engineering in Shiraz University.

The oscillator is utilized to generate radio waves. This device produces sine waves, and using a simple antenna which is quadrant to the body (with quadrant sine wave), can generate 900 MHz sine waves. The output of this device was measured by the TNEMM (Trifield Natural Electro Magnetic Meter) of the faculty of nuclear engineering in Shiraz University (0.1-0.2 mW/cm<sup>2</sup>). To start this research, the first act was to measure the nearest standard distance between telecommunication pylons and residential areas.

In our country, these waves are sent by these antennas in such a way that the radiated signals reach the earth in 50-200 m from the B.T.S. When there is more distance between a mobile phone and the B.T.S antenna, its radiated waves are more and they are more powerful, because it radiates more energy to communicate with the antenna. The waves radiated to farther distances from the antenna, to traveled areas, have some power which can be measured by spectrum analyzer. In this research, it has been investigated that at a distance of 17 meters from the B.T.S antenna (which is the nearest given distance from the residential areas), the power measured by the spectrum analyzer has been 75 dB. Thus, this determined power and distance, is regarded standard in this research, since the purpose of this research is to investigate the effect of radiated waves from the mobile phone and telecommunication pylons, on the people who live in the nearest distance from these pylons. To do this, we tried to put the cage of mature and immature field mice at a distance which its measured power by the spectrum is equal to the recorded power at the 17 m distance from the antenna.

Therefore, using the spectrum analyzer, different powers at the determined distances from the simulator device, were measured. At 5 m distance from the simulator and 17 m distance from the telecommunication pylon, the power is equal and is measured by the spectrum analyzer, in these two different distances, as 75 dB. So, the cages of mature and immature mice were radiated by electromagnetic waves, four hours a day and in four different times, at a 5 m distance from the signal generator of 900 MHz. Each time of radiation was 40

minutes and this continued for 60 days. So, in this research, plastic cages were used to avoid reflection of electromagnetic waves and their extra effect on field rats.

After finishing the period of examination, on the last day, the animals were anesthetized by Etters (made by Merck company), and blood was collected by heart puncture of all animals. Blood samples were used to measure liver enzymes. Finally, the amount of liver enzymes was measured by BT 3000 device made in Italy. All the kits used were provided by Iran Pars Azmoon and the results were analyzed by software SPSS-15, with *t*-test method, considering meaningful level of ( $p < 0.05$ ).

## Results

The result of liver enzymes' amount is mentioned in table 1. Under the affection of electromagnets of mobiles, the amount of liver enzymes in immature group has been decreased in significantly compared with the mature group and this difference between the two groups ( $p = 0.04$ ). but the average of liver enzymes' amount in the mature group increased, and just the average of alkaline phosphate enzymes' amount in mature test group in compare with the mature control group was statistically significant ( $p = 0.008$ ).

**Table 1.** Serum level of liver enzymes in different groups of rats (control-mature, test mature, control-immature, and test immature; N=10 for each group)

Groups	AST(IU/l) (Mean±SD)	ALT(IU/l) (Mean±SD)	ALP(IU/l) (Mean±SD)
Mature-control	226±31.68	77.33±15.48	250.22±17.19
Mature-test	313.67±58.96	98.55±28.85	348.67±27.73*
Immature-control	279.12±49.89	89.50±17.49	400.29±32.01
Immature-test	212.80±28.45*	52±6.53*	315.25±36.74*

\* indicates statistical significance compared with control ( $p < 0.05$ )

## Discussion

Considering the known or unknown harmful aspects of electromagnetic waves, in this investigation as well, these waves lead to some changes in liver enzymes. In fact the main mechanism of electromagnetic waves is to vibrate surface ions of membrane cell that disrupt the electric sensitive channels of plasma membrane that ultimately leads to cell malfunction. The heat of effects electromagnetic wave increases temperature of tissues, cells and increases blood flow, which leads to bleeding from capillaries is due to compression and destruction of tissue [9]. Also, the thermal effects of electromagnetic radiation, result disruption proliferation of immature cells in the bone marrow, reduced red blood cells and white blood cells are reduced [10]. And electromagnetic waves, electric current that stimulates nerves and causes tissue inflammation and decreased levels of interferon  $\gamma$  and the result is a weakening of the immune cell [11, 12]. Electromagnetic waves in young tissues than in older tissues devastating effects due to radiation absorption rate, increasing the rate of cell division and low transfer rate due to lack of myelin nerve to leave a message [13].

Table 1 show that the level of the hepatic enzymes in the immature experimental group has increased drastically in comparison with the immature control group with these changes considered statistically significant. Compared to the mature control group, the level of the phosphatase alkaline in the mature experimental group has increased significantly which is statistically significant. But the mean of the level of ALT and AST has increased a little, being statistically significant.

Aitken et al. reported the result so the 2 month 3 month old rats exposed to electromagnetic radiation at 900 MHz on a permanent basis and after 2 months of the study was the significant decrease in the levels of liver enzymes (AST, ALT, ALP). In the experimental group, as seen in our study are in agreement with the results of the test group immature, but not match up with the results of the test group [14]. Increased levels of these enzymes, which can cause damage to the liver cells, differences in experimental conditions such as the age of the animal and is the source of the wave. According to the report, as it will be a lot of different factors and unknown factors could be the cause of waves are involved, including the frequency of the waves, the duration of irradiated distances source electromagnetic waves, age, race, gender (Gender morph) Stress, vitro dissimilar and unknown factors.

Electromagnetic waves emanating from telecommunication antennas and mobile phones caused an increase in liver enzymes in the immature test group subjects while in the mature test group subjects a dramatic increase of only the Alkaline phosphatase enzyme was

noted compared to the mature control group subjects. In other words, electromagnetic waves emitted by mobile phones caused significant changes in many of the test factors in the immature group while only causing minor effects on the tested factors in the mature test group subjects. It's noteworthy to point out that if the effects of these waves were simultaneously evaluated on the liver tissue cells and the Portal vein, we would achieve more specific results.

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### Authors' Contributions

All authors had equal role in design, work, statistical analysis and manuscript writing.

### Conflict of Interest

The authors declare no conflict of interest.

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