

**King Fahad University of Petroleum and Minerals**

**Electrical Engineering Department**

**EE – 340**

**Term 081**

**Term Project**

**Effects of human exposure to extremely low  
EM frequency**

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## Introduction:

Electromagnetic fields are present everywhere in our environment but are invisible to the human eye. They were first discovered in the 19th century. So

### **What are electromagnetic fields?**

Electromagnetic fields are typically generated by alternating current ([AC](#)) in electrical conductors. The [frequency](#) of the AC can range from one cycle in thousands of years (at the low extreme) to trillions or quadrillions of cycles per second( at the high extreme). The standard unit of EM frequency is the hertz.

Here I will concentrate on low frequency EM and its health effects.

- **Effects of Extremely low frequency (ELF) EM on the human body:**

Exposure to electromagnetic fields is not a new phenomenon. However, during the 20th century, environmental exposure to man-made electromagnetic fields has been steadily increasing as growing electricity demand. There are lots of effects that caused by ( ELF) EM but I will show some of them .

- 1) *Promoting of cancer*
- 2) *Effects of 50 Hz EMF exposure on micronucleus formation and apoptosis in transformed and nontransformed human cell lines.*
- 3) *speed DNA transcription*
- 4) *Effect of extremely low frequency (ELF) exposure on morphological and biophysical properties of human lymphoid cell line .*

### **ELF EM and cancer:**

There are speculations that ELF-EMF can act as promoter or co-promoter of cancer. To date, numerous contradictory results regarding the carcinogenic potential of EMF have been reported in the literature. Although data from various epidemiological studies indicate that exposure to ELF-EMF may lead to an increased risk of certain types of adult and childhood cancer, including leukemia, cancer of central nervous system, and lymphoma

### **Effects of 50 Hz EMF exposure on micronucleus formation and apoptosis in transformed and nontransformed human cell lines:**

Effects of applying extremely low-frequency electromagnetic fields (ELF-EMF) for different durations (24, 48, and 72 h) and different field intensities (0.1-1.0 mT) on

micronucleus (MN) formation and induction of apoptosis were examined in a human squamous cell carcinoma cell line (SCL II) and in a human amniotic fluid cell line (AFC). A statistically significant increase of MN frequency and of induction of apoptosis in SCL II cells after 48-h and 72-h continuous exposure to 50 Hz magnetic field (MF) (0.8 and 1.0 mT) was found. However, exposure of AFC cells to EMF of different intensities and for different exposure times showed no statistically significant differences when compared with controls. These results demonstrate that different human cell types respond differently to EMF. Dose-dependent induction of apoptosis and genotoxic effects, resulting in increased micronucleus formation, could be demonstrated in the transformed cell line, whereas the nontransformed cell line did not show statistically significant effects. These findings suggest that EMF could be a promotor but not an initiator of carcinogenic effects.

### **speed DNA transcription:**

Earlier cell-culture studies by Reba Goodman of Columbia University's Health Sciences Center and Ann Henderson at Hunter College revealed an ELF-related increase in the DNA transcription rates of normally expressed genes in human white blood cells and in salivary-gland cells from fruit flies.

Some cells exposed to 60 Hz, continuous-wave field typical of household appliances. The team then compared genes from these ELF-exposed cells with genes from unexposed control cells. Goodman says the ELF-exposed, normally expressed genes showed a 100 to 400 percent increase in transcription rates compared with the unexposed genes. In contrast, she says, the unexposed genes and the exposed, unexpressed gene never exceeded the normal rate required for cell division.

### **Effect of extremely low frequency (ELF) magnetic field exposure on morphological and biophysical properties of human lymphoid cell line (Raji)**

Human B lymphoid cells (Raji) were exposed for 72 h to a 50 Hz sinusoidal magnetic field at a density of 2 milliTesla (rms). The results of exposure showed a decrease in membrane fluidity as detected by Laurdan emission spectroscopy and DPH fluorescence polarization. Field exposure also resulted in a reorganization of cytoskeletal components. Scanning electron microscopy (SEM) revealed a loss of microvilli in the exposed cells. This change in plasma membrane morphology was accompanied by a different actin distribution, as detected by phalloidin fluorescence. We also present evidence that EMF exposure of Raji cells can interfere with protein phosphorylation. Our observations confirm the hypothesis that electric and magnetic fields may modify the plasma membrane structure and interfere with the initiation of the signal cascade pathways.

### **Conclusion:**

Despite the health effects of Extremely Low Frequency that I introduced, to date there is no evidence to conclude that exposure to low level electromagnetic fields is harmful to human health. But the studies still works to find the evidence and to find the way to avoid these effects.