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**EFFECTS OF  
EXTREMELY LOW FREQUENCY  
ELECTROMAGNETIC FIELDS  
ON  
HUMAN CHROMOSOMES.**

**A thesis presented in partial fulfilment of the  
requirements for the degree of**

**Doctor of Philosophy**

**in**

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New Zealand**

**by**

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## Abstract.

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Electromagnetic fields (EMFs) have been associated with increased incidences of cancer as suggested by epidemiological studies. The *in vitro* sister chromatid exchange (SCE) technique, radiation-induced micronucleus assay (MN assay), COMET assay, and fluorescence *in situ* hybridization (FISH) were used in the present study to test the carcinogenic potentiality of extremely low frequency (ELF) EMFs on human peripheral blood lymphocytes. All experiments were performed single blind and used lymphocytes taken from 6 age-matched donors. The SCE experiments were conducted twice: round 1 (R1) and round 2 (R2), in order to determine whether or not the results obtained could be duplicated.

Detailed analysis of the SCE results showed that there was a significant increase in the number of SCEs/cell in the grouped experimental conditions compared to the controls in both rounds. Similarly, in the MN assay, a significant increase of *mean number of micronucleated CB cells/100 CB cells* ( $M_a$ ) and *mean number of micronuclei/100 CB cells* ( $M_b$ ) was observed in the grouped experimental conditions compared to the controls. Moreover, the highest SCE frequency in R1 was 10.03 for a *square continuous* field, and the SCE frequency of 10.39 for a *square continuous* field in R2 (albeit a different strength) was the second highest in this latter round. But in the MN assay a *square pulsed* field with increasing EMF strength showed the greatest effect on the DNA repair system. The COMET assay also showed that both a *1mT square* field (*continuous or pulsed*) resulted in significant fragmentation of the DNA. On the other hand, a FISH analysis failed to show any translocations.

In the field of EMF research, perhaps the most outstanding question that remains to be answered with certainty is how weak EMFs exert their effects at the molecular level. Various mechanisms are reviewed and evaluated in this thesis. From the results of the research performed in the current study which concentrated on testing and discovering genetic effects, a model is postulated that weak EMFs stimulate the production of free radicals which result in genetic damage. Further extensive research should be conducted to test this hypothesis.

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**DEDICATED**

**TO**

**MY BELOVED WIFE**

**KAMRUNNAHAR BEGUM (Hira)**

**IN APPRECIATION OF HER  
CONTINUOUS HELP,  
SUPPORT AND  
LOVE.**

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