

**Table 1. Studies of EMF Stimulation of DNA and Protein Synthesis
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Table 1 summarizes both ELF and RF studies (mainly frequencies 50Hz, 60Hz, 900MHz, 1.8GHz) relevant to stimulation of DNA and stress protein synthesis in many different cells. 50Hz & 60Hz = domestic supply. 900MHz & 1.8GHz=mobile/cell phone (towers), cordless phones ('DECT'), etc.

Study/Journal	Frequency	Cells/effect on hsps
Balcer-Kubicek et al, 1996 Radiation Res	60Hz domestic supply	HL60 NO synthesis of myc
Blank et al, 1994 Bioelectrochem Bioenerg	60Hz domestic supply	<i>Sciara</i> salivary glands [temperature, EMF, cause same new proteins]
Capri et al, 2004 Int J Radiat Biol	1800MHz DECT & mobile towers	monocytes NO effect on apoptosis, hsp70
Caraglia et al, 2005 J Cell Physiol	1.95GHz DECT & mobile towers	epidermoid cancer cells Induces apoptosis, hsp70
Chauhan et al, 2006 Radiation Res	1.9GHz DECT & mobile towers	human lymphoblastoma (TK6) NO hsp response
Chauhan et al, 2006 Int J Radiat Biol	1.9GHz DECT & mobile towers	two human immune cell-lines HL60,MM6 NO hsp response
Cleary et al, 1997 Bioelectromagnetics	27MHz	HeLa, CHO (also at 2450MHz mammalian cells NO hsp after 2 hr exposure, 24 hr to measurement
Chow and Tung, 2000 FEBS Letters	50Hz domestic supply	<i>E. coli</i> strain XL-1 BLUE + plasmid pUCB DNA repair improved
Czyz et al, 2004 Bioelectromagnetics	modulated 1.71GHz	p53-deficient embryonic stem cells hsp70 expression, but not in wild type

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Daniells et al, 1998 Mutat Res	750MHz	C elegans induced hsp16
Dawe et al, 2005 Bioelectromagnetics	750MHz	C elegans (same lab as above paper) hsp 16 may be due to temperature rise
Di Carlo et al, 2002 J Cell Biochem	60Hz domestic supply	chick embryo repeated EMF causes lower hsp response
Diem et al, 2005. Mutation Res	1800MHz DECT & mobile towers	fibroblasts, GFSH-R-17 granulosa cells non-thermal DNA breakage
Fritze et al, 1997 Neuroscience	900MHz Mobile/cell phone towers	rat brain blood brain barrier leakage at high SAR
Goodman et al, 1983 Science	pulsed 60Hz	<i>Sciara</i> larvae induce cellular transcription
Goodman et al, 1994 Bioelectrochem Bioenerg	60Hz domestic supply	<i>Sciara</i> larvae increased hsp70 transcripts
Harvey et al, 2000 Cell Biol Int	864.3MHz Mobile/cell phone towers	human mast cell line, HMC-1 effects on protein kinase C , stress genes
Hirose et al, 2006a Bioelectromagnetics	2.1425GHz Mobile/cell phone towers	Human IMR-90 fibroblasts NO effect on gene expression of p53
Hirose et al, 2006b Bioelectromagnetics	2.1425GHz Mobile/cell phone towers	human glioblastoma A172, IMR-90 fibroblasts NO effect on apoptosis, phosphorylation of hsp27
Ivancsits et al, 2005 Mutation Res	intermittent 50Hz	NO effect lymphocyte, monocyte, muscle: DNA damage: fibroblast, melanocyte, rat granulose
Jin et al, 1997 Bioelectrochem Bioenerg	60Hz domestic supply	HL60 cells from two sources <i>myc</i> expression in one population, not in other
Kwee et al, 2001 Electro- and Magnetobiology	960MHz	human epithelial amnion (AMA) cells hsp70 increased

Mobile/cell phone towers

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Lacy-Hulbert et al, 1995 Radiation Res	50Hz domestic supply	HL60 NO synthesis of myc or β -actin
Lai & Singh, 1997a Bioelectromagnetics	60Hz domestic supply	rat brain cells melatonin blocks DNA strand breaks
Lai & Singh, 2005 Electromag Biol Med	1800MHz DECT & mobile towers	rat brain cells noise blocks DNA strand breaks
Lantow et al, 2006a Radiation Res	1800MHz DECT & mobile towers	human Mono Mac 6 and K562 cells NO hsp response
Lantow et al, 2006b Radiat Environ Biophys	1800MHz DECT & mobile towers	primary human monocytes, lymphocytes NO hsp response
Lantow et al, 2006c Radiation Res	1800MHz DECT & mobile towers	human Mono Mac 6 and K562 cells NO effect on apoptosis or necrosis
Laszlo et al, 2005 Radiation Res	835MHz Mobile/cell phone towers	cultured mammalian cells NO 'effect within sensitivity of assay'
Laubitz et al, 2006 Experimental Physiol	muscle generated ELF	E coli, Caco-2 cells induce hsp70, protect vs apoptosis
Lee JS et al, 2005 Int J Radiat Biol	849, 1763 MHz	hsp70.1-deficient mice NO hsp induction
Lee S et al, 2005 FEBS Lett	2.45GHz 'Smart meters'	cultured human cells gene regulation: apoptosis 88, cell cycle99
Leszczynski et al, 2002 Differentiation	900MHz Mobile/cell phone towers	human endothelial cells activate hsp27/p38MAPK stress pathway
Liburdy et al, 1993 J Pineal Res	60Hz domestic supply	ER ⁺ MCF7 breast cancer cells block melatonin's oncostatic action
Lim et al, 2005 Radiation Res	900MHz Mobile/cell phone towers	human leukocytes. NO effect on hsp
Lin et al, 1994 J Cell Biochem	60Hz domestic supply	human HL60 cells EMF region of the c-myc promoter

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Lin et al, 1996 Bioelectrochem Bioenerg	60Hz domestic supply	human HL60 cells changes in c-myc transcript levels
Lin et al, 1999 J Cell Biochem	60Hz domestic supply	human HL60 cells EMF consensus sequence in HSP70 promoter
Lin et al, 2001 J Cell Biochem	60Hz domestic supply	human HL60 cells EMF consensus sequence response elements
Lixia et al, 2006 Mutat Res	1.8GHz DECT & mobile towers	human lens epithelial cells increased hsp70 protein
Maes et al, 2006 [Epub] Mutagenesis	900MHz Mobile/cell phone towers	peripheral blood lymphocytes NO effect on DNA damage
Malagoli et al, 2004 Comp Biochem Physiol	50Hz domestic supply	mussel immunocyte activate p38 MAP kinase, induce hsp70, hsp90
Mashevich et al, 2003 Bioelectromagnetics	830MHz	human peripheral blood lymphocytes chromosomal instability
McNamee et al, 2002 Radiat Res	1.9Ghz DECT & mobile towers	human leukocytes NO effect on DNA damage, micronuclei
Miyakawa et al, 2001 Bioelectromagnetics	60Hz domestic supply	C elegans induction of hsp16
Nylund & Leszczynski,2004 Proteomics	900MHZ Mobile/cell phone towers	human endothelial cell line EA.hy926 effects on cytoskeletal proteins
Nylund & Leszczynski,2006 Proteomics	900MHZ Mobile/cell phone towers	human endothelial cell line EA.hy926 response genome- and proteome-dependent
Oktem et al, 2005. Arch Med Res	900MHz Mobile/cell phone towers	rats (oxidative kidney damage) oxidative damage protected by melatonin
Ozguner et al, 2005 Toxicol Ind Health	900MHz Mobile/cell phone towers	rats (oxidative myocardial damage) protection by caffeic acid phenethyl ester

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Penafiel et al, 1997 Bioelectromagnetics	840MHz (AM, FM)	mouse L929 cells (ornithine decarboxylase activity) frequency dependent AM effect, no FM effect
Phillips et al, 1998 Bioelectrochem Bioenerg	813, 836MHz	Molt-4 T-lymphoblastoid cells DNA damage (and ability to repair) varied with SAR
Saffer & Thurston, 1995 Radiation Res	60Hz domestic supply	HL60, Daudi cells NO synthesis of myc
Sanchez et al, 2006 FEBS J	900MHz	human skin cells slight but significant increase in hsp70
Sarimov et al, 2004 IEEE Trans Plasma Sci	895, 915MHz	transformed human lymphocytes affect chromatin conformation
Shallom et al, 2002 J Cell Biochem	915MHz	chick embryos induces hsp70, protects against hypoxia
Shi et al, 2003. Environ health Perspect	60Hz domestic supply	human keratinocytes NO phosphorylation, expression of hsp27
Simko et al, 2006 Toxicol Lett	900MHz Mobile/cell phone towers	human Mono Mac 6 cells NO hsp reponse
Vanderwaal et al, 2006 Int J Hyperthermia	900MHz Mobile/cell phone towers	cultured HeLa, S3 and EA Hy296 cells NO hsp27 phosphorylation increases
Velizarov et al, 1999 Bioelectrochem Bioenerg	960MHz Mobile/cell phone towers	human epithelial cells cell proliferation
Wang et al, 2006 Bioelectromagnetics	2450MHz Smart meters	human glioma A172 cells NO hsp70, hsp27
Weisbrot et al, 2003 J Cell Biochem	900MHz Mobile/cell phone towers	<i>Drosophila</i> hsp708, affects development, reproduction
Winker et al, 2005 Mutation Res	intermittent 50Hz domestic supply	human diploid fibroblasts micronuclei, chromosomal damage

Table 2 Biological Thresholds in the ELF Range

Biological System	Threshold*	Reference
<i>Enzyme reaction rates</i>		
Na,K-ATPase	.2-.3 μ T	Blank & Soo, 1996
cytochrome oxidase	.5-.6 μ T	Blank & Soo, 1998
ornithine decarboxylase	\sim 2 μ T	Mullins et al, 1999
<i>Oxidation-reduction rate</i>		
Belousov-Zhabotinsky	<.5 μ T	Blank & Soo, 2001b
<i>Biosynthesis of stress proteins</i>		
HL60, Sciara, yeast,	<.8 μ T	Goodman et al, 1994
breast (HTB124, MCF7)	<.8 μ T	Lin et al, 1998
chick embryo (anoxia)	\sim 2 μ T	DiCarlo et al, 2000
<i>Disease related block melatonin inhibition</i>		
of breast carcinoma	.2<1.2 μ T	Liburdy et al, 1993
leukemia epidemiology	.3-.4 μ T	Ahlbom et al, 2000 Greenland et al, 2000

*The estimated values are for departures from the baseline, although Mullins et al (1999) and DiCarlo et al (2000) generally give inflection points in the dose-response curves. The leukemia epidemiology values are not experimental and are listed for comparison.