

Worldwide Published Studies Demonstrate Health Impacts of Wireless (RF/Microwave) Radiation

Below are summaries of Research Abstracts on RF/MW radiation taken from National Library of Medicine Website (PUBMED) :

www.ncbi.nlm.nih.gov/entrez/query.fcgi?CMD=search&DB=pubmed

The Summaries below are divided by categories of most prominent effects on the human body. The studies are further categorized by type of study: In-Vitro – cellular lab study; In-Vivo – alive subjects in lab studies; Epidemiological – population sampling of real life conditions. Included with each summaries is the citation of the study: title(in *italics*); authors; research institution; date of study; country of origin; publication

The 3 Bar heading highlights the following information in the study:

<i>Physical area affected &/or symptoms experienced</i>	<i>EMF Device Used</i>	<i>Subject of study</i>
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Brain function changes

Brain Wave Changes	Mobile Phones	humans
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In-Vivo

1) The study finds that 7 frequencies in the human brain wave band from 1-32 Hz are affected by radiation equal to the signal intensity and frequency of mobile phones in talk mode. *“Human brain wave activity during exposure to radiofrequency field emissions from mobile phones”*. D'Costa H, Trueman G, Tang L, Abdel-rahman U, Abdel-rahman W, Ong K, Cosic I.: School of Electrical & Computer Engineering, RMIT University, Melbourne, **Australia**; Australia Phys. Eng. Sci Med. **2003** Dec; 26(4)162 –7 [2]

<i>Brain Wave Changes</i>	<i>Mobile Phones</i>	<i>hypothesis</i>
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2) The authors **hypothesize** that the brain absorbs the RF wave length from digital cell phone transmission at the 1800 Mhz frequency band. *“Brain cells and tissues demodulate the cell-phone's audio frequencies from the radio frequency carrier. Low audio in the ranges of alpha and beta waves are affected by these radio waves and thereby influence brain function. This hypothesis states the case for a **precautionary policy.**”*

“Cellular telephones and effects on the brain: The head as an antenna and brain tissue as a radio receiver.” Weinberger Z, Richter ED.; Jerusalem College of Technology, Jerusalem, **Israel**; Jnl - Med Hypotheses **2002** Nov;59(6):703-5 [22]

In Vitro

<i>Brain damage</i>	<i>cell phones</i>	<i>mice</i>
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3) THE study exposed rats brain neural cells (nervous system) to a GSM cell phone (PCS equivalent) frequency (900 or 1800 Mhz) of different power strengths for 2 hrs. It found highly significant evidence for neuronal damage in the cortex, hippocampus, and basal ganglia in the brains of exposed rats. The study did not identify if all power strengths caused the damage.

“Nerve cell damage in mammalian brain after exposure to microwaves from GSM mobile phones;”; Salford LG, Brun AE, Eberhardt JL, Malmgren L, Persson BR.; Department of Neurosurgery, Lund University, The Rausing Laboratory and Lund University Hospital, Lund, **Sweden**; Jnl - Environ Health Perspect. **2003** Jun;111(7):881-3; discussion A408. [36]

In_Vivo

<i>Brain slow wave affected</i>	<i>Cell phones</i>	<i>humans</i>
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3a) Using an improved method for measuring EEG, the study shows how the slow wave activity of the brain is raised after short period of cell phone use. “Spatial distribution of EMF was especially concentrated around the ipsilateral eye adjacent to the basal surface of the brain.” The effects are more pronounced in children. However the study showed after approximately 15– 20 minutes of non-use the effect had disappeared. This study demonstrates the need for more long term experimental studies. “*Effects of high-frequency electromagnetic fields on human EEG: a brain mapping study.*” ; Kramarenko AV, Tan U.; Central Clinic Hospital N5, Kharkov, **Ukraine**; Jnl - Int J Neurosci. **2003** Jul;113(7):1007-19. [48]

Heart and Circulatory Changes

In Vivo

<i>Brain Blood flow changes</i>	<i>in lab ELF's (extreme low frequency) closer to power line EMF's</i>	<i>depressed humans</i>
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4) This study found effects on the cerebral blood flow of depressed patients from EMF (electromagnetic fields) stimulation in the ELF's (Extremely low frequencies) bands of the frequency spectrum, specifically 1 and 15 Hz. Radio & Microwave frequencies carry an ELF component as part of their communication by-product. In many studies this component of the radio wave has been found to be most troublesome to the body. The study did not state the power level of the signal(frequency), so it may be difficult to correlate to real world exposures.

“*High (15 Hz) and low (1 Hz) frequency transcranial magnetic stimulation have different acute effects on regional cerebral blood flow in depressed patients.*” Psychol Med . **2003 Aug**;33 (6): 997-1006; Loo CK, Sachdev PS, Haindl W, Wen W, Mitchell PB, Croker VM, Malhi GS. :School of Psychiatry, University of New South Wales, **Australia** [3]

Epidemiological

<i>Blood Pressure & Nervous system</i>	<i>Radio equipment</i>	<i>technicians & broadcast workers</i>
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5) The study covered workers employed in transformer and distribution stations, medium wave transmitting stations, radio-service and radio and TV multichannel broadcasting stations. Changes in the circulatory system were observed with a significant relationship between exposure parameters and blood pressure and nervous system disorders. The longer the workers worked at those jobs the greater the occurrence of changes in these disorders.

[Article in Polish] “*Biological effects and health risks of electromagnetic fields at levels classified by INCRIP as admissible among occupationally exposed workers*”. Bortkiewicz A, Gadzicka E, Zmyslony M.; Nofer Institute of Occupational Medicine, Lodz, **Poland**, **2003** [34]

Epidemiological

<i>Heart rate & Blood Pressure Affected</i>	<i>Radio equipment</i>	<i>technicians & broadcast workers</i>
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6) The study examined heart rate variability and blood pressure of radio technicians and operators. It found certain groups of radio workers showed significant greater abnormalities in these parameters compared to unexposed populations.

“*Evaluation of selected functional circulation parameters of workers from various occupational groups exposed to electromagnetic fields of high frequency. III. 24-h*

monitoring of arterial blood pressure.”; Gadzicka E, Bortkiewicz A, Zmyslony M, Palczynski C.; Zakladu Fizjologii Pracy i Ergonomii, Instytutu Medycyny Pracy, Lodzi, **Poland**; Jrn1 - Med Pr. **1997**;48(1):15-24.[32]

In-Vivo

<i>Brain Blood flow affected</i>	<i>digital cell phones & cell towers</i>	<i>humans</i>
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7) The study examined regional cerebral blood flow (rCBF) from exposures to 2 different signals: digital cell phone and base station signals for 12 healthy young men. A sham exposure was included. The study found that only cell phone signals induced changes in rCBF because of their pulse modulated wave. They state “ that pulse modulation of RF EMF signals is necessary to induce changes in the waking and sleep EEG, and substantiates the notion that pulse modulation is crucial for RF EMF-induced alterations in brain physiology.”

“Exposure to pulse-modulated radio frequency electromagnetic fields affects regional cerebral blood flow.” ; Huber R, Treyer V, Schuderer J, Berthold T, Buck A, Kuster N, Landolt HP, Achermann P.; Institute of Pharmacology and Toxicology, University of Zurich, Zurich, **Switzerland.**: Jrn1 - Eur J Neurosci. **2005** Feb;21(4):1000-6.[42]

DNA, Chromosomal and Cellular Changes

In-Vivo

<i>DNA Damage</i>	<i>in lab cell phone frequencies</i>	<i>mice</i>
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8) This study showed that exposure in mice to cell phone frequencies and signal strength can have a detrimental effect on DNA repair mechanisms after a long duration of exposure. The authors comment that the sample size was small and should be repeated.

“Effect of exposure to 900 MHz radiofrequency radiation on intrachromosomal recombination in pKZ1 mice.” Sykes PJ, McCallum BD, Bangay MJ, Hooker AM, Morley AA.; Department of Haematology and Genetic Pathology, Flinders University and Medical Centre, Bedford Park, South **2003, Australia** 5042..[4]

In-Vitro

<i>Cellular stress protein affects</i>	<i>In lab RF/Microwave transmitter</i>	<i>cell culture</i>
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9) The study examines the effects of RF/ MW frequency radiation on cell proliferation under higher room temperatures, 35 & 39 degrees centigrade. Those cells exposed to RF/MW radiation showed significant changes, while controls exposed under same room temperature differences showed no change. This study was rejecting the claim that external temperatures effect cell changes and supports the evidence that RF/MW frequencies without higher room temperatures induce cell changes. This study also supports the studies that show heat shock proteins (stress related proteins) in the body are affected when exposed to RF/MW signals.

“The effects of radiofrequency fields on cell proliferation are non-thermal”; S.. Velizarova, P. Raskmarkb and S. Kwee~'; jrn1 - Bioelectrochemistry and Bioenergetics Volume 48,, Issue 1, February **1999**, Pages 177-180; Bulgaria, Denmark [13]

In-Vitro

<i>Cellular Gene affects</i>	<i>in lab RF/MW transmitter</i>	<i>newborn rats</i>
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10) The study examines exposure of rats to 9.4Ghz frequency at a low 5microwatt/cm² power levels on gene markers in kidney development of newborn rats. This power level

can be found in and around hot spots of broadcast stations, lower than that emitted by cell phones. Although 9.4Ghz is a higher frequency signal than a cell phone, the study suggests cell phone frequencies interfere with certain types of gene expression during early gestation and results in aberrations in the kidney development of the newborn rats.

“Bone morphogenetic protein expression in newborn rat kidneys after prenatal exposure to radiofrequency radiation.”; [Pyrpasopoulou A](#), [Kotoula V](#), [Cheva A](#), [Hytiroglou P](#), [Nikolakaki E](#), [Magras IN](#), [Xenos TD](#), [Tsi boukis TD](#), [Karkavelas G](#).; Laboratory of Pathology, Department of Medicine, School of Health Sciences, Aristotle University of Thessaloniki, Thessaloniki, **Greece**; *Jrnl - Bioelectromagnetics*. **2004** Apr;25(3):216-27. [20]

In- Vitro

<i>cellular brain protein affects</i>	<i>in lab AM signals</i>	<i>rats</i>
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11) The study examines certain enzymes in the developing rat brain after exposure to AM frequency band (500 to 1600 KHZ) at power levels found close to AM radio broadcast antennas. A significant decrease in the enzyme level was observed in the exposed group. “These results indicate that this type of radiation could affect membrane bound enzymes associated with cell signaling, proliferation and differentiation. This may also suggest an affect on the behavior of chronically exposed rats.”

“Radio frequency radiation effects on protein kinase C activity in rats' brain.”; Paulraj R, Behari J. ; School of Environmental Sciences, Jawaharlal Nehru University, New Delhi 110067, **India**.; *Jrnl - : Mutat Res*. **2004** Jan 12;545(1-2):127-30. [21]

In Vitro

<i>cellular CNS (central nervous system enzyme) affects</i>	<i>cell phone</i>	<i>cell cultures</i>
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12)“This paper demonstrates... that radio frequency (RF) radiations irreversibly affect the structural and biochemical characteristics of an important CNS (Central Nervous System) enzyme” in laboratory cell cultures. “These results were obtained by using a commercial cellular phone to reproduce the reality of the human” exposure.

“Structural and kinetic effects of mobile phone microwaves on acetylcholinesterase activity.” [Barteri M](#), [Pala A](#), [Rotella S](#).: Dipartimento di Chimica- Universita degli Studi di Roma "La Sapienza" Piazzale Aldo Moro 5, 00185 Roma, **Italy**; *Jrnl - Biophys Chem*. **2005** Mar 1;113(3):245-53 [25]

Epidemiology

<i>White blood cells higher</i>	<i>radar</i>	<i>human population2</i>
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13) The study showed higher white blood cell counts of WWII radar workers exposed to RF/MW radiation at higher levels and longer durations than the average population. The blood counts showed increasingly elevated as the duration of exposure increased.

“Time-dependent hematological changes in workers exposed to electromagnetic fields.”; Marino AA.: Department of Orthopaedic Surgery, Louisiana State University Medical Center, Shreveport, La. **USA** 71130-3932.; *Jrnl - Am Ind Hyg Assoc J*. **1995** Feb;56(2):189-92.U [61]

In Vitro

<i>cellular stress proteins affects</i>	<i>in lab high microwave levels</i>	<i>human cell cultures</i>
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14) The study found that certain heat shock proteins (protein level of phosphorylated Hsp27 (78Ser)) were significantly decreased at SAR 10W/kg at 1950 MHZ similar to cell phone frequencies but much higher power levels. However, at lower power levels 1 and 2W/kg similar to cell phone power levels, there was no effect on these proteins. Exposure times were 1 to 2 hrs. Heat shock proteins are related to the stress mechanisms of the body.

“Effects of exposure to a 1950 MHz radio frequency field on expression of Hsp70 and Hsp27 in human glioma cells.”: Miyakoshi J, Takemasa K, Takashima Y, Ding GR, Hirose H, Koyama S.; Department of Radiological Technology, School of Health Sciences, Faculty of Medicine, Hirosaki University, Hirosaki, **Japan**; Jrl - Bioelectromagnetics. **2005** May;26(4):251-7.[27]

In-Vitro

DNA damage	in lab higher microwave levels	human blood cells
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15) The study evaluated the toxicity of human blood cells from exposure to different power levels in the frequency levels of 837 MHz and 1908 Mhz, analog & digital cellular phones frequencies. Compared to controls it found 4-fold damage to blood cells after 24 hour exposure by both those frequencies at the high power levels (SARs 5 to 10 w/kg), but not at lower power level (SAR 1 w/kg). Most modern cell phones induce SARs between 1 & 2 w/kg. It found no significant differences at any power level between controls and exposed blood cells for shorter exposure durations than 24 hours.

“Genotoxicity of radiofrequency signals. I. Investigation of DNA damage and micronuclei induction in cultured human blood cells.” Tice RR, Hook GG, Donner M, McRee DI, Guy AW.; ILS, Inc., Research Triangle Park, North Carolina 27709, **USA** ; Jrl - Bioelectromagnetics **2002** Feb;23(2):113-26 [67]

In-Vitro

cellular enzyme affects	in lab RF frequency	yeast cells
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16) The study demonstrates the protective effect of electromagnetic radiation (40.68 MHz at 15 and 30 Watt) on the survivability of yeast cells. The cells showed greater activity of certain types of intracellular enzymes, as well as greater stability of electrostatic characteristics of the cell surface.

“Protective action of electromagnetic radiation (40.68 MHz) on *Saccharomyces cerevisiae* UCM Y-517”; Podgorskii VS, Voichuk SI, Gromozova EN, Gordienko AS.; Jrl - Mikrobiol Z. **2004** Sep-Oct;66(5):48-56. **Russia** [35]

In-Vivo

electrosensitivity affects	in lab RF frequency	predisposed rats
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17) Using a specially bred strain of rats the study concludes that electrosensitivity from radio waves is possible and genetically predisposed. “Genetic susceptibility to radiation.”; Hall EJ, Brenner DJ, Worgul B, Smilenov L.; Columbia University Medical Center, College of Physicians and Surgeons, Center for Radiological Research, New York, NY 10032-3795, **USA**; Jrl - Adv Space Res. **2005**;35(2):249-53.[54]

In-Vitro

cellular stress proteins affects	in lab RF transmitter	chick embryos
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18) THE study finds that chick embryos exposed to ELF (extremely low frequency 1-120Hz) and RF (radio frequency) EMFs at cell phone power levels induce a decrease in HSP70 (heat shock proteins) levels. The resulting decline decreases protection against stress and suggests “ a mechanism which could enhance the probability of cancer and other diseases” “Chronic electromagnetic field exposure decreases HSP70 levels and lowers cytoprotection.”; Di Carlo A, White N, Guo F, Garrett P, Litovitz T., Feb **2002**; Vitreous State Laboratory, Catholic University of America, Washington, DC 20064, **USA**. [58]

In Vivo

DNA affects	2 cell phone frequencies MHz & GHz	human blood cells
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19) Researchers compared the responses of healthy and hypersensitive people to the old and new cell phone signals. Both groups reacted to the new Ghz UMTS Broadband microwaves, not to the old Mhz GSM signal. The Ghz frequency had an effect on chromatin and inhibited formation of DNA double-strand breaks co-localizing DNA repair foci. However hypersensitive people showed a different response in DNA repair foci from both signals compared to healthy controls.

Microwaves from UMTS/GSM mobile phones induce long-lasting inhibition of 53BP1/gamma-H2AX DNA repair foci in human lymphocytes; Belyaev IY, Markovà E, Hillert L, Malmgren LO, Persson BR.; Department of Genetics, Microbiology and Toxicology, Stockholm University, Stockholm, Sweden...; Bioelectromagnetics. **2009** Feb;30(2):129-41. [102]

In Vivo

Blood cells stress respons, genotoxic effects	Cell phones	Hypersensitive & normal humans
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19a) The study found Microwaves from cell phones affect chromatin conformation and 53BP1/gamma-H2AX foci of human lymphocytes (blood cells) of both proclaimed hypersensitive people as well as healthy subjects. These biological markers are indicative of stress response and genotoxic effects. Healthy people did not show a distinctly different response than hypersensitive people.

Microwaves from GSM mobile telephones affect 53BP1 and gamma-H2AX foci in human lymphocytes from hypersensitive and healthy persons; Markovà E, Hillert L, Malmgren L, Persson BR, Belyaev IY; Department of Genetics, Microbiology and Toxicology, Stockholm University, Stockholm, Sweden; Environ Health Perspect, **2005** Sep 113(9):1172-7 [103]

Organ, Endocrine and Enzyme changes

In-Vitro

Sperm DNA damage	in lab cell phone frequencies	male mice
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20) The semen of male mice was exposed to cell phone frequencies and power levels over a period of days. The study “revealed statistically significant damage to both the mitochondrial genome and the nuclear beta-globin locus” in the DNA semen of mice “*Impact of radio frequency electromagnetic radiation on DNA integrity in the male germline*”. Int J Androl. **2005 Jun** 28(3):171-9 Aitken RJ, Bennetts LE, Sawyer D, Wiklendt AM, King BV. : ARC Centre of Excellence in Biotechnology and Development, Discipline of Biological Sciences, and Hunter Medical Research Institute, Newcastle, NSW, Australia. [6]

Epidemiological

Sperm quality affects	occupational RF exposure	human males
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21) THE study examined the semen quality of male occupationally RF exposed workers. It measured 33 parameters of semen quality and four serum hormones of 12 male exposed and 34 non- exposed. It observed minor differences and suggests further studies may be warranted.

Grajewski B; Cox C; Schrader SM; Murray WE; Edwards RM; Turner TW; Smith JM; Shekar SS; Evenson DP; Simon SD; Conover DL ; National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention, Cincinnati, OH 45226, USA.; Jnl - J Occup Environ Med **2000** Oct;42(10):993-1005 [66]

In Vivo

Kidney damage antioxidant reversal	in lab cell phone frequencies	rats
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22) The study finds that propolis (Caffeic acid phenethyl ester), a flavonoid, anti-oxidant, free radical scavenger derived from honeybees, reduces renal (kidney) impairment in rats from cell phone type radiation by 27%.. It does this partially by blocking oxidative processes in the kidneys.

“*A novel antioxidant agent caffeic acid phenethyl ester prevents long-term mobile phone exposure-induced renal impairment in rat.*”; Ozguner F, Oktem F, Ayata A, Koyu A, Yilmaz HR.; Department of Physiology, School of Medicine, Suleyman Demirel University, P. K. 13, Isparta, 32100, **Turkey**; *Jrnl - Mol Cell Biochem.* **2005 Sep**;277(1-2):73-80 [45]

In-Vivo

<i>Thyroid affects</i>	<i>in lab cell phone frequencies</i>	<i>rats</i>
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23) The study finds that electromagnetic radiation similar to that emitted by 900 MHz cellular phones has significant effects on certain thyroid hormones in a specific breed of rats. New digital phones broadcast at around 1900 – 2400 MHz.

“*Effects of 900 MHz electromagnetic field on TSH and thyroid hormones in rats.*”; Koyu A, Cesur G, Ozguner F, Akdogan M, Mollaoglu H, Ozen S.; Department of Physiology, Suleyman Demirel University, School of Medicine, 32260 Isparta, **Turkey**; *Jrnl - : Toxicol Lett.* **2005 Jul** 4;157(3):257-62. Epub 2005 Apr 11; [47]

In-Vivo

<i>Melatonin levels</i>	<i>in lab magnetic fields</i>	<i>2 MS male/female patients</i>
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24) The study examines opposite effects on the yawning reflex of two MS patients after administration of yawning drug, ketanserin, and the application of picotesla EMFs. Under the drug the female MS patient stopped yawning after EMF application, while male MS patient yawning increased after EMF application. The study believes EMFs had an effect on melatonin levels, known to effect sleepiness, increasing levels for the male and decreasing them for female. *Bidirectional effect of electromagnetic fields on ketanserin-induced yawning in patients with multiple sclerosis: the role of melatonin*: Sandyk R.; NeuroCommunication Research Laboratories, Danbury, CT 06811, **USA.**; *Intl J Neuroscience* **1996 Mar**;85(1-2):93-9. [93]

In-Vitro

<i>Sperm motility changes</i>	<i>cell phones</i>	<i>humans</i>
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25) The study examines the effects of sperm degeneration from 27 male volunteers when their sperm was exposed in vitro to EMR from cell phones. THE study found no difference in sperm concentration, but, in contrast to controls, the study found a subtle but statistically significant reduction in sperm motility (movement) in 2 categories, rapid progressive and slow progressive sperm movement. It also showed an increase in the no-motility category of sperm movement in contrast to controls..

Effects of electromagnetic radiation from a cellular phone on human sperm motility: an in vitro study; Erogul O, Oztas E, Yildirim I, Kir T, Aydur E, Komesli G, Irkilata HC, Irmak MK, Peker AF.; Biomedical and Clinical Engineering Centre, Gulhane Military Medical Academy, Etlik, Ankara, **Turkey**; *Arch Med Res.* **2006 Oct**;37(7):840-3. [94]

Neurological & Well Being Effects(sleep, stress, headaches, tinnitus, etc.)

Epidemiological

<i>Stress hormones & circadian rhythm (sleep/wake cycle) affected</i>	<i>Telecommunication equipment</i>	<i>worker population</i>
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26) The study examines certain stress hormones of satellite telecommunications operators. “The long term effect of the exposure to low-level RF EM radiation evoked pronounced stress reaction with changes in the circadian rhythm ... and increased variability of catecholamines secretion”. Circadian rhythms are part of our sleep cycles. “*The effect of low level radiofrequency electromagnetic radiation on the excretion rates of stress hormones in operators during 24-hour shifts.*” Cent Eur J Public Health **2002** Jun; 10(1-2): 24-8 ; Vangelova K, Israel M, Mihaylov S.; Laboratory of Physiology, Psychology and Ergonomics, National Center of Hygiene, Medical Ecology and Nutrition, 15 Dimitar Nestorov Boul., 1431 Sofia, **Bulgaria** [8]

Epidemiological

<i>Headaches, Insomnia, amnesia increases</i>	<i>Radio equipment</i>	<i>worker population</i>
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27) The study uses VHF (Very high frequencies - 170 Mhz) , a frequency found in the low FM radio band, to evaluate the health effects of radio operators. It finds “the incidences of symptoms such as headache, insomnia and amnesia etc. was significantly higher in experimental group. Low power levels of VHF radiation can decrease the nervous system function in occupationally exposed personnel and induce increases in some kinds of enzymes and immunoglobulins.” “*Effect of low intensity and very high frequency electromagnetic radiation on occupationally exposed personnel*” Zhonghua Lao Dong Wei Sheng Zhi Ye Bing Za Zhi: Yuan ZQ, Li F, Wang DG, Wang Y, Zhang P. **2004 Aug** 22(4); 267-9 : Epidemic Prevention Brigade, General Logistics Department, PLA, Beijing 100039, **China** [12]

Epidemiological

<i>Sleep, headaches, depression, dizziness, loss of memory increases</i>	<i>less 300 feet from cell transmitter</i>	<i>human population</i>
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28) This is a population study surveying 530 people living in the vicinity of cellular base stations (cell towers), on 18 Non Specific Health Symptoms. Comparisons of health symptom complaints, in relation to gender and the distance from cell site, revealed significant increases as compared to people living > 300 meters or not exposed to cell site: those living less than 300 mtrs for tiredness, less than 200 m for headache, sleep disruption, discomfort, etc., less than 100 m for irritability, depression, loss of memory, dizziness, libido decrease, etc. Women, significantly more often than men, complained of headache, nausea, loss of appetite, sleep disruption, depression, discomfort and visual disruptions.

[Article in French] “*Study of the health of people living in the vicinity of mobile phone base stations. I. Influences of distance and gender;* Santini R, Santini P, Danze JM, Le Ruz P, Seigne M.; Institut national des sciences appliquees, laboratoire de biochimie-pharmacologie, batiment Louis-Pasteur, 69621 cedex, Villeurbanne, **France**; Jnl -Pathol Biol (Paris). **2003 Sep**;51(7):412-5. [15]

In-Vivo

<i>Sleep disturbances & heart rate variability increases</i>	<i>digital cell phone</i>	<i>humans</i>
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29) The study expounds on 2 prior studies which showed the effects of exposure from digital cell phones (900 Mhz) on sleep parameters and heart rate variability. The phones' power levels induced SARs of 1 w/kg in the body, a typical SAR found from exposure to most cell phones. The studies showed varying degrees of differences between the non-exposed, and the exposed in the sleep stages and heart rate variability of 9 healthy subjects.

“Radio frequency electromagnetic field exposure in humans: Estimation of SAR distribution in the brain, effects on sleep and heart rate”; Huber R, Schuderer J, Graf T, Jutz K, Borbely AA, Kuster N, Achermann P.; Institute of Pharmacology and Toxicology, University of Zurich, Zurich, **Switzerland.**; Jnl - Bioelectromagnetics. **2003** May;24(4):262-76. [42]

Epidemiological

Hearing loss	vicinity radio transmitter	humans
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30) The study demonstrates the hearing loss effect in those individuals who work at and live near radio/television transmitter stations, in contrast to control groups of similar work regimes, lifestyles and socioeconomic class.

“Occupational safety: effects of workplace radiofrequencies on hearing function.”; Oktay MF, Dasdag S, Akdere M, Cureoglu S, Cebe M, Yazicioglu M, Topcu I, Meric F.; Department of Otolaryngology, School of Medicine, Dicle University, Diyarbakir, **Turkey.**; Jnl - Arch Med Res. **2004** Nov-Dec;35(6):517-21. [46]

In_Vivo

Stress reactions	in lab radio transmitter	rats
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31) The study examines stress reaction in rats exposed to RF EMFs. It found exposed rats were less adaptive and had higher stress reactions to stressful situations.

“Changes in reactions in rats during hypokinesia and electromagnetic irradiation of ultrahigh frequency” [Article in Ukrainian]; Temur'iants NA, Chuian OM, Verko NP, Moskovchuk OB, Tumanians OM, Shyshko Olu, Min'ko VA, Kurtseitova EE., ; Tavritcheskiy University by V.I. Vernadsky, Sympheropol, **Ukraine**; Jnl - Fiziol Zh. **2003**;49(1):87-93. [49]

In_Vivo

Sleep brain waves & circadian rhythms affect	in lab radio transmitter	humans
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32) A Russian study showed how certain frequencies of EMFS rffect brain wave patterns which effect sleep patterns. The abstract does not identify the EMF frequencies or power levels used. It cites only that the frequencies were pulsed in the “ultra-broadband and ultrashort frequency range (somewhere in 900 Mhz & higher frequency band) with a repetition frequency of 6 Hz”. The brain’s theta rhythms and circadian rhythms were disturbed, which affect sleep quality.

Actions of pulsed ultra-broadband electromagnetic irradiation on the EEG and sleep in laboratory animals.; Petrova EV, Gulyaeva NV, Titarov SI, Rozhnov YV, Koval'zon VM.; Institute of Higher Nervous Activity and Neurophysiology, Russian Academy of Sciences, 117865 Moscow, **Russia**; Neurosci Behav Physiol. **2005** Feb;35(2):165-70; [90]

Epidemiological

sleep, memory, dizziness, depression, tremors, problem solving, attention affected	cell antennas	humans
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33) Researchers found 2 to 3 times higher incidence of neurobehavioral disorders in a population 85 people living below and opposite cellular antennas on apartment building 66AF-1.docx

roof, versus a control group of 80 people living 2 km away from the antenna site. Exposed group experienced higher incidence of sleep disturbances, memory changes, dizziness, depressive symptoms, tremors, Lower performance was found in problem solving, attention & short term auditory memory tests for the exposed group, especially those living across the antenna site. Power levels varied from 2 to 6 $\mu\text{w}/\text{cm}^2$ across antenna, vs .1 $\mu\text{w}/\text{cm}^2$ for those inhabitants living in the apartments below antenna. An emission reading .1 $\mu\text{w}/\text{cm}^2$ is almost 10 times lower than cell phones and commonly found for those living near cell or broadcast towers.

“Neurobehavioral effects among inhabitants around mobile phone base stations” G. Abdel-Rassoul *, O. Abou El-Fateh, M. Abou Salem, A. Michael, F. Farahat, M. El-Batanouny, E. Salem; Community, Environmental and Occupational Medicine Department, Faculty of Medicine, Menoufiya University; Shebin El-Kom, **Egypt**; Received October **2005**; [99]

In Vivo

<i>Brain dopamine affected</i>	<i>in lab ELF/ EMF application</i>	<i>rats</i>
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34) This study on rats shows how extremely low frequency magnetic field (ELF MF) reduce the reactivity of central dopamine D(1) receptors in rats by showing a reduction of irritability and oral activity. The rats had dopamine neurons chemically damaged by 6-hydroxydopamine (6-OHDA). This animal model showed similar dopamine damage exhibited in Parkinson's disease patients.

“Influence of alternating low frequency magnetic fields on reactivity of central dopamine receptors in neonatal 6-hydroxydopamine treated rats”; Sieron A, Brus R, Szkilnik R, Plech A, Kubanski N, Cieslar G.; Clinic of Internal Diseases and Physical Medicine, Silesian Medical University in Katowice, Zabrze, **Poland**; Bioelectromagnetics **2001** Oct;22(7):479-86. [98]

Epidemiological

<i>Sleep complaints</i>	<i>cell towers</i>	<i>human population</i>
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35) A study of 3526 people analyzing the well being responses to cell tower exposures. Questions pertaining to sleep disturbances, headaches, health complaints and mental and physical health were analyzed. A dosimeter measuring different RF-EMF signal strengths was used. There was no difference in health scores between exposure assessments. People who self reported adverse health effects had greater sleep disturbances.

“Mobile phone base stations and adverse health effects: phase 2 of a cross-sectional study with measured radio frequency electromagnetic fields”; Berg-Beckhoff G, Blettner M, Kowall B, Breckenkamp J, Schlehofer B, Schmiedel S, Bornkessel C, Reis U, Potthoff P, Schüz J; Department of Epidemiology and International Public Health, Faculty of Public Health, University of Bielefeld, **Germany**; Occup Environ Med. **2009** Feb;66(2):124-30. [100]

Epidemiological

<i>Behavioral affects</i>	<i>cell phones</i>	<i>children population</i>
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36) Danish mothers of 13,159 children completed a questionnaire reporting their use of cell phones during pregnancy as well as current cell phone use by the child. Behavioral problems were observed for children who had possible prenatal or postnatal exposure to cell phone use. After adjustment for potential confounders, the odds ratio for a higher overall behavioral problems score was 1.80 in children with both prenatal and postnatal exposure to cell phones.

“Prenatal and postnatal exposure to cell phone use and behavioral problems in children”; Divan HA, Kheifets L, Obel C, Olsen J.; Department of Epidemiology, UCLA School of Public Health, University of California, Los Angeles, CA 90095-1772, **USA**.; Epidemiology. **2008** Jul;19(4):523-9.[103]

Cancer, Lymphomas and Tumor Formations

Epidemiological

<i>Cancers higher: eye, testes, nasal, non - Hodgkin's lymphoma, and breast</i>	<i>Electronic equipment</i>	<i>worker population</i>
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37) Technicians with higher levels of RF exposures, between 10 to 100 microwatts/centimeter² ($\mu\text{w}/\text{cm}^2$) showed a high incidence of melanoma of the eye, testicular cancer, nasopharyngioma, non-Hodgkin's lymphoma, and breast cancer. These health effects were also found in the 20-37 age group, an age group that were not on the job as long as would have been expected for those cancers to develop, predicating that high powers levels can shorten the cancer latency period.

Jrnl - Int J Occup Environ Health **2000** Jul-Sep;6(3):187-93; Richter E; Berman T; Ben-Michael E; Laster R; Westin JB; Unit of Occupational and Environmental Medicine, Hebrew University-Hadassah Medical School, Jerusalem POB 12272, **Israel**. [23]

Epidemiological

<i>Breast Cancer higher</i>	<i>Radio & Telegraph equipment</i>	<i>worker population</i>
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38) The study tabulated the incidence of breast cancer among radio and telegraph workers from 1961 to 2003. The frequency they were exposed to ranged from 405 Khz to 25 Mhz. The under 50 year olds had a lower incidence of breast cancer than those 50 years and older. However both showed a significantly higher incidence than the normal population.

“Follow-up of radio and telegraph operators with exposure to electromagnetic fields and risk of breast cancer.”; Kliukiene J, Tynes T, Andersen A.; The Cancer Registry of Norway, Institute of Population-based Cancer Research, Montebello, NO-0310 Oslo, **Norway**, **2003** [29]

Epidemiological

<i>Non- Hodgkin's lymphoma higher</i>	<i>telecommunications & transport industry</i>	<i>worker population</i>
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39) The study tracked over 2.8 million workers in Sweden from 1971 to 1989 to observe the incidence of Non- Hodgkin's lymphomas. The highest risk was observed in telecommunications and transport workers. The authors explain the higher risk by their exposure to electromagnetic radiation.

“Non-Hodgkin's lymphomas and occupation in Sweden.”; Cano MI, Pollan M.; Cancer Epidemiology Unit, National Centre for Epidemiology, Carlos III Institute of Health, Madrid, **Spain**.: Jrnl - Int Arch Occup Environ Health. **2001** Aug;74(6):443-9. [38]

Epidemiological

<i>Melanoma higher</i>	<i>FM Transmitters</i>	<i>human population</i>
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40) This study examined the possible link between melanoma and proximity to FM broadcasting transmission sites in 4 different countries. A correlation was found between the higher incidence of melanoma and the number of nearby FM transmitters.

“Melanoma incidence and frequency modulation (FM) broadcasting.”; Hallberg O, Johansson O.; Department of Neuroscience, Karolinska Institute, Stockholm, **Sweden**; Jrnl - Arch Environ Health **2002** Jan-Feb;57(1):32-40 [40]

In-Vivo

<i>Malignant Tumors higher</i>	<i>in lab cell phone frequencies & levels</i>	<i>rats</i>
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41) Increase in various malignant tumors (18 exposed vs 5 controls) in certain strain of rats, exposed to 2450 MHz pulsed, modulated at 8 HZ, SARs .4 to .15W/kg - frequency at power level readings similar to cell phone emissions. They also found 7 to 1 increase in pheochromocytoma tumors for exposed vs controls. The authors negated their positive findings by reinterpreting their conclusions to fit their desired outcomes. They concluded the observations as biologically insignificant due to the lack of an increase in any one malignant tumor type.

“In Vivo 2450 MHz exposure in standard rat 2-year bioassay” Chou CK, Guy AW, Kunz LL, Johnson RB, Crowley JJ, Krupp JH., *Bioelectromagnetics* (1992) 13:469-496; *Bioelectromagnetics* (1984) 5:389-398; USAF Report USAFSAM-TR-83-17 (volume 1 - Design, Facilities & Procedures); **United States Air Force Report [98]**

Electrical Occupations and Neurodegenerative Disease Trends

Epidemiology

<i>Parkinsons, Alzheimers Dementia</i>	<i>occupational relationship & electrical exposrs</i>	<i>worker population</i>
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42) A US epidemiological study observed a hypothesized excess of neurodegenerative diseases; Parkinsons, Alzheimer’s, Dementia was associated with a variety of occupations; teachers, clergy, veterinarians, hairdressers, as well as those working with 60 Hz magnetic fields and welders. *“Potential occupational risks for neurodegenerative diseases”*; Park RM, Schulte PA, Bowman JD, Walker JT, Bondy SC, Yost MG, Touchstone JA, Dosemeci M.; Education and Information Division, National Institute for Occupational Safety and Health, MS C-15, 4676 Columbia Parkway, Cincinnati, OH 45226, USA.; *Am J Ind Med.* **2005 Jul**;48(1):63-77 [96]

Epidemiology

<i>Parkinsons, ALS</i>	<i>electrical exposur</i>	<i>worker population</i>
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43) A Colorado State study evaluated relation between deaths from certain neurodegenerative diseases and electrical occupations. The study used a 3 tiered method of magnetic field exposures based on a job-exposure matrix. The study observed a positive association for Parkinson’s disease – odds ratio of 1.5. ALS (Lou Gehrig’s) disease was associated with electrical occupations, but not with magnetic field exposure – odds ratio of 2.3. No consistent associations with magnetic fields were observed for Alzheimer’s disease. *“Occupational exposure to magnetic fields in case-referent studies of neurodegenerative diseases.”*; Noonan CW, Reif JS, Yost M, Touchstone J.; Department of Environmental Health, Colorado State University, **United States.**; *Scand J Work Environ Health.* **2002 Feb**;28(1):42-8 [95]

Epidemiology

<i>Alzheimers, ALS</i>	<i>ELF electrical exposur</i>	<i>worker population</i>
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44) A Swedish epidemiological study evaluated the relation between extremely low frequency magnetic fields (ELF – powerline frequency) from occupational exposures and mortality from neurodegenerative diseases. The study found an increased risk of Alzheimer’s and ALS but no evidence of risk was seen for Parkinson’s disease or multiple sclerosis. *“Neurodegenerative diseases in welders and other workers exposed to high levels of magnetic fields”*; Hakansson N, Gustavsson P, Johansen C, Floderus B.; Institute of Environmental Medicine, Karolinska Institutet, Stockholm, **Sweden.**; Institute of Environmental Medicine, Karolinska Institutet, Stockholm, **Sweden.** [97]

Plants and Wildlife

In Vitro

Plant chlorophyll affected	in lab RF frequency	plant leaves
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45) Chlorophylls were studied in the leaves of black locust (*Robinia pseudoacacia* L.) seedlings exposed to electromagnetic fields of low power density 400 MHz frequencies. Chlorophyll levels decreased for 1, 3 and 8 hour exposure times for 3 weeks, and were enhanced for 2 hour exposure times.

A preliminary study on ultra high frequency electromagnetic fields effect on black locust chlorophylls; Sandu DD, Goiceanu IC, Ispas A, Creanga I, Miclaus S, Creanga DE.

Faculty of Physics, "Al I Cuza" University, 6600 Iasi.; *Acta Biol Hung.* **2005**;56(1-2):109-17, **Hungary** [101]

Reviews of the Scientific Literature on RF/MW

View Point

The authors in this review of the scientific literature claim that the connection between RF radiation and adverse health effects is limited. However, they admit that there is a lack of RF studies examining the long term, low level effects of this radiation on health. They call for more of these types of studies to truly understand correlation of long term exposure.

"Health risks of electromagnetic fields. Part II: Evaluation and assessment of radio frequency radiation"; Habash RW, Brodsky LM, Leiss W, Krewski D, Repacholi M.; McLaughlin Centre for Population Health Risk Assessment, Institute of Population Health, University of Ottawa, Ottawa, Ontario, **Canada**; *Jrnl - Crit Rev Biomed Eng.* **2003**;31(3):197-254. [11]

View Point

This paper gives an overview of present scientific knowledge in health research at RF/MW levels to which the general population is typically exposed. The paper claims that long term studies suffer from weak methodologies and are few in number, however the authors support the validity of laboratory human experimental, short term exposure studies which reveal demonstrated biological changes by RF/MW radiation. The authors of this paper conclude "because of the present fragmentary scientific database, a **precautionary approach** when dealing with radio and microwave frequency radiation is recommended for the individual and the general population".

[Article in German] *"Radio and microwave frequency radiation and health--an analysis of the literature"*; Roosli M, Rapp R, Braun-Fahrlander C.; Institut fur Sozial- und Praventivmedizin der Universitat Basel, **Switzerland**.; *Jrnl - Gesundheitswesen.* **2003** Jun;65(6):378-92 [16]

View Point

The article presents new literature on the biological effects of RF electromagnetic fields, and explains the cellular and biological interactions occurring during RF/MW exposures.

[Abstract does not go into great detail about what they found – need the complete study]

"Biologic effects and health consequences of low and high (radio) frequency electromagnetic fields."; Srebro Z, Dziobek K.; *Folia Med Cracov.* **2003**;44(1-2):201-5., **Poland** [33]

View Point

The article discusses the lack of knowledge by the medical profession in recognizing RF/MicroWave radiation overexposure symptoms, and points out how to identify those symptoms based on today's standards. [Abstract does not point out the identifying markers] .*"Medical aspects of radiofrequency radiation overexposure"*; *Health Phys* **2002** Mar;82(3):387-91, **USA** [51]

View Point

The article is critical of current national and international measurement parameters used to establish safety standards for EMFs from all frequency ranges. It believes the use of SARs (specific absorption rates) is a deficient measurement parameter. The authors support the use of parameters that identify electromagnetic interaction with different cellular functions such as DNA responses.

“*Comment: a biological guide for electromagnetic safety: the stress response.*”; Blank M, Goodman R ; Department of Physiology, Columbia University, New York, New York 10032, USA. ; Jnl – Bioelectromagnetics. **2004 Dec**;25(8):642-6; discussion 647-8. [55]

View Point

A scientist who tends to side with industry, believes more studies are needed to validate various past epidemiological and cellular studies that find links between cancer and cellular damage by EM Radiation from RF/ and Microwave frequencies. This is a different stance from that taken by industry scientists who announced in 2004 that there is no effect from electro magnetic radiation at current wireless communication levels.

“*Mobile phones, mobile phone base stations and cancer: a review.*”; Moulder JE, Foster KR, Erdreich LS, McNamee JP. ; Radiation Oncology, Medical College of Wisconsin, Milwaukee, WI 53226, USA.; Jnl - Int J Radiat Biol. **2005 Mar**;81(3):189-203 [53]

View Point

A spokesman for the larger military/industrial scientific RF/MW community demonstrates a reversal and admits that research on man has been limited to thermal reactions by RF/MW radiation. More research is needed examining human perception from a variety of RF parameters. “*Behavioral and cognitive effects of microwave exposure*”; D'Andrea JA, Adair ER, de Lorge JO; Naval Health Research Center Detachment, Brooks City-Base, Texas, USA Bioelectromagnetics. **2003**; Suppl 6:S39-62.[69]

Hypothesis

The paper demonstrates inadequacy of RF/MW observation-criteria in lab sleep study procedures. RF/MW lab research is limited to single-channel frequencies procedures rather than real world RF broadband exposures. Results also show that simple sleep monitoring systems based on single-channel EEG analysis, without access to the brain's original biosignals, are not adequate for sleep studies. [Article in German]

“*Investigation of sleep disorders in the vicinity of high frequency transmitters*”; Leitgeb N, Schrottner J, Cech R, Kerbl R.; Institut für Krankenhaustechnik, Technische Universität Graz.; Jnl - Biomed Tech Berlin, Germany. **2004 Aug**;49(7-8):186-93. [18]