SELECTED STUDIES ON

ELECTROSENSITIVITY (ES) AND

ELECTROMAGNETIC HYPER-SENSITIVITY (EHS)

4th edition (March 26th 2018)

with over 2,000 studies and references.

- *There are many thousands of peer-reviewed studies relevant to ES/EHS.*
- *This limited selection of over 2,000 studies and references aims to provide an indication of the wide range of studies and references available.*
- *This selection does not attempt to give the earliest or most recent studies on any topic.*
- *This selection concentrates on positive studies which indicate the range of relevant evidence.*
- *Some studies and references appear under two or more headings where these are relevant.*

CONTENTS

(32) *Calcium flux, VGCC, cell membrane permeability, phospholipids*
(33) *Cancers, immunodeficiency*
(34) *Cardiovascular effects and cerebral blood flow, hypoperfusion*
(35) *Cell apoptosis*
(36) *Cell proliferation*
(37) *Cellular membrane*
(38) *Central nervous system tumours*
(39) *Chemical sensitivities and electrosensitivity*
(40) *Chondrogenesis*
(41) *Chromosomal alterations*
(42) *Chronic Fatigue Syndrome, ME*
(43) *Cilia, primary cilia, sensory cilia, intracellular calcium signalling*
(44) *Coherence*
(45) *Colon cancer*
(46) *Connexins, gap junction transmembrane proteins*
(47) *Cortisol changed*
(48) *Cryptochromes, radical pairs*
(49) *Dehydration*
(50) *Differences in EHS subjects*
(51) *DNA damage*
(52) *Dopamine*
(53) *Duration of exposure: protective or adverse*
(54) *Electroanaesthania*
(55) *Electrokinesis, mechanoelectrical transduction, piezoelectric, tectorial membrane*
(56) *Electroreception, electrosensory organs, ampullae of Lorenzini*
(57) *Electrotaxis, galvanotaxis*
(58) *Encephalomyelitis*
(59) *Endocrine system*
(60) *Endogenous electric currents*
(61) *Entanglement*
(62) *Enzyme effects, lysozyme, calcineurin*
(63) *Epidermal growth factor receptor (EGFR)*
(64) *Epigenetic effects*
(65) *Erythrocyte changes, echinocytes*
(66) *Estrogen beta receptors*
(67) *Fertility reduced: (i) Female (ii) Male and female birth ratio (iii) Male (iv) Sterility*
(68) *Fetal effects, Prenatal Exposure, Embryo survival*
(69) *Fractal mechanisms, scalar*
(70) *GABAA receptor*
(71) *Gender differences*
(72) *Gene expression*
(73) *Genetic variants, DNA sequence variations, polymorphisms*
(74) *Genomic instability, DNA damage, genotoxic, micronuclei*
(75) *Genotoxicity*
(76) *Glioma, glioma cells*
(77) *Glucose metabolism, glucocorticoid receptors, diabetes*
(78) *Glutamate receptors, neuronal signalling, NMDA receptor*
(79) *Glutathione (antioxidant) reduced, oxidative stress*
(80) *Gravielectric effects, gravitation*
(81) *Gut-microbiota-brain axis*
(82) *Heat shock proteins*
(83) *Heavy metals, aluminium, mercury in dental amalgam*
(84) *Hippo singaling pathway*
(85) *Hormesis and biphase effects*
(86) *Hydrogen bonds, water, DNA*
(87) *Hyperbaric oxygen treatment*
(88) *Immune response, lymphocytes*
(89) *Individual and interindividual variability, individual sensitivity*
(90) *Inflammation*
(91) *Insulin levels*
(92) *Integrins, transmembrane receptors, extracellular matrix*
(93) *Ionising radiation*
(94) *Iron, iron binding, ferretin*
(95) *Kidney effects*
(96) *Leukaemia*

		(97) Light, Light Emitting Diodes (LEDs), blue light, light dependent effects (98) Lipid metabolism (99) Lipid peroxidation, visual and somatosensory potentials (100) Liver lipids (101) Lung cancer (102) Lymphocytes, lymphoma cancers (103) Magnesium, deficiency (104) Magnetite (105) Magneto-reception (106) MAPK/ERK signalling pathway (107) Mast cells and histaminemia (108) Melanogenesis (109) Melanoma (110) Melanopsin, EM photo-sensitivity (111) Melatonin reduction, circadian effects (112) Meridians, acupuncture points, endogenous fields (113) Mesenchymal stem cells (114) Metabolic theory and effects (115) Metallic and electric implants (116) Microglial cells, neuroglia, CNS immune system (117) MicroRNA (118) Migraine, headache (119) Millimetre waves, mmW, 30-300 GHz, terahertz, (120) Miscarriage (121) Mitochondrial dysfunction, leading to ROS (122) Muscarinic receptor M1 (123) Muscular activity, extra-cranial, chewing (124) Myelin, demyelination, Multiple Sclerosis (MS) (125) Natural killer cells (126) Nerve conduction, neuromodulation (127) Neurogenesis (128) Neurological effects, neuronal changes, EEG, cognitive function, learning, memory, sleep (129) Neurological effects, muscular, peripheral nervous system (130) Nitric oxide (131) Non-Hodgkin lymphoma, T-cell, follicular lymphoma (132) Non-linear effects, 'windows', partial non-linear, frequency dependency (133) Non-thermal effects (134) Obesity (135) Olfaction (136) Optogenetics, photobiology (137) Oxidative stress, redox state (138) p53, tumour suppressor protein (139) Pancreatic lesions (140) Parametric oscillation, frequency resonance (141) Parkinson's Disease (142) Perception, sensed presence, hypnotisability (143) Phosphates, Posner molecules, quantum entanglement (144) Phospholipid bilayers (145) Phosphorylation, ATP, magnesium and calcium dependence (146) Photobiomodulation (PBM), Low Level Laser(Light) Therapy (LLLT) (147) Photo-induced electron transfer, cryptochrome, DNA, magnetoreception, visual stimulation (148) Photons, Biophotons, Photosensitivity (149) Photosynthesis (150) Polarisation (151) Polyamines (152) Potassium, voltage-gated potassium channels (153) Prion, protein misfolding (154) Protein expression, proteome, miRNA (155) Pulses, electrical, laser (156) Purkinje cells, brain effects (157) Radical pairs, Free radicals (158) Reactive oxygen species (ROS), Heat shock proteins (HSP) (159) Resonance signalling, ion cyclotron resonance	

3. Summary: Some key findings, with dates first described

- *Electrosensitivity symptoms from man-made devices were recorded in the late 19th century.*
- *Electromagnetic hyper-sensitivity (EHS) symptoms were described in radio engineers in 1932.*
- *Skin changes in people with EHS were shown in 1994.*
- *Genetic variants were 9.7 times more likely in people with EHS (2014).*
- *Objective tests for diagnosing real physiological EHS were published in 2015.*
- *3d MRI scans showed brain differences in people with EHS in 2017.*

- *Various biological mechanisms and pathways for sensitivity to electromagnetic energy are becoming established. Three have been seen as especially significant.*
  (a) ERK cascade protein expression (2007), within two minutes of RF exposure, inducing transcription and phosphorylation leading to gene expression and long-term potentiation in the glial cells, which has been compared with potentiation in musicians' brains.
  (b) Magnesium (2012), an antioxidant and calcium-blocker, in the form of the isotope ^{25}Mg, has been proposed as having a magnetic effect through the radical pair mechanism or nuclear spin selectivity. Magnesium is linked with enzyme phosphorylation/ATP and downstream neurological effects such as depression and migraines. These consequences could also, however, be associated with electromagnetic effects on VGCCs.
  (c) VGCCs, or voltage-gated calcium channels (2013), are affected by environmental electromagnetic energy. Downstream consequences include excessive oxidative stress, leading to neurological effects, DNA breaks and cancer.
- *Other receptors, mechanisms and pathways include calcineurin, cryptochromes, gene expression, hydrogen bonds, magnetite, mast cell degranulation, melatonin, myelin, primary cilia, stochastic resonance and the sympathetic nervous system.*

- *EHS or 'El-allergy' was recognised in the ICD-10 code of 2000.*
- *Sweden recognised people with EHS as functionally impaired in 2000, later followed by other countries, along with awarding financial compensation for unemployment and disability.*
- *"Certain sensitive individuals" were recognised by WHO/ICNIRP in 2002 as needing long-term non-thermal safety guidelines, lower than ICNIRP's short-term heating-only guidelines.*
- *EUROPAEM 2016 biological guidelines specify safety levels for sensitive people from 2016.*

SUMMARY: ***Some key findings, with dates first described or established***	
Solar EM radiation variations: effects on plants[1]	1801
Solar EM radiation variations: effects on humans[2]	1860s
Solar EM radiation variations: effects on insects[3]	1881
Man-made electromagnetic fields: sensitivity effects on humans[4]	1889

[1] Herschel, Sir William: "XIII. Observations tending to investigate the nature of the sun, in order to find the causes or symptoms of its variable emission of light and heat; with remarks on the use that may possibly be drawn from solar observations" [On the relationship between sunspots and wheat yields] *Phil Trans R Soc Lond.* (1801) Article.

[2] Lamont J, quoted in Chizhevskiy AL "Teoriya geliotaraksii" [The theory of heliotaxis] Moscow (1930), in Kholodov YuA: "The reactions of animals and man to magnetic fields", in Chernigovskiy VN: "The effect of certain space and geophysical factors on the biosphere of the Earth" Problems of Space Geometry. (1973) NASA: TT F-15,158.

[3] Swinton AH: "Locusts and Sun Spots" *Science.* (1881) PMID: 17741741. Article.

[4] Anon. "The telephone as a cause of ear troubles" *BMJ.* (1889) Article.

Non-thermal effects (20 kHz)[5]	1896
Man-made electromagnetic fields: sensitivity in fish[6]	1917
Electromagnetic Sensitivity, Electromagnetic Hyper-Sensitivity (EHS) in humans (RF)[7]	1932
Blood: pearl chain/rouleaux formation[8]	1946
Cataracts[9]	1948
Brain tumours, leukaemia (microwaves)[10]	1953
Solar and geomagnetic effects[11]	1960
Microwave hearing, tinnitus[12]	1961
Cardiovascular effects[13]	1962
Microwave hearing, tinnitus[14]	1962
Electromagnetic Sensitivity symptoms (ELF)[15]	1966
Bone tumours[16]	1968
Blood-brain barrier leakage[17]	1974
Calcium flux[18]	1974

[5] D'Arsonval AC et al.: "Action des courants à haute fréquence sur les toxins bactériennes" *Compt Rend., Acad d Sci.* (1896).

[6] Parker GH et al.: "The response of catfish, Amiurus nebulosus, to metallic and non-metallic rods." Am J Physiol. (1917) Abstract.

[7] Schliephake E: "Arbeitsgebiete auf dem Kurzwellengebiet" ["Fields of the Short-wave region"] *Dtsch Med Wochenschr.* (1932); Czerski P et al: "Przypadek 'choroby mikrofalowej'" [A case of 'Microwave Sickness'] *Medycyna Pracy* (1964), etc.

[8] Teige K, Stary Z (1946) "Aggregation of Red Blood Cells in a Strong Electric Field" Nature. 158(4022): 794; PMID: 20276880; doi:10.1038/158794a0.

[9] Richardson AW et al.: "Experimental Lenticular Opacities Produced by Microwave Irradiations" *Arch Phys Med Rehabil.* (1948) PMID: 18107279.

[10] McLaughlin JT: "A Study of Possible Health Hazards from Exposure to Microwave Radiation" *Hughes Aircraft Copr., Culver City, Calif.* (1953) MS.

[11] Acheson ED et al.: "Some comments on the relationship of the distribution of multiple sclerosis to latitude, solar radiation, and other variables" *Acta Psychiatrica Scand.* (1960) PMID: 13681205. Abstract.

[12] Frey AH: "Auditory system response to radio frequency energy: Technical Note" *Aerospace Med.* (1961) PMID: 13895080; pdf.

[13] Presman AS et al.: "Non-thermal effect of microwaves on the rhythm of cardiac contractions in animals. II. Studies on the effect of pulsed microwaves" *Biull Eksp Biol Med*. (1962) Russian. PMID: 14488637 (trans. Wright Patterson Air Force Base, Ohio, USA, June 21 1962, FTD-TT-62-501/1 + 2, AD 283882).

[14] Frey AH: "Human auditory system response to modulated electromagnetic energy" *J Appl Physiol*(1962)PMID: 13895081.

[15] Asanova TP et al.: "Health Conditions of Workers Exposed to an Electrical Field of 400-500 Kilovolt Open Distributing Installations" *Soviet Biotechnology and Bioastronautics.* (1966) Translation (1969). Copy.

[16] McElhaney JH et al.: "Electric fields and bone loss of disuse" *J Biomech.* (1968) PMID: 16329309.

[17] Frey AH: "Differential biologic effects of pulsed and continuous electromagnetic fields and mechanisms of effect" *Ann N Y Acad Sci.*(1974) PMID: 4613239.

[18] Kaczmarek LK et al.: "Weak electric gradients change ionic and transmitter fluxes in cortex" *Brain Res.* (1974) abstract; Bawin SM et al.: "Sensitivity of calcium binding in cerebral tissue to weak environmental electric fields oscillating at low frequency" *Proc Natl Acad Sci U S A.* (1976) PMID: 1064869; pdf.

Non-linear effects, 'Windows' effects[19]	1977
Leukaemia, childhood (power lines)[20]	1979
Depression, suicide[21]	1979
Fetal damage (microwaves)[22]	1981
Melatonin reduced[23]	1981
Breast cancer, female (power lines)[24]	1982
Skin cancer (microwaves)[25]	1982
Leukaemia, adult[26]	1982
Leukaemia, acute myeloid[27]	1982
Cancer (microwaves)[28]	1984
DNA synthesis, from time-varying magnetic fields[29]	1984
Glutathione (antioxidant) reduced[30]	1985
Amyotrophic lateral sclerosis (ALS), Motor Neuron Disease, Lou Gehrig's disease[31]	1986
Behavioural changes, from non-thermal static and time-varying magnetic fields[32]	1986

[19] Bawin SM et al.: "Possible mechanisms of weak electromagnetic field coupling in brain tissue", pages 75-86; in Taylor LS et al.: *The Physical Basis of Electromagnetic Interactions with Biological Systems* (The Office of Naval Research) (1977) Article.

[20] Wertheimer N et al: "Electrical wiring configurations and childhood cancer" *Am J Epidemiol.* (1979) PMID: 453167.

[21] Reichmanis M et al: "Relation between suicide and the electromagnetic field of overhead power lines" *Physiol Chem Phys.*(1979) PMID: 542502.

[22] Nawrot PS et al.: "Effects of 2.45 GHz CW microwave radiation on embryofetal development in mice" *Teratology.* (1981) PMID: 7330780.

[23] Wilson BW et al.: "Chronic exposure to 60-Hz electric fields: effects on pineal function in the rat" *Bioelectromagnetics.* (1981) PMID: 7326058.

[24] Wertheimer N et al.: "Adult cancer related to electrical wires near the home" *Int J Epidemiol.* (1982) PMID: 7152787.

[25] Szmigielski S et al.: "Accelerated development of spontaneous and benzopyrene-induced skin cancer in mice exposedto 2450-MHz microwave radiation" *Bioelectromagnetics.* (1982) PMID: 7126270. Abstract.
Szudziński A et al.: "Acceleration of the development of benzopyrene-induced skin cancer in mice by microwave radiation" *Arch Dermatol Res.* (1982) PMID: 6299207.

[26] Milham S Jr "Mortality from leukemia in workers exposed to electrical and magnetic fields" *N Engl J Med.* (1982) PMID: 7088076; abstract.

[27] Wright WE et al.: "Leukaemia in workers exposed to electrical and magnetic fields" *Lancet.* (1982) PMID: 6128476.

[28] Guy AW (1984) Study Findings (presented by Chou CK, Kunz L at the Bioelectromagnetics Society (BEMS) Conference, Atlanta, July 1984) Bioelectromagnetics Research Laboratory, University of Washington School of Medicine, Seattle; sponsored by the U.S. Air Force ["Microwaves Promote Cancer" Microwave News, July/August 1984, iv(6): 1, 4-5.]; published as: Chou CK, Guy AW, Kunz LL, Johnson RB, Crowley JJ, Krupp JH (1992) "Long-term, low-level microwave irradiation of rats" Bioelectromagnetics. 13(6): 469-496; PMID: 1482413. Article. The experiments, in 1980-82, at a SAR of 0.15 - 0.4 W/kg (below 1998 ICNIRP heating safety guidelines) at 2.45 GHz (Wifi carrier frequency) for daily for 25 months, showed a statistically significant increase of primary malignancies of nearly 4 times compared with controls.

[29] Liboff AR et al.: "Time-varying magnetic fields: effect on DNA synthesis" *Science.* (1984) PMID: 6695183.

[30] Bernat R: "Glutathione concentration and peptidase activity in the lens after exposure to microwaves" *Acta Physiol Pol.* (1985) PMID: 3837605.

[31] Deapen DM et al.: "A case-control study of amyotrophic lateral sclerosis" *Am J Epidemiol.* (1986) PMID: 3962963.

[32] Thomas JR et al.: "Low-intensity magnetic fields alter operant behavior in rats" *Bioelectromagnetics.* (1986) PMID: 3801058.

Breast cancer (male)[33]	1990
Brain tumours, glioblastoma[34]	1991
Calcium-dependent phosphorylation[35]	1991
Mast cell degranulation[36]	1994
DNA damage[37]	1994
DNA damage[38]	1995
Stochastic resonance, voltage-dependent ion channels[39]	1995
Grounding and earthing health effects[40]	2000
EHS: ICD-10 "El-Allergy"[41]; EHS: functional impairment (Sweden)	2000
Power frequency classified as 2B human carcinogen[42]	2001
"Certain sensitive individuals" recognised by WHO/ICNIRP[43]	2002
Magnesium-dependent phosphorylation in enzymes[44]	2004
ERK cascade of protein expression as signalling mechanism[45]	2007
Alzheimer's disease[46]	2009
Brain tumours, glioma etc., from mobile phones[47]	2009

[33] Tynes T et al.: "Electromagnetic fields and male breast cancer" *Lancet.* (1990) PMID: 1979420.

[34] Törnqvist S et al.: "Incidence of leukaemia and brain tumours in some "electrical occupations"" *Br J Ind Med.* (1991) PMID: 1911402.

[35] Shuvalova LA et al.: "Weak Magnetic Field Influence on the Speed of Calmodulin Dependent Phosphorylation of Myosin in Solution" Dokladi Academy of Science USSR, (1991).

[36] Johansson O et al.: "Skin changes in patients claiming to suffer from "screen dermatitis": a two-case open-field provocation study" *Exp Dermatol.* (1994) PMID: 7881769.

[37] Sarkar S et al.: "Effect of low power microwave on the mouse genome: a direct DNA analysis" *Mutat Res.* (1994) PMID: 7506381.

[38] Lai H et al.: "Acute low-intensity microwave exposure increases DNA single-strand breaks in rat brain cells" *Bioelectromagnetics.* (1995) PMID: 7677797.

[39] Bezrukov SM et al.: "Noise-induced enhancement of signal transduction across voltage-dependent ion channels" *Nature.* (1995) PMID: 7477370.

[40] Ober AC: "Grounding the human body to neutralize bio-electrical stress from static electricity and EMFs" *Energ Sustain Dev J.* (2000) Article.

[41] Nordic Council of Ministers: "The Nordic Adaptation of Classification of Occupationally Related Disorders (Diseases and Symptoms) to ICD-10" (2000) pdf; p.33 (ICD-10.R68.8), p.55.

[42] International Agency for Research on Cancer (IARC), World Health Organization (WHO): "Non-Ionizing Radiation, Part 1: Static and ELF Electric and Magnetic Fields" *IARC Monographs on the Evaluation of Carcinogenic Risks to Humans.* 80 (2002).

[43] ICNIRP: "General approach to protection against non-ionizing radiation" *Health Phys.* (2002) PMID: 11906144.

[44] Buchachenko AL et al.: "Dependence of mitochondrial ATP synthesis on the nuclear magnetic moment of magnesium ions" *Dokl Biochem Biophys.* (2004) PMID: 15378926.

[45] Friedman J at al.: (2007) "Mechanism of short-term ERK activation by electromagnetic fields at mobile phone frequencies" *Biochem J.* (2007) PMID: 17456048; pdf.

[46] Huss A et al: "Residence near power lines and mortality from neurodegenerative diseases: longitudinal study of the Swiss population" *Am J Epidemiol.*(2009) PMID: 18990717.

[47] Hardell L et al: "Epidemiological evidence for an association between use of wireless phones and tumor diseases" *Pathophysiology* (2009) PMID: 19268551.

Radio frequency classified as 2B human carcinogen[48]	2011
Magnetic effects on enzymatic synthesis by magnesium nuclear spin, publicised[49]	2012
Safety levels for children (Bioinitiative, 2012)[50]	2012
VGCCs mechanism, accepted[51]	2013
Genetic variants associated with EHS[52]	2014
Oxidative stress mechanism, accepted[53]	2015
Objective tests for diagnosing EHS[54]	2015
Tumour promotion[55]	2015
Safety levels for sensitive people (EUROPAEM 2016)[56]	2016
Primary cilia sensitivity[57]	2017
3d fMRI scans show brain differences in people with EHS[58]	2017
Autoimmune disease affected by electrosmog; Vitamin-D receptors[59]	2017
Large study confirming RF (mobile phones) as a carcinogen[60]	2018

[48] International Agency for Research on Cancer (IARC), World Health Organization (WHO): "IARC Classifies radiofrequency electromagnetic fields as possibly carcinogenic to humans" Press Release no. 208 (2011); pdf (2013).

[49] Hore PJ: "Are biochemical reactions affected by weak magnetic fields?" *Proc Natl Acad Sci U S A.* (2012) PMID: 22307585; pdf.

[50] Bioinitiative (2012) Conclusions.

[51] Pall ML: "Electromagnetic fields act via activation of voltage-gated calcium channels to produce beneficial or adverse effects" *J Cell Mol Med.* (2013) PMID: 23802593.

[52] De Luca C et al: "Metabolic and genetic screening of electromagnetic hypersensitivity subjects as a feasible tool for diagnostics and intervention" *Mediators Inflamm.* (2014) PMID: 24812443; pdf.

[53] Yakymenko I et al: "Oxidative mechanisms of biological activity of low-intensity radiofrequency radiation" *Electromagn Biol Med.* (2015) PMID: 26151230.

[54] Belpomme D et al: "Reliable disease biomarkers characterizing and identifying electrohypersensitivity and multiple chemical sensitivity as two etiopathogenic aspects of a unique pathological disorder" *Rev Environ Health* (2015) PMID: 26613326; pdf.

[55] Lerchl A et al: "Tumor promotion by exposure to radiofrequency electromagnetic fields below exposure limits for humans" *Biochem Biophys Res Commun.* (2015) PMID: 25749340;
Sofftitti M et al: "Life-span exposure to sinusoidal-50 Hz magnetic field and acute low-dose γ radiation induce carcinogenic effects in Sprague-Dawley rats" *Int J Radiat Biol* (2016) PMID: 26894944.

[56] Belyaev I et al.: "EUROPAEM EMF Guideline 2016 for the prevention, diagnosis and treatment of EMF-related health problems and illnesses" *Rev Environ Health* (2016) PMID: 27454111. Article. Table 3; Table 4.

[57] Cai S et al.: "Primary cilia are sensors of electrical field stimulation to induce osteogenesis of human adipose-derived stem cells" *FASEB J.* (2017) PMID: 27825103.

[58] Heuser G et al.: "Functional brain MRI in patients complaining of electrohypersensitivity after long term exposure to electromagnetic fields" *Rev Environ Health.* (2017) PMID: 28678737; pdf. Heuser G et al.: "Corrigendum" *Rev Environ Health.* (2017) PMID: 29206645.

[59] Marshall TG et al.: "Electrosmog and autoimmune disease" *Immunol Res.* (2017) PMID: 27412293. Article.

[60] Hardell L et al.: "Comment on NTP study" (2018) Article.
Lin JC: "Potential Game Changer for Mobile-Phone Radio-Frequency Radiation Carcinogenesis" *Rad Sci Bull. IEEE.* (2016); pdf.

Large study confirming RF (phone masts) as a carcinogen[61]	2018

[61] Falcioni L et al.: "Report of final results regarding brain and heart tumors in Sprague-Dawley rats exposed from prenatal life until natural death to mobile phone radiofrequency field representative of a 1.8 GHz GSM base station environmental emission" *Environ Res.* (2018) PMID: 29530389. Article.

2. Some key studies and reviews

(useful introductory or general studies)*

- Aschermann C: "Electrosensitivity: A patient with Burn-like Skin Manifestations" *Umwelt-Medizin-Gesellschaft.*(2011) Article (trans).
- *Belpomme D et al: "Reliable disease biomarkers characterizing and identifying electrohypersensitivity and multiple chemical sensitivity as two etiopathogenic aspects of a unique pathological disorder" *Rev Environ Health* (2015) PMID: 26613326. Article.
- *Belyaev I et al.: "EUROPAEM EMF Guideline 2016 for the prevention, diagnosis and treatment of EMF-related health problems and illnesses" *Rev Environ Health* (2016) PMID: 27454111. Article.
- *Buchner K et al.: "Changes of Clinically Important Neurotransmitters under the Influence of Modulated RF Fields - A Long-term Study under Real-life Conditions" *Umwelt-Medizin-Gesellschaft* (2011) Article.
- *Carpenter D (ed.): "Idiopathic environmental intolerance" *Rev Environ Health.* (2015).
- Choy RYS et al.: "Electrical Sensitivities in Allergy Patients" *Clin Ecol.* (1987) Article.
- Dahmen N et al.: "Blood laboratory findings in patients suffering from self-perceived electromagnetic hypersensitivity (EHS)" *Bioelectromagnetics.* (2009) PMID: 19259984.
- *De Luca C et al: "Metabolic and genetic screening of electromagnetic hypersensitivity subjects as a feasible tool for diagnostics and intervention" *Mediators Inflamm.* (2014) PMID: 24812443. Article.
- Eger H: ["Causal, Legally Recognized Proof of the Damage Potential of Technical Highfrequency Fields - a Case Report"] *Umwelt-Medizin-Gesellschaft* (2014) abstract.
- *Eger H et al.: "Specific Health Symptoms and Cell Phone Radiation in Selbitz, Bavaria, Germany: Evidence of a Dose-Response Relationship" *Um Medizin Gesellschaft* (2010) Article (trans).
- *Genuis SJ et al.: "Electromagnetic hypersensitivity: fact or fiction?" *Sci Tot Env.* (2012) PMID: 22153604. Article.
- Gibson PR: "Introduction to the Special Issue on Environmental Sensitivities: Living on the Margins with Access Denied" *Ecopsychology.* (2017) link.
- *Gibson PR et al.: "Unmet health care needs for persons with environmental sensitivity" *J Multidiscip Healthc.* (2015) PMID: 25670904. Article.
- Griesz-Brisson M: "Electrosensitivity from a neurological point of view" *Neuorepidemiology* (2013) 41: 275, no.227 (page 275).
- *Havas M et al.: "Dirty electricity and electromagnetic hypersensitivity: five case studies" *World Health Organization Workshop on Electrical Hypersensitivity, Prague* (2004) Article.
- *Healer J: "Review of studies of people occupationally exposed to radio-frequency radiations" (in: Cleary SF "Biological Effects … of Microwave Radiation" (1969) BRH/DBE 70-02: 90-97).
- *Hedendahl L et al.: "Electromagnetic hypersensitivity - an increasing challenge to the medical profession" *Rev Environ Health* (2015) PMID: 26372109. Article.
- *Heuser G et al.: "Functional brain MRI in patients complaining of electrohypersensitivity after long term exposure to electromagnetic fields" *Rev Environ Health.* (2017) PMID: 28678737. Article. Heuser G et al.: "Corrigendum" *Rev Environ Health.* (2017) PMID: 29206645.
- Hocking B "Preliminary report: symptoms associated with mobile phone use" *Occup Med (Lond).* (1998) PMID: 10024730. Article.
- *Hocking B: "Microwave sickness: a reappraisal" *Occ Med (Lond).* (2001) PMID: 11235831. Article.
- *Johansson O: "Electrohypersensitivity: a functional impairment due to an inaccessible environment" *Rev Environ Health* (2015) PMID: 26613327; Article.
- *Kaszuba-Zwolińska J et al.: "Electromagnetic field induced biological effects in humans" *Przegl Lek.* (2015) Review. PMID: 27012122. Article.

- *Levallois P et al.: "Study of self-reported hypersensitivity to electromagnetic fields in California" *Environ Health Perspect.* (2002) PMID: 12194896; article.
- Mueller CH et al.: "Project NEMESIS: perception of a 50 Hz electric and magnetic field at low intensities (laboratory experiment)" *Bioelectromagnetics.* (2002) PMID: 11793403.
- *Navarro E et al.: "The Microwave Syndrome: A preliminary study in Spain" *Electromagn Biol Med.* (2003); article.
- *Oberfeld G et al.: "The Microwave Syndrome: Further Aspects of a Spanish Study" (2002). Article.
- Pall ML: "How to Approach the Challenge of Minimizing Non-Thermal Health Effects of Microwave Radiation from Electrical Devices" *Int J Innovat Res Engin Management (IJIREM).* (2015) Article.
- Pall ML: "Microwave frequency electromagnetic fields (EMFs) produce widespread neuropsychiatric effects including depression" *J Chem Neuroanat.* (2015) PMID: 26300312.
- Redmayne M et al: "Radiofrequency exposure in young and old: different sensitivities in light of age-relevant natural differences" *Rev Environ Health* (2015) PMID: 26613328.
- Saravanamuttu S et al.: "A Survey on the Impact of RF-EMF from Wireless Devices on Information Technology Professionals" *Europ J Exper Biol.* (2016) Article.
- *Schilling CJ: "Effects of acute exposure to ultrahigh radiofrequency radiation on three antenna engineers" *Occup Environ Med.* (1997) PMID: 9166136. Article.
- Smith CW: "Nursing the electrically-sensitive patient" *Com Ther Nurs Midw.* (1997) 9439262.
- Tresidder A et al.: "Electrosensitivity: Sources, Symptoms, and Solutions" in Rosch PJ (ed.) *Bioelectromagnetic and Subtle Energy Medicine*; CRC Press, (2014) 2nd ed.: 567-585.
- *Tuengler A et al.: "Hypothesis on how to measure electromagnetic hypersensitivity" *Electromagn.Biol. Med.* (2013) PMID: 23301924. Article.

3. Specific ES/EHS symptoms and EM effects from man-made environmental radiation

- *Specific symptoms caused by intolerance of low-level electromagnetic exposure have been reported since the end of the 19th century. They have been confirmed as consistent since the discovery of the condition of hyper-sensitivity in 1932.*
- *These specific symptoms are caused by a wide range of EM exposures. Most modern radiation devices like mobile phones and WiFi have both low and microwave frequencies, each producing symptoms.*
- *These specific symptoms are present both among people in the general population, and among people who have been diagnosed with hyper-sensitivity.*
- *In most populations the proportion of people in the general population reporting specific symptoms associated with low-level electromagnetic exposure is often 30-40%.*
- *In most surveys the proportion of people with hyper-sensitivity reporting these specific symptoms associated with low-level electromagnetic exposure is about 3-4%.*

(a) Specific symptoms: prevalence, related intolerances, etc.

- Carpenter DO: "Excessive exposure to radiofrequency electromagnetic fields may cause the development of electrohypersensitivity" *Altern Ther Health Med.* (2014) Research Gate; PMID: 25478802.
- Eltiti S et al.: "Development and evaluation of the electromagnetic hypersensitivity questionnaire" *Bioelectromagnetics.* (2007) PMID: 17013888. Article.
- Hallberg O et al.: "Letter to the editor: will we all become electrosensitive?" *Electromagn Biol Med.* (2006) PMID: 16954121. Article.
- Hojo S et al.: "Development and evaluation of an electromagnetic hypersensitivity questionnaire for Japanese people" *Bioelectromagnetics.* (2016) PMID: 27324106.
- Karvala K et al.: "Prevalence of various environmental intolerances in a Swedish and Finnish general population" *Environ Res.* (2018) PMID: 29161654.
- Kato Y et al.: "Reported functional impairments of electrohypersensitive Japanese: A questionnaire survey" *Pathophysiology.* (2012) PMID: 22458999.
- Levallois P et al.: "Study of self-reported hypersensitivity to electromagnetic fields in California" *Environ Health Perspect.* (2002) PMID: 12194896; article.
- Liboff AR: "The electromagnetic basis of social interactions" *Electromagn Biol Med.* (2017) PMID: 27786565.
- Nordin M et al.: "Sleep and sleepiness in environmental intolerances: a population-based study" *Sleep Med.* (2016) PMID: 27810173.
- Palmquist E et al.: "Overlap in prevalence between various types of environmental intolerance" *Int J Hyg Environ Health.* (2014) PMID: 24029726.
- Sage C: "The implications of non-linear biological oscillations on human electrophysiology for electrohypersensitivity (EHS) and multiple chemical sensitivity (MCS)" *Rev Environ Health.* (2015) PMID: 26368042.
- Schreier N et al.: "The prevalence of symptoms attributed to electromagnetic field exposure: a cross-sectional representative survey in Switzerland" *Soz Praventivmed.* (2006) PMID: 17193782.
- Thomas S et al.: "Exposure to radio-frequency electromagnetic fields and behavioural problems in Bavarian children and adolescents" *Eur J Epidemiol.* (2010) PMID: 19960235.
- Vuokko A et al.: "Environmental Intolerance, Symptoms and Disability Among Fertile-Aged Women" *Int J Environ Res Public Health.* (2018) PMID: 29419757.

(b) 5G, millimetre waves

- Di Ciaula A: "Towards 5G communication systems: Are there health implications?" *Int J Hyg Environ Health.* (2018) PMID: 29402696.

- Pakhomov AG et al.: "Current state and implications of research on biological effects of millimeter waves: a review of the literature" *Bioelectromagnetics.* (1998) PMID: 9771583. Article. Includesdetails for sensitivity and hyper-sensitivity, from:
    - Afanas'eva TN et al.: "Side effects of the EHF-therapy for essential hypertension" in: *11th Russian Symposium: 'Millimeter Waves in Medicine and Biology'* (1997).
    - Golovacheva TV: "EHF therapy in complex treatment of cardiovascular diseases" in:*10th Russian Symposium: 'Millimeter Waves in Medicine and Biology"* (1995).
    - Lebedeva NN: "Sensor and subsensor reactions of a healthy man to peripheral effects of low-intensity millimeter waves" *Millimetrovie Volni v Biologii i Meditcine.* (1993).
    - Lebedeva NN: "Neurophysiological mechanisms of biological effects of peripheral action of low-intensity nonionizing electromagnetic fields in humans" in:*10th Russian Symposium: 'Millimeter Waves in Medicine and Biology"* (1995).

(c) Base Stations, Mobile Phone/Radio/TV Masts, Electromagnetic Pollution

- Abdel-Rassoul G et al.: "Neurobehavioral effects among inhabitants around mobile phone base stations" *Neurotoxicology.* (2007) PMID: 16962663.
- Adebayo EA et al.: "Effect of radiofrequency radiation from telecommunication base stations on microbial diversity and antibiotic resistance" *J Appl Sci Environ Manage.* (2014) abstract. Article.
- Al-Quzwini O et al.: "Male fertility and its association with occupational and mobile phone towers hazards: An analytic study" *Middle East Fertility Soc J.* (2016) Article.
- Aschermann C: "Electrosensitivity: A patient with Burn-like Skin Manifestations" *Umwelt-Medizin-Gesellschaft.*(2011) Article (trans).
- Aschermann C: "Observations from a Psychotherapy Practice on Mobile Telecommunications and DECT Telephones" *Umwelt-Medizin-Gesellschaft.* (2004; rev. 2009) Article (trans).
- Aschermann C: "Personality changes caused by mobile telecommunications" *Umwelt-Medizin-Gesellschaft.* (2010) Article (trans).
- Bise W: "Low power radio-frequency and microwave effects on human electroencephalogram and behaviour" *Physiol Chem Phys.* (1978) PMID: 751078.
- Blettner N et al.: "Mobile phone base stations and adverse health effects: phase 1 of a population-based, cross-sectional study in Germany" *Occup Environ Med.* (2009) PMID: 19017702.
- Borkiewicz A et al.: "Subjective symptoms reported by people living in the vicinity of cellular phone base stations: review" (Polish) *Med Pr.* (2004) PMID: 15620045.
- Bortkiewicz A et al.: "Heart rate variability (HRV) analysis in radio and TV broadcasting stations workers" *Int J Occup Med Environ Health.* (2012) PMID: 23224733.
- Boscolo P et al.: "Effects of electromagnetic fields produced by radiotelevision broadcasting stations on the immune system of women" *Sci Total Environ.* (2001) PMID: 11419593.
- Buchner K et al.: "Changes of Clinically Important Neurotransmitters under the Influence of Modulated RF Fields - A Long-term Study under Real-life Conditions" *Umwelt-Medizin-Gesellschaft* (2011) (copy).
- Chandran M et al.: "A survey on the impact of radiation emitted by the cell phone tower on human subjects" *Int J LifeSc Biotechn Pharm Res.* (2012) Article.
- Dode AC et al.: "Mortality by neoplasia and cellular telephone base stations in the Belo Horizonte municipality, Minas Gerais state, Brazil" *Sci Total Environ.* (2011) PMID: 21741680.
- Dolk H et al.: "Cancer incidence near radio and television transmitters in Great Britain. I. Sutton Coldfield transmitter" *Am J Epidemiol.* (1997) PMID: 8982016.
- Dolk H et al.: "Cancer incidence near radio and television transmitters in Great Britain. II. All high power transmitters" *Am J Epidemiol.* (1997) PMID: 8982017.
- Eger H et al.: "Einfluss der räumlichen Nähe von Mobilfunksendeanlagen auf die Krebsinzidenz" [Influence of the spatial proximity of mobile radio stations to the incidence of cancer] *Umwelt-Medizin-Gesellschaft.* (2004) summary.
- Eger H et al.: "Specific Health Symptoms and Cell Phone Radiation in Selbitz, Bavaria, Germany - Evidence of a Dose-Response Relationship" *Umwelt Medizin Gesellschaft (2010)* article in trans.

- Eskander EF et al.: "How does long term exposure to base stations and mobile phones affect human hormone profiles?" *Clin Biochem.* (2012) PMID: 22138021.
- Gandhi G et al.: "A cross-sectional case control study on genetic damage in individuals residing in the vicinity of a mobile phone base station" *Electromagn Biol Med.* (2015) PMID: 25006864.
- Ghosh PM et al.: "A Review of the Potential Health Hazards of Radio Frequency Radiation from Cellular Base Station" *Brit J Appl Sci Techn.* (2017) Article.
- Gomez-Perretta C et al: "Subjective symptoms related to GSM radiation from mobile phone base stations: a cross-sectional study" *BMJ Open* (2013) PMID: 24381254. Article.
- Gulati S et al.: "Phenotypic and genotypic characterization of antioxidant enzyme system in human population exposed to radiation from mobile towers" *Mol Cell Biochem.* (2017) PMID: 28819931.
- Hallberg Ö et al.: "Alzheimer mortality - why does it increase so fast in sparsely populated areas?" *Europ Biol Bioelectromag.* (2005) Article.
- Hocking B et al.: "Cancer incidence and mortality and proximity to TV towers" *Med J Aust.* (1996) PMID: 8985435. Article.
- Hocking B et al.: "Decreased survival for childhood leukemia in proximity to television towers" *Arch Environ Health.* (2003) PMID: 15369273.
- Houshyari M et al.: "Incidence of Seminoma Cancer in Staffs that Worked in Electromagnetic Waves Station; Three Cases Report" *Iran J Cancer Prev.* (2015) PMID: 25821575. PMC4360355.
- Huss A et al.: "Environmental Radiofrequency Electromagnetic Fields Exposure at Home, Mobile and Cordless Phone Use, and Sleep Problems in 7-Year-Old Children" *PLoS One.* (2015) PMID: 26509676.
- Hutter H et al.: "Subjective symptoms, sleeping problems, and cognitive performance in subjects living near mobile phone base stations" *Occup Environ Med.* (2006) PMID: 16621850.
- Huttunen P et al.: "Involuntary human hand movements due to FM radio waves in a moving van" *Acta Physiol Hung.* (2011) PMID: 21616774.
- Johnson Liakouris AG: "Radiofrequency (RF) Sickness in the Lilienfield Study: an effect of modulated microwaves?" *Arch Environ Health.* (1998) PMID:9814721. Article.
- Khurana VG et al: "Epidemiological evidence for a health risk from mobile phone base stations" *Int J Occup Environ Health* (2010) PMID: 20662418. Article.
- Kolodynski AA, Kolodynska W: "Motor and psychological functions of school children living in the area of the Skrunda Radio Location Station in Latvia" *Sci Total Environ.* (1996) PMID: 8717320.
- Kundi M et al.: "Mobile phone base stations-Effects on wellbeing and health" *Pathophysiology*. (2009) PMID: 19261451.
- Levitt B et al.: "Biological effects from exposure to electromagnetic radiation emitted by cell tower base stations and other antenna arrays" *Environ Rev.* (2010) Article.
- Liu J: "[Hazards of radio frequency magnetic field and their prevention and control]" *Wei Sheng Yan Jiu.* (2002) PMID: 12572370.
- Meo SA et al.: "Association of Exposure to Radio-Frequency Electromagnetic Field Radiation (RF-EMFR) Generated by Mobile Phone Base Stations with Glycated Hemoglobin (HbA1c) and Risk of Type 2 Diabetes Mellitus" *Int J Environ Res Public Health.* (2015) PMID: 26580639. PMC4661664.
- Navarro EA et al.: "The microwave syndrome: a preliminary study in Spain" *Electromagnetic Biol Med.* (2003) Abstract.
- Parsaei H et al.: "A Multilayer Perceptron Neural Network–Based Model for Predicting Subjective Health Symptoms in People Living in the Vicinity of Mobile Phone Base Stations" *Ecopsychology.* (2017) link. Article.
- Preece AW et al.: "Health response of two communities to military antennae in Cyprus" *Occup Environ Med.* (2007) PMID: 17259164.
- Santini R et al.: "Survey study of people living in the vicinity of cellular phone base stations" *Electromagn Biol Med.* (2003) Article.

- Santini R et al.: "Investigation on the health of people living near mobile telephone relay stations: I. Incidence according to distance and sex" *Pathol Biol. (Paris)* (2002) PMID: 12168254.
- Santini R et al.: "Symptoms experienced by people in the vicinity of base stations: II. Incidence of age, duration of exposure, location of subjects in relation to the antennas and other electromagnetic factors" *Pathol Biol.(Paris)* (2003) PMID: 12948762.
- Saravanamuttu S et al.:"Survey of People Living at the Vicinity of Cellualr Base Transmitting Stations in an Urban and Rural Locality" *Int J Curr Res.* (2016) Article.
- Shahbazi-Gahrouei D: "Base Transceiver Station Antennae Exposure and Human Health" *Int J Prev Med.* (2017) PMID: 29114375. PMC5651665.
- Shahbazi-Gahrouei D et al.: "Health effects of living near mobile phone base transceiver station (BTS) antennae: a report from Isfahan, Iran" *Electromagn Biol Med.* (2014) PMID: 23781985.
- Shinjyo T: [Signifikanter Rückgang klinischer Symptome nach Senderabbau – eine Interventionsstudie] "Significant Decrease of Clinical Symptoms after Mobile Phone Base Station Removal –An Intervention Study" *Umwelt-Medizin-Gesellschaft.* (2014) copy.
- Singh K et al.: "Effect of electromagnetic radiations from mobile phone base stations on general health and salivary function" *J Int Soc Prev Community Dent.* (2016) PMID: 27011934.
- Sorgucu U et al.: "Measurement and analysis of electromagnetic pollution generated by GSM-900 mobile phone networks in Erciyes University, Turkey" *Electromagn Biol Med.* (2012) PMID: 22676177.
- Suvorov IM: "[Clinical monitoring in areas of exposure to radiofrequency electromagnetic fields]" *Med Tr Prom Ekol.* (2013) PMID: 23785812.
- Taheri M et al.: "The effect of Base Transceiver Station waves on some immunological and hematological factors in exposed persons" *Hum Antibodies.* (2017) PMID: 27911288.
- Tuysuz B et al.: "Measurement and mapping of the GSM-based electromagnetic pollution in the Black Sea region of Turkey" *Electromagn Biol Med.* (2017) PMID: 27463094.
- Wolf R et al.: "Increased Incidence of Cancer near a Cell-Phone Transmitter Station" *Int J Cancer Prevent.* (2004) article.
- Zinelis SA: "Short-term exposure to mobile phone base station signals" *Environ Health Perspect.* (2008) PMID: 18288295; article.
- Zothansiama et al.: "Impact of radiofrequency radiation on DNA damage and antioxidants in peripheral blood lymphocytes of humans residing in the vicinity of mobile phone base stations" *Electromagn Biol Med.* (2017) PMID: 28777669.
- Zwamborn APM et al.: "Effects of Global Communication System Radio-Frequency Fields on Well-being and Cognitive Functions of Human Subjects with and without Subjective Complaints" *Netherlands Organisation for Applied Scientific Research (TNO)* (2003) Article.

(d) Car electronics

- Buczyński A et al.: "The assessment of oxygen metabolism selected parameters of blood platelets exposed to low frequency magnetic radiation in cars--in vitro studies" *Rocz Akad Med Bialymst.* (2005) PMID: 16119619.
- Lewicka M et al.: "The impact of electromagnetic radiation of different parameters on platelet oxygen metabolism - in vitro studies" *Adv Clin Exp Med.* (2015) PMID: 25923084. Article.

(e) Combined exposures, multiple sources

- Kamali K et al.: "Effects of electromagnetic waves emitted from 3G+wi-fi modems on human semen analysis" *Urologia.* (2017) PMID: 28967061.

(f) Computers, TVs

- Eriksson N et al.: "The psychosocial work environment and skin symptoms among visual display terminal workers: a case referent study" *Int J Epidemiol.* (1997) PMID: 9447405.

- Johansson O et al: "Cutaneous mast cells are altered in normal health volunteers sitting in front of ordinary TVs/PCs - results from open-field provocation experiments" *J Cut Pathol.* (2001) PMID: 11737520.

(g) Conductive plumbing, ground currents

- Wertheimer N et al.: "Childhood cancer in relation to indicators of magnetic fields from ground current sources" *Bioelectromagnetics.* (1995) PMID: 7612030.

(h) Electrical injuries, lightning shock

- Andrews CJ et al.: "Neurological and neuropsychological consequences of electrical and lightning shock: review and theories of causation" *Neural Regen Res.* (2017) PMID: 28616016.; article.
- Duff K et al.: "Electrical injury and lightning injury: a review of their mechanisms and neuropsychological, psychiatric, and neurological sequelae" *Neuropsychol Rev.* (2001) PMID: 11572471.
- Park CH et al.: "Investigation of cognitive circuits using steady-state cerebral blood volume and diffusion tensor imaging in patients with mild cognitive impairment following electrical injury" *Neuroradiology.* (2017) PMID: 28689261.
- van Zomeren AH et al.: "Lightning stroke and neuropsychological impairment: cases and questions" *J Neurol Neurosurg Psychiatry.* (1998) PMID: 9647306. Article.

(i) Electric blankets

- Li DK et al.: "Electric blanket use during pregnancy in relation to the risk of congenital urinary tract anomalies among women with a history of subfertility" *Epidemiology.* (1995) PMID: 8562623.

(j) Fluorescent lights and ground currents

- Milham S: "An off-the-shelf meter for measuring body amperage: A new gold standard for epidemiologic studies?" *Electromagn Biol Med.* (2017) PMID: 28650676. Article.

(k) Intermediate frequency, induction heating hobs

- Kumari K et al.: "Behavioral testing of mice exposed to intermediate frequency magnetic fields indicates mild memory impairment" *PLoS One.* (2017) PMID: 29206232. PMC5714647.

(l) Laptop computers

- Avendaño C et al.: "Use of laptop computers connected to internet through Wi-Fi decreases human sperm motility and increases sperm DNA fragmentation" *Fertil Steril.* (2012) PMID: 22112647.
- Bellieni CV et al.: "Exposure to electromagnetic fields from laptop use of "laptop" computers" *Arch Environ Occup Health.* (2012) PMID: 22315933.
- Mortazavi SA et al.: "The Fundamental Reasons Why Laptop Computers should not be Used on Your Lap" *J Biomed Phys Eng.* (2016) PMID: 28144597. PMC5219578.

(m) LCD, Liquid Crystal Display

- Lewicka M et al.: "Impact of electromagnetic radiation emitted by monitors on changes in the cellular membrane structure and protective antioxidant effect of vitamin A - In vitro study" *Int J Occup Med Environ Health.* (2017) PMID: 28584329.
- Lewicka M et al.: "The effect of electromagnetic radiation emitted by display screens on cell oxygen metabolism - in vitro studies" *Arch Med Sci.* (2015) PMID: 26788099. PMC4697066.

(n) LEDs, Light Emitting Diodes

- Behar-Cohen F et al.: "Light-emitting diodes (LED) for domestic lighting: any risks for the eye?" *Prog Retin Eye Res.* (2011) PMID: 21600300.

- Jaadane I et al.: "Retinal damage induced by commercial light emitting diodes (LEDs)" *Free Radic Biol Med.* (2015) PMID: 25863264.
- Renard G et al.: "[The dangers of blue light: True story!]" *J Fr Ophtalmol.* (2016) PMID: 27039979.
- Shang YM et al.: "Light-emitting-diode induced retinal damage and its wavelength dependency in vivo" *Int J Ophthalmol.* (2017) PMID: 28251076. Article.

(o) Mobile Phones, mobile devices *(see also Prenatal Exposure)*

- Abu Khadra KM et al.: "Evaluation of selected biochemical parameters in the saliva of young males using mobile phones" *Electromagn Biol Med.* (2015) PMID: 24499288.
- Al-Khlaiwi T et al.: "Association of mobile phone radiation with fatigue, headache, dizziness, tension and sleep disturbance in Saudi population" *Saudi Med J.* (2004) PMID: 15195201.
- Arbabi-Kalati F et al.: "Effect of mobile phone usage time on total antioxidant capacity of saliva and salivary immunoglobulin a" *Iran J Public Health.* (2014) PMID: 26005658.
- Baby NM et al.: "The Effect of Electromagnetic Radiation due to Mobile Phone Use on Thyroid Function in Medical Students Studying in a Medical College in South India" *Indian J Endocrinol Metab.* (2017) PMID: 29285437. PMC5729662.
- Bhargav H et al.: "Acute effects of mobile phone radiations on subtle energy levels of teenagers using electrophotonic imaging technique: A randomized controlled study" *Int J Yoga.* (2017) PMID: 28149063.
- Bidabadi E et al.: "Subjective Neurological Symptoms Among Mobile Phone Users" *Caspian J Neurol Sci.* (2015) DOI: 10.18869/acadpub.cjns.1.1.43. Article.
- Cao Z et al.: [Effects of electromagnetic radiation from cellular telephone handsets on symptoms of neurasthenia] *Wei Sheng Yan Jiu.* (2000) PMID: 12520956.
- Carter B et al.: "Association Between Portable Screen-Based Media Device Access or Use and Sleep Outcomes: A Systematic Review and Meta-analysis" *JAMA Pediatr.* (2016) PMID: 27802500. PMC5380441.
- Chahal H et al.: "Availability and night-time use of electronic entertainment and communication devices are associated with short sleep duration and obesity among Canadian children" *Pediatr Obes.* (2013) PMID: 22962067.
- Cheung CH et al.: "Daily touchscreen use in infants and toddlers is associated with reduced sleep and delayed sleep onset" *Sci Rep.* (2017) PMID: 28406474. PMC5390665.
- Chia SE et al.: "Prevalence of headache among hand-held cellular telephone users in Singapore: a community study" *Environ Health Perspect.* (2000) PMID: 11102297. PMC1240163.
- Chiu CT et al: "Mobile phone use and health symptoms in children" *J Formos Med Assoc.* (2014) PMID: 25115529.
- Cho YM et al.: "A cross-sectional study of the association between mobile phone use and symptoms of ill health" *Environ Health Toxicol.* (2016) PMID: 27788568. Article.
- Cho YM et al.: "A follow-up study of the association between mobile phone use and symptoms of ill health" *Environ Health Toxicol.* (2016) PMID: 28111420. PMC5365277.
- Cox RAF et al.: "Cerebral symptoms from mobile telephones" *Occup Enrivon Med.* (2000) PMC1739958. Article.
- Цибулін [Cybuljin] ОС et al.: "Subjective symptoms in young people during prolonged cell phone use" *Bìologìâ ta valeologìâ.* (2016) Abstract. Article.
- Das S et al.: "A study on the effect of prolonged mobile phone use on pure tone audiometry thresholds of medical students of Sikkim" *J Postgrad Med.* (2017) PMID: 28272071. PMC5664865.
- Deniz OG et al.: "Effects of short and long term electromagnetic fields exposure on the human hippocampus" *J Microsc Ultrastruct.* (2017) Abstract. Article.
- Desai NR et al.: "Pathophysiology of cell phone radiation: oxidative stress and carcinogenesis with focus on male reproductive system" *Reprod Biol Endocrinol.* (2009) PMID: 19849853. Article.

- Dube N et al.: "The use of entertainment and communication technologies before sleep could affect sleep and weight status: a population-based study among children" *Int J Behav Nutr Phys Act.* (2017) PMID: 28724380. PMC5517950.
- Durusoy R et al.: "Mobile phone use, school electromagnetic field levels and related symptoms: a cross-sectional survey among 2150 high school students in Izmir" *Environ Health.* (2017) PMID: 28577556. Article.
- Exelmans L et al.: "Bedtime mobile phone use and sleep in adults" *Soc Sci Med.* (2016) PMID: 26688552.
- Eyvazlou M et al: "Association between overuse of mobile phones on quality of sleep and general health among occupational health and safety students" *Chronobiol Int.* (2016) PMID: 26942630.
- Frey AH: "Headaches from cellular telephones: are they real and what are the implications?" *Environ Health Perspect.* (1998) PMID: 9441959.
- Hallberg O: "Adverse health indicators correlating with sparsely populated areas in Sweden" *Eur J Cancer Prev.* (2007) PMID: 17220707.
- Hadar A et al.: "Answering the missed call: Initial exploration of cognitive and electrophysiological changes associated with smartphone use and abuse" *PLoS One.* (2017) PMID: 28678870. Article.
- Hallberg O et al.: "Mobile Handset Output Power and Health" *Electromag Biol Med.* (2004) Abstract.
- Hocking B: "Preliminary report: symptoms associated with mobile phone use" *Occup Med (Lond).* (1998) PMID: 10024730. Abstract.
- Hocking B et al.: "Neurological abnormalities associated with mobile phone use" *Occup Med (Lond).* (2000) PMID: 10975136. Article.
- Hocking B et al.: "Neurological changes induced by a mobile phone" *Occup Med (Lond).* (2002) PMID: 12422029.
- Hu Y et al.: "Alterations in White Matter Integrity in Young Adults with Smartphone Dependence" *Front Hum Neurosci.* (2017) PMID: 29163108. PMC5673664.
- Huber R et al.: "Electromagnetic fields, such as those from mobile phones, alter regional cerebral blood flow and sleep and waking EEG" *J Sleep Res.* (2002) PMID: 12464096. Article.
- Hyland GJ: "Physics and biology of mobile telephony" *Lancet.* (2000) PMID: 11117927.
- Ikeda K et al: "Association between mobile phone use and depressed mood in Japanese adolescents: a cross-sectional study" *Environ Health Prev Med.* (2014)PMID: 24347468.
- Kerekhanjanarong V et al.: "The effect of mobile phone to audiologic system" *J Med Assoc Thai.* (2005) PMID: 16623034.
- Khan MM: "Adverse effects of excessive mobile phone use" *Int J Occup Med Environ Health.* (2008) PMID: 19228576.
- Kim J et al.: "Association between Exposure to Smartphones and Ocular Health in Adolescents" *Ophthalmic Epidemiol.* (2016) PMID: 27254040.
- Koca O et al.: "A new problem in inflammatory bladder diseases: use of mobile phones!" *Int Braz J Urol.* (2014) PMID: 25251956. Article.
- Korpinen L et al.: "Near Retirement Age (≥55 Years) Self-Reported Physical Symptoms and Use of Computers/Mobile Phones at Work and at Leisure" *Healthcare (Basel).* (2017) PMID: 28991182.
- Kwok SW et al.: "Smart Device Use and Perceived Physical and Psychosocial Outcomes among Hong Kong Adolescents" *Int J Environ Res Public Health.* (2017) PMID: 28218719. Article.
- Kwon MS et al.: "GSM mobile phone radiation suppresses brain glucose metabolism" *J Cereb Blood Flow Metab.* (2011) PMID: 21915135.
- Lee JE et al.: "Relationship between Mobile Phone Addiction and the Incidence of Poor and Short Sleep among Korean Adolescents: a Longitudinal Study of the Korean Children & Youth Panel Survey" *J Korean Med Sci.* (2017) PMID: 28581275. Article.
- Lippi G et al.: "Acute effects of 30 minutes of exposure to a smartphone call on in vitro platelet function" *Blood Transfus.* (2017) PMID: 27177410. PMC5448831.

- Lissak G: "Adverse physiological and psychological effects of screen time on children and adolescents: Literature review and case study" *Environ Res.* (2018) PMID: 29499467.
- Lowden A et al.: "Sleep after mobile phone exposure in subjects with mobile phone-related symptoms" *Bioelectromagnetics.* (2011) PMID: 20857453.
- Lu X et al.: "Association of excessive mobile phone use during pregnancy with birth weight: an adjunct study in Kumamoto of Japan Environment and Children's Study" *Environ Health Prev Med.* (2017) PMID: 29165149. Article.
- Mahmoudabadi FS et al.: "Use of mobile phone during pregnancy and the risk of spontaneous abortion" *J Environ Health Sci Eng.* (2015) PMID: 25937931. PMC4416385.
- Makker K et al.: "Cell phones: modern man's nemesis?" *Reprod Biomed Online.* (2009) Review. PMID: 19146782.
- Manjunatha N et al.: "Idiopathic environmental intolerance (electromagnetic hypersensitivity syndrome)" *Natl Med J India.* (2011) PMID: 22680087. Articile.
- Marino AA et al.: "Trigeminal neurons detect cellphone radiation: Thermal or nonthermal is not the question" *Electromagn Biol Med.* (2017) PMID: 27419655.
- Medeiros LN et al.: "Tinnitus and cell phones: the role of electromagnetic radiofrequency radiation" *Braz J Otorhinolaryngol.* (2016) PMID: 26602000. Article.
- Meo SA et al.: "Mobile phone related-hazards and subjective hearing and vision symptoms in the Saudi population" *Int J Occup Med Environ Health.* (2005) PMID: 16052891.
- Mishra SK et al.: "Effect of Cell Phone Radiations on Orofacial Structures: A Systematic Review" *J Clin Diagn Res.* (2017) PMID: 28658925.
- Mohammadianinejad SE et al.: "The Effects of Exposure to Low Frequency Electromagnetic Fields in the Treatment of Migraine Headache: A Cohort Study" *Electron Physician.* (2016) PMID: 28163863. PMC5279981.
- Mortazavi SAR et al.: "Women with hereditary breast cancer predispositions should avoid using their smartphones, tablets and laptops at night" *IJBMS.* (2018) Article.
- Mortazavi SM et al.: "Survey of the Effects of Exposure to 900 MHz Radiofrequency Radiation Emitted by a GSM Mobile Phone on the Pattern of Muscle Contractions in an Animal Model" *J Biomed Phys Eng.* (2015) PMID: 26396968.
- Munezawa T et al.: "The association between use of mobile phones after lights out and sleep disturbances among Japanese adolescents: a nationwide cross-sectional survey" *Sleep.* (2011) PMID: 21804663. PMC3138156.
- Oftedal G et al.: "Symptoms experienced in connection with mobile phone use" *Occup Med (Lond).* (2000) PMID: 10912374.
- Oshima N et al.: "The suicidal feelings, self-injury, and mobile phone use after lights out in adolescents" *J Pediatr Psychol.* (2012) PMID: 22728900.
- Panda NK et al.: "Audiologic disturbances in long-term mobile phone users" *J Otolaryngol Head Neck Surg.* (2010) PMID: 20122338.
- Redmayne M et al: "The relationship between adolescents' well-being and their wireless phone use: a cross-sectional study" *Environ Health* (2013) PMID: 24148357.
- Royant-Parola S et al.: [The use of social media modifies teenagers' sleep-related behavior] *Encephale.* (2017) PMID: 28602529.
- Sage C et al.: "Electromagnetic Fields, Pulsed Radiofrequency Radiation, and Epigenetics: How Wireless Technologies May Affect Childhood Development" *Child Dev.* (2017) PMID: 28504324.
- Salama OE et al.: "Cellular phones: are they detrimental?" *J Egypt Public Health Assoc.* (2004) PMID: 16918147.
- Sandström M et al.: "Mobile phone use and subjective symptoms. Comparison of symptoms experienced by users of analogue and digital mobile phones" *Occup Med (Lond).* (2001) PMID: 11235824.
- Shivashankara AR et al.: "Effect of cell phone use on salivary total protein, enzymes and oxidative stress markers in young adults: a pilot study" *J Clin Diagn Res.* (2015) PMID: 25859446. Article.

- Stalin P et al.: "Mobile Phone Usage and its Health Effects Among Adults in a Semi-Urban Area of Southern India" *J Clin Diagn Res.* (2016) PMID: 26894095. Article.
- Straker L et al.: "Mobile technology dominates school children's IT use in an advantaged school community and is associated with musculoskeletal and vision symptoms" *Ergonomics.* (2017) PMID: 29103354.
- Szyjkowska A et al.: "[Subjective symptoms related to mobile phone use--a pilot study]" *Pol Merkur Lekarski.* (2005) PMID: 16379318.
- Szyjkowska A et al: "The risk of subjective symptoms in mobile phone users in Poland - an epidemiological study" *Int J Occup Med Environ Health* (2014) PMID: 24692074.
- Szyjkowska A et al.: "[Effect of stress and intensity of mobile phone using on the health and subjective symptoms in GSM workers]" *Med Pr.* (2017) Polish. PMID: 28731073.
- Tamura H et al.: "Association between Excessive Use of Mobile Phone and Insomnia and Depression among Japanese Adolescents" *Int J Environ Res Public Health.* (2017) PMID: 28661428.
- Thomée S et al.: "Mobile phone use and stress, sleep disturbances, and symptoms of depression among young adults--a prospective cohort study" *BMC Public Health.* (2011) PMID: 21281471.
- Twenge JM et al.: "Decreases in Psychological Well-Being Among American Adolescents After 2012 and Links to Screen Time During the Rise of Smartphone Technology" *Emotion.* (2018) PMID: 29355336.
- Velayutham P et al.: "High-frequency hearing loss among mobile phone users" *Indian J Otolaryngol Head Neck Surg.* (2014) PMID: 24533378. PMC3918279.
- Wang J et al.: "Mobile Phone Use and The Risk of Headache: A Systematic Review and Meta-analysis of Cross-sectional Studies" *Sci Rep.* (2017) PMID: 28974725. Article.
- Wilén J et al.: "Subjective symptoms among mobile phone users – a consequence of absorption of radiofrequency fields?" Bioelectromagnetics. (2003) PMID: 12669297.
- Wilmer HH et al.: "Smartphones and Cognition: A Review of Research Exploring the Links between MobileTechnology Habits and Cognitive Functioning" *Front Psychol.* (2017) PMID: 28487665. PMC5403814.
- Yakymenko I et al.: "Subjective symptoms in young cell phone users in Ukraine" *Environment and Health.* (2015) Text. Article.
- Yılmaz D et al.: "Analysis of the mobile phone effect on the heart rate variability by using the largest Lyapunov exponent" *J Med Syst.* (2010) PMID: 20703598.
- Yogesh S et al.: "Mobile usage and sleep patterns among medical students" *Indian J Physiol Pharmacol.* (2014) PMID: 25464686.
- Zhang J et al.: "Acute effects of radiofrequency electromagnetic field emitted by mobile phone on brain function" *Bioelectromagnetics.* (2017) PMID: 28426166.
- Zheng F et al.: "Association between mobile phone use and inattention in 7102 Chinese adolescents: a population-based cross-sectional study" *BMC Public Health.* (2014) PMID: 25273315.
- Zheng F et al.: "Association between mobile phone use and self-reported well-being in children: a questionnaire-based cross-sectional study in Chongqing, China" *BMJ Open.* (2015) PMID: 25967996. PMC4431134.

(p) MRI Scanners

The magnetic fields near MRI scanners, inducing electric currents in people moving through them, can cause specific ES/EHS symptoms, with a subset potentially hyper-sensitive (Schaap K et al., 2014). The Lorenzt force of a magnetic field on the inner ear fluid's electrical currents may explain nystagmus or involuntary eye movements.

- Bongers S et al.: "Exposure to static magnetic fields and risk of accidents among a cohort of workers from a medical imaging device manufacturing facility" *Magn Reson Med.* (2016) PMID: 26079378.

- de Vocht F et al.: "Exposure, health complaints and cognitive performance among employees of an MRI scanners manufacturing department" *J Magn Reson Imaging.* (2006) PMID: 16374876.
- de Vocht F et al.: "Transient health symptoms of MRI staff working with 1.5 and 3.0 Tesla scanners in the UK" *Eur Radiol.* (2015) PMID: 25764089.
- Fiechter M et al.: "Impact of cardiac magnetic resonance imaging on human lymphocyte DNA integrity" *Eur Heart J.* (2013) PMID: 23793096. PMC3736059.
- Franco G et al.: [Health effects of occupational exposure to static magnetic fields used in magnetic resonance imaging: a review] *Med Lav.* (2008) PMID: 18254536.
- Güngör HR et al.: [Are there any adverse effects of static magnetic field from magnetic resonance imaging devices on bone health of workers?] *Eklem Hastalik Cerrahisi.* (2014) PMID: 24650383.
- Gungor HR et al.: "Chronic Exposure to Static Magnetic Fields from Magnetic Resonance Imaging Devices Deserves Screening for Osteoporosis and Vitamin D Levels: A Rat Model" *Int J Environ Res Public Health.* (2015) PMID: 26264009. PMC4555256.
- Schaap K et al.: "Exposure to MRI-related magnetic fields and vertigo in MRI workers" *Occup Environ Med.* (2015) PMID: 26561507.
- Schaap K et al: "Occupational exposure of healthcare and research staff to static magnetic stray fields from 1.5-7 Tesla MRI scanners is associated with reporting of transient symptoms" *Occup. Environ. Med.* (2014) PMID: 24714654.
- van Nierop LE et al.: "Simultaneous exposure to MRI-related static and low-frequency movement-induced time-varying magnetic fields affects neurocognitive performance: A double-blind randomized crossover study" *Magn Reson Med.* (2014) PMID: 25224577.
- Ward BK et al.: "Vestibular stimulation by magnetic fields" *Ann N Y Acad Sci.* (2015) PMID: 25735662.
- Zanotti G et al.: "Subjective symptoms and their evolution in a small group of magnetic resonance imaging (MRI) operators recently engaged" *Electromagn Biol Med.* (2015) PMID: 26444203.
- Zanotti G et al.: "Subjective symptoms in Magnetic Resonance Imaging operators: prevalence, short-term evolution and possible related factors" *Med Lav.* (2016) PMID: 27464899.

(q) Neonatal Incubators

- Bellieni CV et al.: "Electromagnetic fields in neonatal incubators: the reasons for an alert" *J Matern Fetal Neonatal Med.* (2017) PMID: 28988507.
- Bellieni CV et al.: "Electromagnetic fields produced by incubators influence heart rate variability in newborns" *Arch Dis Child Fetal Neonatal Ed.* (2008) PMID: 18450804.

(r) Photosensitivity, blue light effects, photic responses; see also LEDs

- Bonmati-Carrion MA et al.: "Protecting the melatonin rhythm through circadian healthy light exposure" *Int J Mol Sci.* (2014) PMID: 25526564.
- Chepesiuk R: "Missing the dark: health effects of light pollution" *Environ Health Perspect.* (2009) PMID: 19165374; pdf.
- Eriksson N et al.: (2010) "Web-based, participant-driven studies yield novel genetic associations for common traits" *PLoS Genet.* (2010) PMID: 20585627.
- Everett HC: "Sneezing in response to light" *Neurology.* (1964)PMID: 14144120; extract.
- Hydén D et al.: "On light-induced sneezing" *Eye (Lond).* (2009) PMID: 19575036.
- Johansson O et al.: "A case of extreme and general cutaneous light sensitivity in combination with so-called 'screen dermatitis' and 'electrosensitivity' - a successful rehabilitation after vitamin A treatment - a case report", *J Aust Coll Nutr & Env Med.* (1999) abstract.
- Krishnan HC et al.: "Synchrony and desynchrony in circadian clocks: impacts on learning and memory" *Learn Mem.* (2015) PMID: 26286653.
- Matynia A et al.: "Peripheral Sensory Neurons Expressing Melanopsin Respond to Light" *Front Neural Circuits.* (2016) PMID: 27559310.

- Moseley H et al.: "The risk to normal and photosensitive individuals from exposure to light from compact fluorescent lamps" *Photodermatol Photoimmunol Photomed.* (2011) Review. PMID: 21535166.
- Renard G et al.: "The dangers of blue light: True story!" *J Fr Ophtalmol.* (2016) French. PMID: 27039979.
- Semes LP et al.: "The photic sneeze response: a descriptive report of a clinic population" *J Am Optom Assoc.* (1995) PMID: 7673597.
- van der Meijden WP et al.: "Individual Differences in Sleep Timing Relate to Melanopsin-Based Phototransduction in Healthy Adolescents and Young Adults" *Sleep.* (2016) PMID: 27091519.

(s) Power Lines, ELF, high frequency voltage transients, magnetic fields

Linesmen working on telephone cables in during the late 19th century showed some of the first specific symptoms associated with electromagnetic exposure. Recently, high frequency voltage transients, or 'dirty' electricity, have been associated with similar specific symptoms.

- Akerstedt T et al.: "A 50-Hz electromagnetic field impairs sleep" *J Sleep Res.* (1999) PMID: 10188140. Article.
- Balamuralikrishnan B et al.: "Evaluation of chromosomal alteration in electrical workers occupationally exposed to low frequency of electro magnetic field (EMFs) in Coimbatore population, India" *Asian Pac J Cancer Prev.* (2012) PMID: 22938490. Article.
- Blackman CF: "Can EMF exposure during development leave an imprint later in life?" *Electromagn Biol Med.* (2006) PMID: 17178582.
- Carlberg M et al.: "Case-control study on occupational exposure to extremely low-frequency electromagnetic fields and glioma risk" *Am J Ind Med.* (2017) PMID: 28394434.
- Celikler S et al.: "A biomonitoring study of genotoxic risk to workers of transformers and distribution line stations" *Int J Environ Health Res.* (2009) PMID: 20183199.
- Coghill RW et al.: "Extra low frequency electric and magnetic fields in the bedplace of children diagnosed with leukaemia: a case-control study" *Eur J Cancer Prev.* (1996) PMID: 8818603.
- Di Giampaolo L et al.: "Follow up study on the immune response to low frequency electromagnetic fields in men and women working in a museum" *Int J Immunopathol Pharmacol.* (2006) PMID: 17291405.
- Fajardo-Gutiérrez A et al.: [Residence close to high-tension electric power lines and its association with leukemia in children] *Bol Med Hosp Infant Mex.* (1993) PMID: 8427647.
- Ghadamgahi M et al: "Memory loss risk assessment for the students nearby high-voltage power lines - a case study" *Environ Monit Assess.* (2016) PMID: 27194231.
- Gobba F: "[Subjective non-specific symptoms related with electromagnetic fields: description of 2 cases]" *Epidemiol Prev.* (2002) Italian. PMID: 12408003.
- Gubernskiy YD et al.: "[Hygienic aspects of electromagnetic pollution of indoor environment]" *Gig Sanit.* (2016) PMID: 27430061.
- Guénel P et al.: "Exposure to 50-Hz electric field and incidence of leukemia, brain tumors, and other cancers among French electric utility workers" *Am J Epidemiol.* (1996) PMID: 8956623.
- Havas M (2008) "Dirty electricity elevates blood sugar among electrically sensitive diabetics and may explain brittle diabetes" *Electromagn Biol Med.* 27(2): 135-146; PMID: 18568931.
- Havas M: "Electromagnetic Hypersensitivity: Biological Effects of Dirty Electricity with Emphasis on Diabetes and Multiple Sclerosis" *Electromagn Biol Med.*(2006) PMID: 17178585.
- Havas M et al.: "Power quality affects teacher wellbeing and student behavior in three Minnesota Schools" *Sci Total Environ.* (2008) PMID: 18556048.
- Henshaw DL: "Does our electricity distribution system pose a serious risk to public health?" *Med Hypotheses.* (2002) PMID: 12160679.
- Huang J et al.: "Association between exposure to electromagnetic fields from high voltage transmission lines and neurobehavioral function in children" *PLoS One.* (2013) PMID: 23843999. PMC3700989.

- Jalilian H et al.: "Occupational exposure to extremely low frequency magnetic field and risk of Alzheimer disease: A systematic review and meta-analysis" *Neurotoxicology.* (2017) PMID: 29278690.
- Juutilainen J et al.: "Early pregnancy loss and exposure to 50-Hz magnetic fields" *Bioelectromagnetics.* (1993) PMID: 8323573.
- Kabuto M et al.: "Childhood leukemia and magnetic fields in Japan: a case-control study of childhood leukemia and residential power-frequency magnetic fields in Japan" *Int J Cancer.* (2006) PMID: 16496405. 10.1002/ijc.21374.
- Kunt H et al.: "Effects of electromagnetic radiation exposure on bone mineral density, thyroid, and oxidative stress index in electrical workers" *Onco Targets Ther.* (2016) PMID: 26929645. PMC4758783.
- Li DK et al.: "A population-based prospective cohort study of personal exposure to magnetic fields during pregnancy and the risk of miscarriage" *Epidemiology.* (2002) PMID: 11805581.
- Li DK et al.: "Exposure to Magnetic Field Non-Ionizing Radiation and the Risk of Miscarriage: A Prospective Cohort Study" *Sci Rep.* (2017) PMID: 29235463.
- Li DK et al.: "Maternal exposure to magnetic fields during pregnancy in relation to the risk of asthma in offspring" *Arch Pediatr Adolesc Med.* (2011) PMID: 21810627.
- Li H et al.: "Exosomal Small RNA Sequencing Uncovers the microRNA Dose Markers for Power Frequency Electromagnetic Field Exposure" *Biomarkers.* (2018) PMID: 29297241.
- Liu H et al.: "Occupational electromagnetic field exposures associated with sleep quality: a cross-sectional study" *PLoS One.* (2014) PMID: 25340654.
- Lowenthal RM et al.: "Residential exposure to electric power transmission lines and risk of lymphoproliferative and myeloproliferative disorders: a case-control study" *Intern Med J.* (2007) PMID: 17543004.
- Maisch D et al.: "Chronic Fatigue Syndrome: Is prolonged exposure to environmental level powerline frequency electromagnetic fields a co-factor to consider in treatment?" *JACNEM.* (1998) Article.
- Maisch D et al.: "Changes in Health Status in a Group of CFS and CF Patients Following Removal of Excessive 50 Hz Magnetic Field Exposure" *JACNEM.* (2002) Article.
- Marino AA et al.: "Hazard at a distance: effects of exposure to the electric and magnetic fields of high voltage transmission lines" *Med Res Eng.* (1977) PMID: 349303.
- Milham S Jr: "Mortality in workers exposed to electromagnetic fields" *Environ Health Perspect.* (1985) PMID: 4085433. PMC1568699.
- Okano H et al.: "The physiological influence of alternating current electromagnetic field exposure on human subjects" *IEEE Int Conf SMC.* (2017) abstract.
- Pedersen C et al.: "Occupational exposure to extremely low-frequency magnetic fields and risk for central nervous system disease: an update of a Danish cohort study among utility workers" *Int Arch Occup Environ Health.* (2017) PMID: 28429106.
- Passi R et al.: "Electrical Grounding Improves Vagal Tone in Preterm Infants" *Neonatology.* (2017) PMID: 28601861.
- Shamsi Mahmoudabadi F et al.: "Exposure to extremely low frequency electromagnetic fields during pregnancy and the risk ofspontaneous abortion: a case-control study" *J Res Health Sci.* (2013) PMID: 24077469. Article.
- Thériault G et al.: "Cancer risks associated with occupational exposure to magnetic fields among electric utility workers in Ontario and Quebec, Canada, and France: 1970-1989" *Am J Epidemiol.* (1994) PMID: 8172168.
- Turner MC et al.: "Occupational exposure to extremely low-frequency magnetic fields and brain tumor risks in the INTEROCC study" *Cancer Epidemiol Biomarkers Prev.* (2014) PMID: 24935666. PMC4154968.
- Wang Z et al.: "Effects of electromagnetic fields exposure on plasma hormonal and inflammatory pathway biomarkers in male workers of a power plant" *Int Arch Occup Environ Health.* (2016) PMID: 25808749.

- Wang Z et al.: "Effects of electromagnetic fields on serum lipids in workers of a power plant" *Environ Sci Pollut Res Int.* (2016) PMID: 26423285.
- Wang Q et al.: "Residential exposure to 50 Hz magnetic fields and the association with miscarriage risk: a 2-year prospective cohort study" *PLoS One.* (2013) PMID: 24312633. PMC3849403.
- Zhang D et al.: "Resveratrol may reverse the effects of long-term occupational exposure to electromagnetic fields on workers of a power plant" *Oncotarget.* (2017) PMID: 28537898; pdf.

(t) Pre-natal Exposure

- Bahreyni Toossi MH et al.: "Exposure to mobile phone (900-1800 MHz) during pregnancy: tissue oxidative stress after childbirth" *J Matern Fetal Neonatal Med.* (2017) PMID: 28434276.
- Birks L et al.: "Maternal cell phone use during pregnancy and child behavioral problems in five birth cohorts" *Environ Int.* (2017) PMID: 28392066. PMC5506372.
- Divan HA et al: "Prenatal and postnatal exposure to cell phone use and behavioral problems in children" *Epidemiology* (2008) PMID: 18467962.
- Erkut A et al.: "The effect of prenatal exposure to 1800 MHz electromagnetic field on calcineurin and bone development in rats" *Acta Cir Bras.* (2016) PMID: 26959616; pdf.
- Li DK et al.: "A prospective study of in-utero exposure to magnetic fields and the risk of childhood obesity" *Sci Rep.* (2012) PMID: 22844581. PMC3406339.
- Li DK et al.: "Electric blanket use during pregnancy in relation to the risk of congenital urinary tract anomalies among women with a history of subfertility" *Epidemiology.* (1995) PMID: 8562623.
- Li DK et al.: "Maternal exposure to magnetic fields during pregnancy in relation to the risk of asthma in offspring" *Arch Pediatr Adolesc Med.* (2011) PMID: 21810627.
- Lu X et al.: "Association of excessive mobile phone use during pregnancy with birth weight: an adjunct study in Kumamoto of Japan Environment and Children's Study" *Environ Health Prev Med.* (2017) PMID: 29165149. Article.
- Özorak A et al.: "Wi-Fi (2.45 GHz)- and mobile phone (900 and 1800 MHz)-induced risks on oxidative stress and elements in kidney and testis of rats during pregnancy and the development of offspring" *Biol Trace Elem Res.* (2013) PMID: 24101576.
- Su XJ et al.: "Correlation between exposure to magnetic fields and embryonic development in the first trimester" *PLoS One.* (2014) PMID: 24977708. PMC4076237.
- Sudan M et al: "Prenatal and postnatal Cell Phone Exposure and Headaches in Children" *Open Pediatr. Med. Journal* (2012) PMID: 23750182.
- Yüksel M et al.: "Long-term exposure to electromagnetic radiation from mobile phones and Wi-Fi devices decreases plasma prolactin, progesterone, and estrogen levels but increases uterine oxidative stress in pregnant rats and their offspring" *Endocrine.* (2016) PMID: 26578367.

(u) Provocation Tests

- Havas M: "Radiation from wireless technology affects the blood, the heart, and the autonomic nervous system" *Rev. Environ Health* (2013) PMID: 24192494.
- Huttunen P et al.: "FM-radio and TV tower signals can cause spontaneous hand movements near moving RF reflector" *Pathophysiology* (2009) PMID: 19268549.
- Huttunen P et al.: "Involuntary human hand movements due to FM radio waves in a moving van" *Acta Physiol Hung.* (2011) PMID: 21616774.
- Köteles F et al: "Idiopathic environmental intolerance attributed to electromagnetic fields (IEI-EMF) and electrosensitivity (ES) - are they connected?" *Int J Hyg Environ Health* (2013) PMID: 22698789.
- Leitgeb N: "Electromagnetic hypersensitivity" in *Proceedings, International Workshop on Electromagnetic Fields and Non-Specific Health Symptoms, Graz, Austria.* (COST 244bis: Biomedical Effects of EMFs, WHO, ICNIRP) (1998) pdf.

- Leitgeb N et al.: "Electrosensibility and electromagnetic hypersensitivity" *Bioelectromagnetics* (2003) PMID: 12929157.
- McCarty DE et al.: "Electromagnetic hypersensitivity: evidence for a novel neurological syndrome" *Int J Neurosci.* (2011) PMID: 21793784.
- Rea WJ et al.: "Electromagnetic field sensitivity" *J Bioelectricity* (1991) (copy).

(v) Radar, radio frequency, short wave and microwave transmitters

- Baste V et al.: "Radiofrequency electromagnetic fields; male infertility and sex ratio of offspring" *Eur J Epidemiol.* (2008) PMID: 18415687.
- Degrave E et al.: "Causes of death among Belgian professional military radar operators: a 37-year retrospective cohort study" *Int J Cancer.* (2009) PMID: 19035449.
- Goldsmith JR: "Epidemiologic evidence relevant to radar (microwave) effects" *Environ Health Perspect.* (1997) PMID: 9467086.
- Grayson JK: "Radiation exposure, socioeconomic status, and brain tumor risk in the US Air Force: a nested case-control study" *Am J Epidemiol.* (1996) PMID: 8610663.
- Hamburger S et al.: "Occupational exposure to non-ionizing radiation and an association with heart disease: an exploratory study" *J Chronic Dis.* (1983) PMID: 6643646.
- Møllerløkken OJ et al.: "Is fertility reduced among men exposed to radiofrequency fields in the Norwegian Navy?" *Bioelectromagnetics.* (2008) PMID: 18240289.
- Mortazavi SM et al.: "Alterations of visual reaction time and short term memory in military radar personnel" *Iran J Public Health.* (2013) PMID: 23785684.
- Oktay MF et al.: "Occupational safety: effects of workplace radiofrequencies on hearing function" *Arch Med Res.* (2004) PMID: 15631877.
- Peleg M et al.: "Radio frequency radiation-related cancer: assessing causation in the occupational/military setting" *Environ Res.* (2018) PMID: 29433020.
- Richter ED et al.: "Brain cancer with induction periods of less than 10 years in young military radar workers" *Arch Environ Health.* (2002) PMID: 12530592.
- Richter E et al.: "Cancer in radar technicians exposed to radiofrequency/microwave radiation: sentinel episodes" *Int J Occup Environ Health.* (2000) PMID: 10926722.
- Singh S et al.: "Effect of occupational EMF exposure from radar at two different frequency bands on plasma melatonin and serotonin levels" *Int J Radiat Biol.* (2015) PMID: 25565559.
- Singh S et al.: "Occupational EMF exposure from radar at X and Ku frequency band and plasma catecholamine levels" *Bioelectromagnetics.* (2015) PMID: 26058851.
- Suvorov IM: "[Clinical monitoring in areas of exposure to radiofrequency electromagnetic fields]" *Med Tr Prom Ekol.* (2013) PMID: 23785812.
- Szmigielski S: "Cancer morbidity in subjects occupationally exposed to high frequency (radiofrequency and microwave) electromagnetic radiation" *Sci Total Environ.* (1996) PMID: 8717316.
- Yakymenko I et al.: "Long-term exposure to microwave radiation provokes cancer growth: evidences from radars and mobile communication systems" *Exp Oncol.* (2011) PMID: 21716201.
- Yu C et al.: "Biological effects and mechanisms of shortwave radiation: a review" *Mil Med Res.* (2017) PMID: 28729909. PMC5518414.

Thermal and non-thermal effects of radar:

- Mitchell JC: "Radiofrequency radiation accident follow-up in the U.S. Air Force [three case studies]" USAF School of Aeropsace Medicine. Aeromedical Review 3-81. (1981) Article.
- Servantie B: "Human pathology caused by radar [three case studies]" USAF School of Aeropsace Medicine. Aeromedical Review 3-81. (1981) Article.

(w) Smart Meters

- Lamech F: "Self-Reporting of Symptom Development From Exposure to Radiofrequency Fields of Wireless Smart Meters in Victoria, Australia: A Case Series" *Altern Ther Health Med.* (2014) PMID: 25478801.

(x) Toys

- Mamrot P et al.: "[Assessment of the safety of toys with special reference to electromagnetic safety in view of binding regulations: a pilot study]" *Med Pr.* (2005) PMID: 15998001.

(y) Visual Display Terminals (VDT), Visual Display Units (VDU)

- Lindbohm ML et al.: "Magnetic fields of video display terminals and spontaneous abortion" *Am J Epidemiol.* (1992) PMID: 1462964.

(z) WiFi

- Çelik Ö et al.: "Oxidative stress of brain and liver is increased by Wi-Fi (2.45GHz) exposure of rats during pregnancy and the development of newborns" *J Chem Neuroanat.* (2015) PMID: 26520617.
- Dasdag S et al.: "Effect of long-term exposure of 2.4 GHz radiofrequency radiation emitted from Wi-Fi equipment on testes functions" *Electromagn Biol Med.* (2015) PMID: 24460421.
- Hassanshahi A et al.: "The effect of Wi-Fi electromagnetic waves in unimodal and multimodal object recognition tasks in male rats" *Neurol Sci.* (2017) PMID: 28332042.
- Ibitayo AO et al.: "RAPD Profiling, DNA Fragmentation, and Histomorphometric Examination in Brains of Wistar Rats Exposed to Indoor 2.5 Ghz Wi-Fi Devices Radiation" *Biomed Res Int.* (2017) PMID: 28904975.
- Johansson O et al: "Exacerbation of demyelinating syndrome after exposure to wireless modem with public hotspot" *Electromagn Biol Med.* (2016) PMID: 27355805.
- Kamali K et al.: "Effects of electromagnetic waves emitted from 3G+wi-fi modems on human semen analysis" *Urologia.* (2017) PMID: 28967061.
- Markov M et al.: "Wi-Fi technology - an uncontrolled global experiment on the health of mankind" *Electromagn Biol Med.* (2013) PMID: 23675623. Article.
- Marshall TG et al.: "Electrosmog and autoimmune disease" *Immunol Res.* (2017) PMID: 27412293; pdf.
- Mohammadianinejad SE et al.: "The Effects of Exposure to Low Frequency Electromagnetic Fields in the Treatment of Migraine Headache: A Cohort Study" *Electron Physician.* (2016) PMID: 28163863. PMC5279981.
- Nazıroğlu M et al.: "Recent reports of Wi-Fi and mobile phone-induced radiation on oxidative stress and reproductive signaling pathways in females and males" *J Membr Biol.* (2013) PMID: 24105626.
- Othman H et al.: "Effects of prenatal exposure to WIFI signal (2.45GHz) on postnatal development and behavior in rat: Influence of maternal restraint" *Behav Brain Res.* (2017) PMID: 28288806.
- Özorak A et al.: "Wi-Fi (2.45 GHz)- and mobile phone (900 and 1800 MHz)-induced risks on oxidative stress and elements in kidney and testis of rats during pregnancy and the development of offspring" *Biol Trace Elem Res.* (2013) PMID: 24101576.
- Paknahad M et al.: "Effect of radiofrequency radiation from Wi-Fi devices on mercury release from amalgam restorations" *J Environ Health Sci Eng.* (2016) PMID: 27418965.
- Saili L et al.: "Effects of acute exposure to WIFI signals (2.45GHz) on heart variability and blood pressure in Albinos rabbit" *Environ Toxicol Pharmacol.* (2015) PMID: 26356390.
- Shahin S et al: "2.45 GHz Microwave Radiation Impairs Learning and Spatial Memory via Oxidative/Nitrosative Stress Induced p53 Dependent/Independent Hippocampal Apoptosis: Molecular Basis and Underlying Mechanism" *Toxicol Sci.* (2015) PMID: 26396154.

- Topsakal S et al.: "The ameliorative effect of gallic acid on pancreas lesions induced by 2.45 GHz electromagnetic radiation (Wi-Fi) in young rats" *J Rad Res Appl Sci.* (2017) doi.org/10.1016/j.jrras.2017.04.009; pdf.

(aa) Wireless headsets

- Sage C et al.: "Fatal collision? Are wireless headsets a risk in treating patients?" *Electromagn Biol Med.* (2018) PMID: 29400585.

4. Specific ES symptoms from, and sensitivity to, natural geomagnetic disturbances

Most life on Earth depends on solar radiation. Solar and other fluctuations cause geomagnetic disturbances which can cause biological effects in plants and animals. These affect people with sensitivity to solar and geomagnetic energy. As with man-made radiation, some people and animals are more sensitive than others, as with Aurora Disturbance Sensitive People (ADSP). Magnetic pulses, magnetic ropes (discovered in 2007) and water content can also enhance biological effects of cosmic ionising rays and may also relate to gravielectric effects.

Websites providing geomagnetic and solar forecasts:

Aurora Forecast
Flarecast.eu
Geomagnetic and Solar Activity Forecast (BGS, NERC)
Geomagnetic Forecast (Laboratory of X-ray astronomy of the Sun, LPI RAS, Russia)
Space Weather Prediction Center (NOAA)
Spaceweather.com

- Abdollahi F et al.: "Correlation of multiple sclerosis (MS) incidence trends with solar and geomagnetic indices: Time to revise the method of reporting MS epidemiological data" *Iran J Neurol.* (2014) PMID: 25295148. PMC4187332.
- Acheson ED et al.: "Some comments on the relationship of the distribution of multiple sclerosis to latitude, solar radiation, and other variables" *Acta Psychiatrica Scand.* (1960) PMID: 13681205. Abstract.
- Alabdulgade A et al.: "Human heart rhythm sensitivity to earth local magnetic field fluctuations" *J Vibroengineering.* (2015) abstract; pdf.
- Alabdulgader A et al.: "Long-Term Study of Heart Rate Variability Responses to Changes in the Solar and Geomagnetic Environment" *Sci Rep.* (2018) PMID: 29422633. PMC5805718.
- Azcárate T et al.: "Influence of geomagnetic activity and atmospheric pressure in hypertensive adults" *Int J Biometeorol.* (2017) PMID: 28357508.
- Baevsky RM et al.: "Meta-analyzed heart rate variability, exposure to geomagnetic storms, and the risk of ischemic heart disease" *Scr Med (Brno).* (1997) PMID: 11543511.
- Baevsky RM et al.: "Regulation of autonomic nervous system in space and magnetic storms" *Adv Space Res.* (1998) PMID: 11541400.
- Belisheva NK et al.: "The effect of cosmic rays on biological systems – an investigation during GLE events" *Astrophys Space Sci Trans.* (2011) Abstract.
- Belova NA et al.: "The Effect of Extremely Low Frequency Alternating Magnetic Field on the Behavior of Animals in the Presence of the Geomagnetic Field" *J Biophys.* (2015) PMID: 26823664; pdf.
- Benli AR et al.: "Changing Efficacy of Wet Cupping Therapy in Migraine with Lunar Phase: A Self-Controlled Interventional Study" *Med Sci Mon.* (2017) DOI: 10.12659/MSM.905199.
- Berk M et al.: "Do ambient electromagnetic fields affect behaviour? A demonstration of the relationship between geomagnetic storm activity and suicide" *Bioelectromagnetics.* (2006) PMID: 16304696.
- Bevington M: "Lunar biological effects and the magnetosphere" *Pathophysiology* (2015) PMID: 26462435.
- Binhi VN et al.: "Biological effects of the hypomagnetic field: An analytical review of experiments and theories" *PLoS One.* (2017) PMID: 28654641; pdf.
- Bureau YR et al.: "Decreased latencies for limbic seizures induced in rats by lithium-pilocarpine occur when daily average geomagnetic activity exceeds 20 nanoTesla" *Neurosci Lett.* (1995) PMID: 7675323.
- Chae KS et al.: "Potential Impact of Geomagnetic Field in Transcranial Magnetic Stimulation for the Treatment of Neurodegenerative Diseases" *Front Hum Neurosci.* (2017) PMID: 29021752. PMC5623677.

- Chernouss S et al.: "Geophysical hazard for human health in the circumpolar Auroral belt: Evidence of a relationship between heart rate variation and electromagnetic disturbances" *Nat Hazards.* (2001) Abstract.
- Chichinadze G et al.: "[Influence of geomagnetic storms on the balance of autonomic regulatory mechanisms]" *Georgian Med News.* (2005) PMID: 16234599.
- Close J: "Are stress responses to geomagnetic storms mediated by the cryptochrome compass system?" *Proc Biol Sci.* (2012) PMID: 22418257. PMC3321722.
- Cornélissen G et al.: "Blood pressure, heart rate and melatonin cycles synchronization with the season, earth magnetism and solar flares" *Scr Med (Brno).* (2010) PMID: 21566725. PMC3091818.
- Dimitrova S et al.: "Influence of local geomagnetic storms on arterial blood pressure" *Bioelectromagnetics.* (2004) PMID: 15300726.
- Dupont MJ et al.: "Geophysical variables and behavior: XCIX. Reductions in numbers of neurons within the parasolitary nucleus in rats exposed perinatally to a magnetic pattern designed to imitate geomagnetic continuous pulsations: implications for sudden infant death" *Percept Mot Skills.* (2004) PMID: 15209312.
- Dupont MJ et al.: "Reduced litter sizes following 48-h of prenatal exposure to 5 nT to 10 nT,0.5 Hz magnetic fields: implications for sudden infant deaths" *Int J Neurosci.* (2005) PMID: 15823935.
- Feigin VL et al.: "Geomagnetic storms can trigger stroke: evidence from 6 large population-based studies in Europe and Australasia" *Stroke.* (2014) PMID: 24757102; pdf.
- Freund F et al.: "Nature of Pre-Earthquake Phenomena and their Effects on Living Organisms" *Animals (Basel).* (2013) PMID: 26487415. PMC4494396.
- Gurfinkel YI et al.: "Geomagnetic storm under laboratory conditions: randomized experiment" *Int J Biometeorol.* (2017) PMID: 29030697.
- Halberg F et al.: "Time structures (chronomes) of the blood circulation, populations' health, human affairs and space weather" *World Heart J.* (2011) abstract; pdf.
- Hiscock HG et al.: "The quantum needle of the avian magnetic compass" *Proc Natl Acad Sci U S A.* (2016) PMID: 27044102.
- Hrushesky WJ et al.: "Sunspot dynamics are reflected in human physiology and pathophysiology" *Astrobiology.* (2011) PMID: 21391821. PMC3063695.
- Huttunen P et al.: "Dowsing can be interfered with by radio frequency radiation" *Pathophysiology.* (2012) PMID: 22365422.
- Juckett DA: "Correlation of a 140-year global time signature in cancer mortality birth cohorts with galactic cosmic ray variation" *Int J Astrobiol.* (2007) Abstract.
- Kay RW: "Geomagnetic storms: association with incidence of depression as measured by hospital admission" *Br J Psychiatry.* (1994) PMID: 8199794.
- Kleĭmenova NG et al.: "[Seasonal variations in the myocardial infarction incidence and possible effects of geomagnetic micropulsations on the cardiovascular system in humans]" *Biofizika.* (2007) PMID: 18225664.
- Krylov VV: "Biological effects related to geomagnetic activity and possible mechanisms" *Bioelectromagnetics.* (2017) PMID: 28636777.
- Kvachadze I et al.: "[Vegetative regulatory mechanisms in different Geomagnetic conditions depending on a degree of physical conditioning]" *Georgian Med News.* (2016) PMID: 27249445.
- Leão P et al.: "North-Seeking Magnetotactic Gammaproteobacteria in the Southern Hemisphere" *Appl Environ Microbiol.* (2016) PMID: 27401974; pdf.
- Liboff AR: "Why are living things sensitive to weak magnetic fields? *Electromagn Biol Med.* (2014) PMID: 23915203; pdf.
- Markov AL et al.: "[Vulnerability to atmospheric and geomagnetic factors of the body functions in healthy male dwellers of the Russian North]" *Aviakosm Ekolog Med.* (2013) PMID: 23814894; Eng. Trans.: *Hum Physiol.* (2015) abstract.

- Martínez-Bretón JL et al.: "Artificial reproduction of magnetic fields produced by a natural geomagnetic storm increases systolic blood pressure in rats" *Int J Biometeorol.*(2016) PMID: 27094916.
- McCraty R et al.: "Synchronization of Human Autonomic Nervous System Rhythms with Geomagnetic Activity in Human Subjects" *Int J Environ Res Public Health.* (2017) PMID: 28703754; pdf.
- Mo WC et al.: "Shielding of the Geomagnetic Field Alters Actin Assembly and Inhibits Cell Motility in Human Neuroblastoma Cells" *Sci Rep.* (2016) PMID: 27029216.
- Mulligan BP et al.: "Experimental simulation of the effects of sudden increases in geomagnetic activity upon quantitative measures of human brain activity: validation of correlational studies" *Neurosci Lett.* (2012) PMID: 22484013.
- Natan E et al.: "The symbiotic magnetic-sensing hypothesis: do Magnetotactic Bacteria underlie the magnetic sensing capability of animals?" *Mov Ecol.* (2017) PMID: 29085642; pdf.
- Nishimura T et al.: "Stronger geomagnetic fields may be a risk factor of male suicides" *Psychiatry Clin Neurosci.* (2014) PMID: 24612477.
- O'Connor RP et al.: "Geophysical variables and behavior: LXXXII. A strong association between sudden infant death syndrome and increments of global geomagnetic activity--possible support for the melatonin hypothesis" *Percept Mot Skills.* (1997) PMID: 9106826.
- O'Connor RP et al.: "Geophysical variables and behavior: LXXXV. Sudden infant death, bands of geomagnetic activity, and pc1 (0.2 to 5 HZ) geomagnetic micropulsations" *Percept Mot Skills.* (1999) PMID: 10483626.
- Oraevskiĭ VN et al.: "[Effect of geomagnetic activity on the functional status of the body]" *Biofizika.* (1998) PMID: 9914843.
- Otsuka K et al.: "Alternating light-darkness-influenced human electrocardiographic magnetoreception in association with geomagnetic pulsations" *Biomed Pharmacother.* (2001) PMID: 11774870.
- Ozheredov VA et al.: "Influence of geomagnetic activity and earth weather changes on heart rate and blood pressure in young and healthy population" *Int J Biometeorol.* (2017) PMID: 27878388.
- Ozheredov VA et al.: "[Influence of some weather factors and the geomagnetic activity on the development of severe cardiological pathologies]" *Biofizika.* (2010) PMID: 20184151.
- Palmer SJ et al.: "Solar and geomagnetic activity, extremely low frequency magnetic and electric fields and human health at the Earth's surface" *Surv Geophys.* (2006) Article.
- Panagopoulos DJ et al.: "On the biophysical mechanism of sensing atmospheric discharges by living organisms" *Sci Total Environ.* (2017) PMID: 28558424.
- Papathanasopoulos P et al.: "The possible effects of the solar and geomagnetic activity on multiple sclerosis" *Clin Neurol Neurosurg.* (2016) PMID: 27161905.
- Persinger MA: "Enhancement of limbic seizures by nocturnal application of experimental magnetic fields that simulate the magnitude and morphology of increases in geomagnetic activity" *Int J Neurosci.* (1996) PMID: 8884398.
- Persinger MA: "Geomagnetic variables and behavior: LXXXIII. Increased geomagnetic activity and group aggression in chronic limbic epileptic male rats" *Percept Mot Skills.* (1997) PMID: 9450296.
- Persinger MA et al.: "Geophysical variables and behavior: CIII. Days with sudden infant deaths and cardiac arrhythmias in adults share a factor with PC1 geomagnetic pulsations: implications for pursuing mechanism" *Percept Mot Skills.* (2001) PMID: 11453188.
- Persinger MA et al.: "Sudden unexpected death in epileptics following sudden, intense, increases in geomagneticactivity: prevalence of effect and potential mechanisms" *Int J Biometeorol.* (1995) PMID: 7601551.
- Persinger MA: "Wars and increased solar-geomagnetic activity: aggression or change in intraspecies dominance?" *Percept Mot Skills.* (1999) PMID: 10485122.
- Piccardi G et al.: "The 22-year solar cycle and chemical tests" *J Interdiscip Cycle Res.* (1972) link.

- Pinzon-Rodriguez A et al.: "Zebra finches have a light-dependent magnetic compass similar to migratory birds" *J Exp Biol.* (2017) PMID: 28356366.
- Podolská K: "The Impact of Ionospheric and Geomagnetic Changes on Mortality from Diseases of the Circulatory System" *J Stroke Cerebrovasc Dis.* (2017) PMID: 29074064.
- Rapoport SI et al.: "[Geomagnetic pulsations and myocardial infarctions]" *Ter Arkh.* (2006) PMID: 16821424.
- Rapoport SI et al.: "[Melatonin as a most important factor of natural electromagnetic fields impacting patients with hypertensive disease and coronary heart disease. Part 1]" *Klin Med (Mosk).* (2011) PMID: 21861395.
- Rapoport SI et al.: "[Melatonin as a most important factor in the action of weak natural magnetic fields on patients with hypertensive disease and coronary heart disease. Part 2]" *Klin Med (Mosk).* (2011) PMID: 21932552.
- Rapoport SI et al.: "[Melatonin production in hypertonic patients during magnetic storms]" *Ter Arkh.* (2001) PMID: 11858104.
- Rouleau N et al.: "Electromagnetic fields as structure-function zeitgebers in biological systems: environmental orchestrations of morphogenesis and consciousness" *Front Integr Neurosci.* (2014) PMID: 25426035; pdf.
- Rozhkov VN et al.: ["Psychophysiological and cardiohemodynamic effects of solar, geomagnetic and meteorological factors in man living in Arctic area"] *Fiziol Cheloveka.* (2014) Russian. PMID: 25707219.
- Sajedi SA et al.: "Geomagnetic disturbances may be environmental risk factor for multiple sclerosis: an ecological study of 111 locations in 24 countries" *BMC Neurol.* (2012) PMID: 22998435.
- Sajedi SA et al.: "Which Environmental Factor Is Correlated with Long-Term Multiple Sclerosis Incidence Trends: Ultraviolet B Radiation or Geomagnetic Disturbances?" *Mult Scler Int.* (2017) PMID: 29204297. PMC5674510.
- Saroka KS et al.: "Similar Spectral Power Densities Within the Schumann Resonance and a Large Population of Quantitative Electroencephalographic Profiles: Supportive Evidence for Koenig and Pobachenko" *PLoS One.* (2016) PMID: 26785376. PMC4718669.
- Schienle A et al.: "Atmospheric electromagnetism: individual differences in brain electrical response to simulated sferics" *Int J Psychophysiol.* (1996) PMID: 8792205.
- Shaposhnikov D et al.: "The influence of meteorological and geomagnetic factors on acute myocardial infarction and brain stroke in Moscow, Russia" *Int J Biometeorol.* (2014) PMID: 23700198.
- Simmons SL et al.: "South-seeking magnetotactic bacteria in the Northern Hemisphere" *Science.* (2006) PMID: 16424338; pdf.
- St-Pierre LS et al.: "Experimental induction of intermale aggressive behavior in limbic epileptic rats by weak, complex magnetic fields: implications for geomagnetic activity and the modern habitat?" *Int J Neurosci.* (1998) PMID: 10069616.
- Stoupel EG et al.: "Space weather and human deaths distribution: 25 years' observation (Lithuania, 1989-2013)" *J Basic Clin Physiol Pharmacol.* (2015) PMID: 26068901.
- Tada H: "Association of geomagnetic disturbances and suicides in Japan, 1999-2010" *Environ Health Prev Med.* (2014) PMID: 24005993.
- Timofejeva I et al.: "Identification of a Group's Physiological Synchronization with Earth's Magnetic Field" *Int J Environ Res Public Health.* (2017) PMID: 28862697; pdf.
- Vaitl D et al.: "Headache and sferics" *Headache.* (2001) PMID: 11703470.
- Villoresi G et al: "[Myocardial infarct and geomagnetic disturbances: analysis of data on morbidity and mortality]" *Biofizika* (1998) PMID: 9783069.
- Walach H et al.: "Sferics and headache: a prospective study" *Cephalalgia.* (2001) PMID: 11531901.
- Zaporozhan V et al.: "Mechanisms of geomagnetic field influence on gene expression using influenza as a model system: basics of physical epidemiology" *Int J Environ Res Public Health.* (2010) PMID: 20617011; pdf.

- Zenchehko TA et al.: "[Relation between microcirculation parameters and Pc3 geomagnetic pulsations]" *Biofizika.* (2010) PMID: 20968090.
- Zenchenko TA et al.: "[The dynamics of pulse rate and biochemical parameters in blood of healthy individuals in relation to Pc5-6 geomagnetic pulsations]" *Biofizika.* (2015) PMID: 26016037.
- Zhang HT et al.: "Shielding of the geomagnetic field reduces hydrogen peroxide production in human neuroblastoma cell and inhibits the activity of CuZn superoxide dismutase" *Protein Cell.* (2017) PMID: 28447293; pdf.

5. Earthing and Grounding

Earthing and Grounding, where the body takes negative ions from the surface of the Earth, also relate to anti-oxidant studies and studies dealing with oxidative stress, as well as the body's biofield.
The practice of Earthing or Grounding is discouraged where the Earth has high electric fields and high frequency voltage transients caused by return currents. This is common in parts of Canada and the USA and can sometimes occur on the Earth of home wiring anywhere.

- Applewhite R: "The effectiveness of a conductive patch and a conductive bed pad in reducing induced human body voltage via the application of earth ground" *Europ Biol Bioelectromagnetics.* (2005) pdf.
- Brown D et al.: "Pilot study on the effect of grounding on delayed-onset muscle soreness" *J Altern Complement Med.* (2010) PMID: 20192911.
- Brown R et al.: "Grounding the human body during yoga exercise with a grounded yoga mat reduces blood viscosity" *Open Journal of Preventive Medicine*. (2015) pdf.
- Chevalier G: "Changes in pulse rate, respiratory rate, blood oxygenation, perfusion index, skin conductance, and their variability induced during and after grounding human subjects for 40 minutes" *J Altern Complement Med.* (2010) PMID: 20064020.
- Chevalier G: "The effect of grounding the human body on mood" *Psychol Rep.* (2015) PMID: 25748085.
- Chevalier G et al.: "Earthing: health implications of reconnecting the human body to the Earth's surface electrons" *J Environ Public Health.* (2012) PMID: 22291721.
- Chevalier G et al.: "Earthing (grounding) the human body reduces blood viscosity-a major factor in cardiovascular disease" *J Altern Complement Med.* (2013) PMID: 22757749.
- Ghaly M et al.: "The biologic effects of grounding the human body during sleep as measured by cortisol levels and subjective reporting of sleep, pain, and stress" *J Altern Complement Med.* (2004) PMID: 15650465.
- Hammerschlag R et al.: "Biofield Physiology: A Framework for an Emerging Discipline" *Glob Adv Health Med.* (2015) PMID: 26665040. PMC4654783.
- Hillman D: "Effects of Extraneous Electricity on Dairy Cattle, Other Animals, and Humans - A Guide for Dairymen, Veterinarians, and Investigators of Stray Voltage" *J Vet Sci Med Diagn.* (2014) abstract.
- Hillman D et al.: "Electric and magnetic fields (emf) affect milk production and behavior of cows: results using shielded-neutral isolation transformer" *12th International Conference on Production Diseases in Farm Animals*, Michigan State University, MI; (2004) pdf.
- Hillman D et al.: "Relationship of electric power quality to milk production of dairy herds - field study with literature review" *Sci Total Environ.* (2013) PMID: 23416176.
- Milham S et al.: "Tumor-specific frequencies and ocular melanoma" *Biol Med.* (2017) PMID: 27552371.
- Ober AC: "Grounding the human body to neutralize bio-electrical stress from static electricity and EMFs" *Energ Sustain Dev J.* (2000) Article.
- Ober AC: "Grounding the human body to earth reduces chronic inflammation and related chronic pain" *Energ Sustain Dev J.* (2003) Article.
- Ober AC et al.: "Does grounding the human body to earth reduce chronic inflammation and related chronic pain?" *Europ Bioelectromagn Assoc.* Budapest. (2003) Article.
- Oschman JL: "Our place in nature: Reconnecting with the earth for better sleep" *J Altern Complement Med.* (2004) PMID: 15650460. Article.
- Oschman JL: "Chronic disease: are we missing something?" *J Altern Complement Med.* (2011) PMID: 21438673. PMC3151462.
- Oschman JL: "Can electrons act as antioxidants? A review and commentary" *J Alten Complement Med.* (2007) PMID: 18047442. Article.
- Oschman JL: "Charge transfer in the living matrix" *J Bodyw Mov Ther.* (2009) PMID: 19524846.

- OschmanJL et al.: "Biophysics of Earthing (Grounding) the Human Body" in Rosch PJ (ed.) *Bioelectromagnetic and Subtle Energy Medicine* (2nd ed.) CRC Press: Taylor & Francis; (2015) pdf.
- Oschman JL et al.: "The effects of grounding (earthing) on inflammation, the immune response, wound healing, and prevention and treatment of chronic inflammatory and autoimmune diseases" *J Inflamm Res.* (2015) PMID: 25848315.
- Passi R et al.: "Electrical Grounding Improves Vagal Tone in Preterm Infants" *Neonatology.* (2017) PMID: 28601861.
- Rohde MK et al.: "The Association between Residence Floor Level and Cardiovascular Disease: The Health and Environment in Oslo Study" *J Environ Public Health.* (2016) PMID: 28053608.
- Sinatra ST et al.: "Electric Nutrition: The Surprising Health and Healing Benefits of Biological Grounding (Earthing)" *Altern Ther Health Med.* (2017) PMID: 28987038.
- Sokal K et al.: "Earthing the human organism influences bioelectrical processes" *J Altern Complement Med.* (2012) PMID: 22420736.
- Sokal P et al.: "Differences in Blood Urea and Creatinine Concentrations in Earthed and Unearthed Subjects during Cycling Exercise and Recovery" *Evid Based Complement Alternat Med.* (2013) PMID: 24066011.

6. Shielding (buildings and clothing) and Treatment

(a) Shielding: buildings

There has been much research into how buildings can be made protective against electromagnetic energy. This has particularly involved development of concrete with mixes of material materials to reduce the permittivity of cement mixtures. Materials tested include carbon black, carbon fibre, carbonaceous nano/micro inerts, chlorinated polyethylene/carbon nanofiber nanocomposites, ferrite–paraffin polymer composites, flexible graphite or submicron graphite particles, fly ash, graphene oxide/ferrofluid/cement composites, magnetite, Mn–Zn ferrite, multi-walled carbon nanotube cement composites, nano-titanium dioxide and nickel-coated carbon nanofiber, thermoplastic natural rubber filled magnetite nanocomposites, steel slag, and stainless steel fibers of diameter 8 μm and length 6 mm. The last, steel fibers, showed a shielding effectiveness of 70 dB at 1.5 GHz, while ferrite–paraffin polymer composites reached −46.60 dB at 10.5 GHz for an absorber thickness of 2 mm.

- Bantsisa G et al.: "Comparison of low cost shielding-absorbing cement paste building materials in X-band frequency range using a variety of wastes" *Ceram Int.* (2012) Crossref.
- Baoyi L et al.: "The electromagnetic characteristics of fly ash and absorbing properties of cement-based composites using fly ash as cement replacement" *Construct Build Materials.* (2012) Abstract.
- Bayrakdar H: "Complex permittivity, complex permeability and microwave absorption properties of ferrite–paraffin polymer composites" *J Magn Magn Mater.* (2011) Crossref.
- Cao JY et al.: "Colloidal graphite as an admixture in cement and as a coating on cement for electromagnetic interference shielding" *Cement Concr Res.* (2003) Crossref.
- Cao JY et al.: "Use of fly ash as an admixture for electromagnetic interference shielding" *Cement Concr Res.* (2004) Crossref.
- Chung DDL: "Carbon materials for structural self-sensing, electromagnetic shielding and thermal interfacing" *Carbon.* (2012) Crossref.
- Dai YW et al.: "Electromagnetic wave absorbing characteristics of carbon black cement-based composites" *Cement Concr Res.* (2010) Crossref.
- Dai YS et al.: "Radar-wave absorbing property of cement-based composite doped with steel slag" *J Chin Ceram Soc.* (2009) Crossref.
- Fan Y et al.: "Utilization of Stainless-steel Furnace Dust as an Admixture for Synthesis of Cement-based Electromagnetic Interference Shielding Composites" *Sci Rep.* (2017) Article.
- Guan HT et al.: "Cement based electromagnetic shielding and absorbing building materials" *Cement Concr Compos.* (2006) Crossref.
- Hasted JB et al.: "Microwave absorption by water in building materials" *Br J Appl Phys.* (1964) Abstract.
- Huang YB et al.: "Electromagnetic properties of high ferric oxide fly ash" *J Build Mater.* (2010) Crossref.
- Khushnood RA et al.: "Improvement in electromagnetic interference shielding effectiveness of cement composites using carbonaceous nano/micro inerts" *Constr Build Mater.* (2015) Crossref.
- Kong I et al.: "Magnetic and microwave absorbing properties of magnetite–thermoplastic natural rubber nanocomposites" *J Magn Magn Mater.* (2010) Crossref.
- Li BY et al.: "The electromagnetic characteristics of fly ash and absorbing properties of cement-based composites using fly ash as cement replacement" *Constr Build Mater.* (2012) Crossref.
- Li Z et al.: "Effect of nano-titanium dioxide on mechanical and electrical properties and microstructure of reactive powder concrete" *Mater Res Express.* (2017) IOPscience.
- Lu LN et al.: "TiO2 containing electromagnetic wave absorbing aggregate and its application in concrete" *Constr Build Mater.* (2017) Crossref.
- Mondal S et al.: "Highly conductive and flexible nano-structured carbon-based polymer nanocomposites with improved electromagnetic-interference-shielding performance" *Mater Res Express.* (2017) Abstract.

- Prasad A et al.: "Effective permittivity of random composite media: a comparative study" *Physica B.* (2007) Crossref.
- Sachdev VK et al.: "Electromagnetic Shielding Performance Of Graphite In Cement Matrix For Applied Application" *Advanc Mater Letters.* (2015) Abstract.
- Schooneveld H et al: "Electromagnetic field reduction restores health of electro-sensitive people" *Electrohypersensitivity (EHS) Foundation, The Netherlands*, 3rd ed. (2016).
- Shah MA et al.: "Microwave absorption by water in building materials: Aerated concrete" *Br J Appl Phys.* (1965) abstract.
- Singh AP et al.: "Graphene oxide/ferrofluid/cement composites for electromagnetic interference shielding application" *Nanotechnology.* (2011) Crossref.
- Singh AP et al.: "Multiwalled carbon nanotube/cement composites with exceptional electromagnetic interference shielding properties" *Carbon.* (2013) Crossref.
- Vizi GN et al.: "Building materials and electromagnetic radiation: The role of material and shape" *J Build Eng.* (2016) Abstract. Article.
- Wang BM et al.: "Electromagnetic wave absorbing properties of multi-walled carbon nanotube/cement composites" *Constr Build Mater.* (2013) Crossref.
- Wang ZJ et al.: "Freezing–thawing effects on electromagnetic wave reflectivity of carbon fiber cement based composites" *Constr Build Mater.* (2014) Crossref.
- Wen SH et al.: "Electromagnetic interference shielding reaching 70 dB in steel fiber cement" *Cement Concr Res.* (2004) Crossref. Article.
- Xie S et al.: "Effect of 3D woven fabrics on the microwave absorbing and mechanical properties of gypsum composites using carbon black as an absorbent" *Mater Res Express.* (2017) IOPscience.
- Zhang XZet al.: "Microwave absorbing properties of double-layer cementitious composites containing Mn–Zn ferrite" *Cement Concr Compos.* (2010) Crossref.

(b) Shielding: clothing

Traditionally, fabric with silver wire inserted was used for clothing and nets. Research progresses on the use of stainless steel fibres and similar materials in a variety of weaves.

- Chen HC et al.: "Electromagnetic and Electrostatic Shielding Properties of Co-weaving-knitting Fabrics Reinforced Composites" *Compo. Part A: Appl Sci Manufacturing.* (2004) Crossref.
- Chen HC et al.: "Electromagnetic Shielding Effectiveness of Copper/Stainless Steel/Polyamide Fiber Co-Woven-Knitted Fabric Reinforced Polypropylene Composites" *J Reinforced Plast Composites.* (2008) Abstract.
- Cheng KB et al.: "Electromagnetic shielding effectiveness of copper/glass fibers knitted fabric reinforced polypropylene composites" *Composites Part A: Appl Sci Manufacturing.* (2000) Crossref.
- Cheng KB et al.: "Electromagnetic Shielding Effectiveness of Stainless Steel/Polyester Woven Fabrics" *Textile Res J.* (2001) Abstract.
- Cheng L et al.: "Electromagnetic shielding effectiveness and mathematical model of stainless steel composite fabric" *J Text Instit.* (2015) Abstract.
- Das A et al.: "Effect of various parameters on electromagnetic shielding effectiveness of textile fabrics" *Indian J Fibre Text Res.* (2009) Article.
- Duran D et al.: "Electromagnetic shielding characterization of conductive woven fabrics produced with silver-containing yarns" *Text Res J.* (2015) Abstract.
- Ozen MS: "Investigation of the electromagnetic shielding effectiveness of carded and needle bonded nonwoven fabrics produced at different ratios with conductive steel fibers" *J Eng Fibers Fabr.* (2015) Article.
- Ozen MS et al.: "Investigation of electromagnetic shielding effectiveness of needle punched nonwoven fabric produced from conductive silver coated staple polyamide fibre" *J Text Instit.* (2016) Abstract.

- Palanisamy S et al: "Study on textile comfort properties of polypropylene blended stainless steel woven fabric for the application of electromagnetic shielding effectiveness" *IOP Conf Ser.: Mater Sci Eng.* (2017) Article.
- Safarova V et al.: "Electromagnetic field shielding fabrics with increased comfort properties" *Adv Mat Res.* (2013) Article.
- Su CI et al.: "Effect of stainless steel containing fabrics on electromagnetic shielding effectiveness" *Text Res J.* (2004) Abstract.
- Tezel S et al.: "Comparison of electromagnetic shielding effectiveness of conductive single jersey fabrics with coaxial transmission line and free space measurement techniques" *Text Res J.* (2014) Abstract.

(c) Treatment

Most doctors advocate elimination or reduction of exposure to electromagnetic energy as the first protocol in the treatment of electrosensitivity. This may involve the removal of sources of electromagnetic energy, or protection and shielding from them.

- Belyaev I et al.: "EUROPAEM EMF Guideline 2016 for the prevention, diagnosis and treatment of EMF-related health problems and illnesses" *Rev Environ Health.* (2016) PMID: 27454111; pdf.
- Hagström M et al: "Electromagnetic hypersensitive Finns: Symptoms, perceived sources and treatments, a questionnaire study" *Pathophysiology.*(2013) PMID: 23557856; pdf.
- Hagström M et al: "Reducing electromagnetic irradiation and fields alleviates experienced health hazards of VDU work" *Pathophysiology*. (2013) PMID: 22364840.
- Heuser G: "EMF/EHS Induced Injury and Sensitivity: Evaluation and Treatment" (pdf)
- Heuser G: Testing Protocol.
- Schooneveld H et al: "Electromagnetic field reduction restores health of electro-sensitive people" *Electrohypersensitivity (EHS) Foundation, The Netherlands*, 3rd ed. (2016).

7. Living with EHS: Functional impairment, socio-economic effects, human rights; Use of meters

Functional impairment, socio-economic effects, human rights:

- Budzinski BI et al: "White zones", free from mobile phone coverage – unrealistic or required by law?" *Neue Zeitschrift für Verwaltungsrecht* (2015) trans.
- Crumpler S: "MCS and EHS: An Australian Perspective" *Ecopsychology.* (2017) link.
- D'Agnolo L: "Are "Wi-Fi Allergies" an Impairment Covered by the ADA?" *Nat Law Rev.* (2017) article.
- Eberle S: "An Underworld Journey: Learning to Cope with Electromagnetic Hypersensitivity" *Ecopsychology.* (2017) link.
- Evans J: "Displaced by Chemical and Electrical Hypersensitivities" *Ecopsychology.* (2017) link.
- Gibson PR: "Introduction to the Special Issue on Environmental Sensitivities: Living on the Margins with Access Denied" *Ecopsychology.* (2017) link.
- Gibson PR et al.: "Unmet health care needs for persons with environmental sensitivity" *J Multidiscip Healthc.* (2015) PMID: 25670904; pdf.
- Johansson O: "Electrohypersensitivity: a functional impairment due to an inaccessible environment" *Rev Environ Health* (2015) PMID: 26613327; pdf.
- Johansson O.: "Electrohypersensitivity; State-of-the-Art of a Functional Impairment" *El Biol & Med.* (2006) PMID: 17178584.
- Kato Y et al.: "Reported functional impairments of electrohypersensitive Japanese: A questionnaire survey" *Pathophysiology.* (2012) PMID: 22458999.
- Massey KA: "The Challenge of Nonionizing Radiation: A Proposal for Legislation" *Duke Law J.* (1979) pdf.
- Richman R et al.: "A pilot neighborhood study towards establishing a benchmark for reducing electromagnetic field levels within single family residential dwellings" *Sci Total Environ.* (2014) PMID: 23962434.
- Roda C et al.: "Mobile phone infrastructure regulation in Europe: Scientific challenges and human rights protection" *Environ Sci Policy.* (2014) Abstract. Article.
- Stenberg B et al.: "Medical and social prognosis for patients with perceived hypersensitivity to electricity and skin symptoms related to the use of visual display terminals" *Scand J Work Environ Health* (2002) PMID: 12432989; pdf.

Use of meters:

- Dieudonné M: "L'instrumentation profane. Sur l'usage d'instruments de mesure des champs électro-magnétiques par les personnes électro-hypersensibles" [Lay InstrumentationOn Electro-hypersensitive Persons' Use of Electromagnetic Field Measuring Devices] *Rev d'anthropologie des connaissances.* (2016) Abstract.
- Milham S: "An off-the-shelf meter for measuring body amperage: A new gold standard for epidemiologic studies?" *Electromagn Biol Med.* (2017) PMID: 28650676; pdf.

8. Legislation relevant to EHS:

European and International Resolutions
Global health
Nuremberg Code
UK early health retirement and DWP support allowances
UK disability and equality legislation
UK EMF legislation
UK health & safety legislation
United Nations
USA accommodation for people with EHS

European and International Resolutions:

- Council of Europe: Resolution 1815 (Parliamentary Assembly, 2011) Point 8.1.4:
  "Pay particular attention to 'electrosensitive' people who suffer from a syndrome of intolerance to electromagnetic fields and introduce special measures to protect them, including the creation of wave-free areas not covered by the wireless network."
- European Union: Parliamentary Resolution (2008/2211(INI)) (2009) Point 28:
  "Calls on Member States to follow the example of Sweden and to recognise persons that suffer from electrohypersensitivity as being disabled so as to grant them adequate protections as well as equal opportunities."
- European Union: PECCEM: (October 25 2016):
  "Open letter to the European Economic and Social Committee (EESC): to repair the damage caused by the conflicts of interest and procedural irregularities in its midst arising from the adoption of the counter-opinion on electromagnetic hypersensitivity (EHS)"
- International Justice Resource Centre: Committee on the Rights of Persons with Disabilities: Accessibility:
  "As long as goods, products and services are open or provided to the public, they must be accessible to all, regardless of whether they are owned and/or provided by a public authority or a private enterprise."
  "The strict application of universal design to all new goods, products, facilities, technologies and services should ensure full, equal and unrestricted access for all potential consumers, including persons with disabilities, in a way that takes full account of their inherent dignity and diversity."

Global Health:

- Hyland GJ: "Environmental Impact of Electrosmog" in: Clements-Croome D (ed.): "Electromagnetic Environments and Health in Buildings" Spon Press, Taylor & Francis (2004) p.162.
- Oberfeld G: "Precaution in Action - Global Public Health Advice Following BioInitiative 2007" *Bionitiative* (2012) pdf.

Nuremberg Code:

For the general public, (i) the absence of definitive findings about the long-term health effects of exposure to EM energy, and (ii) the absence of knowledge and voluntary consent about enforced irradiation with EM exposure, suggest that governments are indulging in a massive health experiment without voluntary and informed consent, contravening the Nuremberg Code of 1947.
Ten principles of the Nuremberg Code:

1. Required is the voluntary, well-informed, understanding consent of the human subject in a full legal capacity.
2. The experiment should aim at positive results for society that cannot be procured in some other way.
3. It should be based on previous knowledge (e.g., an expectation derived from animal experiments) that justifies the experiment.
4. The experiment should be set up in a way that avoids unnecessary physical and mental suffering and injuries.

5. It should not be conducted when there is any reason to believe that it implies a risk of death or disabling injury.
6. The risks of the experiment should be in proportion to (that is, not exceed) the expected humanitarian benefits.
7. Preparations and facilities must be provided that adequately protect the subjects against the experiment's risks.
8. The staff who conduct or take part in the experiment must be fully trained and scientifically qualified.
9. The human subjects must be free to immediately quit the experiment at any point when they feel physically or mentally unable to go on.
10. Likewise, the medical staff must stop the experiment at any point when they observe that continuation would be dangerous.

The Nuremberg Code

UK allowances and health retirement:

The following have been awarded in the UK since 2012 to people with EHS, including Department of Work (DWP) and Pensions allowances:

- Early retirement on health grounds
- ESA (Employment and Support Allowance)
- JSA (Job Seeker's Allowance) exemptions
- PIP (Personal Independence Payment)

see ES-UK Newsletters

UK disability and equality legislation:

- Equality Act 2010
- Equality Act: Recruitment
- Flexible Working Regulations (2014)

UK EMF legislation:

- HSE: "Electromagnetic Fields at Work: A guide to the Control of EMFs at Work Regulations: 2016",

UK health & safety legislation:

- Health and Safety at Work Act 1974

United Nations:

Basic human rights, such as choosing where to live and work, are often denied for people with EHS.

- United Nations: "Convention on the Rights of Persons with Disabilities" (2006)
- United Nations: "The Standard Rules on the Equalization of Opportunities for Persons with Disabilities" (1993)
- United Nations: "The Universal Declaration of Human Rights" (1948)

USA accommodation for people with EHS:

- USA's Department of Labor: Job Accommodation Network (JAN)

9. Diagnostic markers

Physiological objective markers for EHS are becoming well established and now include:

- *3d fMRI brain scans showing changes in blood flow*
- *cerebral blood perfusion scans*
- *genetic variants up to 10 times more common*
- *markers such as heat shock protein, melatonin, saliva alpha amylase*

- Andrianome S et al.: "Increasing levels of saliva alpha amylase in electrohypersensitive (EHS) patients" *Int J Radiat Biol.* (2017) PMID: 28466664.
- Austrian Medical Association: *"Guideline of the Austrian Medical Association for the diagnosis and treatment of EMF related health problems and illnesses (EMF syndrome)"* (2012) pdf.
- Belpomme D et al: "Reliable disease biomarkers characterizing and identifying electrohypersensitivity and multiple chemical sensitivity as two etiopathogenic aspects of a unique pathological disorder" *Rev Environ Health* (2015) PMID: 26613326; pdf.
- Belyaev I et al.: "EUROPAEM EMF Guideline 2016 for the prevention, diagnosis and treatment of EMF-related health problems and illnesses" *Rev Environ Health* (2016) PMID: 27454111; pdf.
- De Luca C et al: "Metabolic and genetic screening of electromagnetic hypersensitivity subjects as a feasible tool for diagnostics and intervention" *Mediators Inflamm.* (2014) PMID: 24812443; pdf.
- Heuser G et al.: "Functional brain MRI in patients complaining of electrohypersensitivity after long term exposure to electromagnetic fields" *Rev Environ Health.* (2017) PMID: 28678737; pdf. Heuser G et al.: "Corrigendum" *Rev Environ Health.* (2017) PMID: 29206645.
- Heuser G: Testing Protocol.
- Nordic Council of Ministers: "The Nordic Adaptation of Classification of Occupationally Related Disorders (Diseases and Symptoms) to ICD-10" (2000) pdf; p.33 (ICD-10.R68.8), p.55.

10. Biological safety guidelines; criticism of heating-only guidelines; actual levels

(a) Necessity of biological safety guidelines for sensitive people
(b) Biological safety guidelines
(c) Objective biological safety guidelines
(i) Radiofrequency safety guideline markers
(ii) Power line safety guideline markers
(d) Criticism of heating safety guidelines: FCC, WHO and ICNIRP
(e) Appeal to UN and WHO for biological safety guidelines
(f) Biological long-term safety guidelines
(g) Heating short-term guidelines (6 minutes)
(h) Natural levels
(i) Typical exposure levels
(j) Risk assessment for EHS and related EM effects
(k) Utilitarian 'cost' argument; difference between:
(i) Stochastic cancer death risk from ionising radiation, and
(ii) Deterministic EHS 'living death' risk from non-ionising radiation
(l) Subservience of WHO to IAEA on radiation
(m) UK's switch from AGNIR to COMARE
(n) Radio frequency radiation safety guidelines (chart)

(a) Necessity if biological safety guidelines for sensitive people

Biological guidelines for electromagnetic exposure need to cover particularly vulnerable members of the general public, such as children, the ill, the elderly and those sensitive or intolerant to such EM exposure.

The WHO's private group ICNIRP has instructed governments that they need to adopt non-thermal guidelines to protect such people, and especially "certain sensitive individuals". The UK says that it follows ICNIRP but it has not followed this advice yet.

- ICNIRP: "General approach to protection against non-ionizing radiation" *Health Phys.* (2002) PMID: 11906144.
"Different groups in a population may have differences in their ability to tolerate a particular Non-Ionizing Radiation (NIR) exposure. For example, children, the elderly, and some chronically ill people might have a lower tolerance for one or more forms of NIR exposure than the rest of the population. Under such circumstances, it may be useful or necessary to develop separate guideline levels for different groups within the general population, but it may be more effective to adjust the guidelines for the general population to include such groups."
"Some guidelines may still not provide adequate protection for certain sensitive individuals nor for normal individuals exposed concomitantly to other agents, which may exacerbate the effect of the NIR exposure, an example being individuals with photosensitivity."

- UK's Health & Safety Executive's Guide: Control of Electromagnetic Fields at Work Regulations 2016:
'Employees at particular risk': sections 49-61; pages 17-22:
"You must give special consideration to the safety of employees at particular risk (even if you are in compliance with the exposure limits)." (section 49, page 17)
Risks for employees at particular risk can be at non-thermal levels, including WiFi, Bluetooth, mobile phones and cordless phones, for pregnant women and those with active or passive medical implants, even when the employer has provided an environment in compliance with the ICNIRP heating-only guidelines.
Employees intolerant of electromagnetic exposures are likely to be "at particular risk".

Employers, once notified, have to undertake a risk assessment and then take special consideration of such employees.

- Statutory Instruments (2016): No. 588 HEALTH AND SAFETY: The Control of Electromagnetic Fields at Work Regulations 2016.
  (Non-thermal electromagnetic sensitivity symptoms:
  Part 1: *"employee at particular risk" means: (a) "an employee who has declared to his or her employer a condition which may lead to a higher susceptibility to the potential effects of exposure to electromagnetic fields."* (p.2)
  Part 1: 2 (b) *"non-thermal effects, related to the stimulation of nerves or sensory organs due to the presence of electromagnetic fields."* (p.8)
  Part 2: Direct biophysical effects of exposure Action levels – non-thermal effects (p.9)
  Exposure limit values: non-thermal effects: Table ELV1: (b) *"protection measures have been adopted which minimise, so far as is reasonably practicable, the sensory effects related to movement in static magnetic fields, including nausea and vertigo."* (p.11)

- Directive 2013/35/EU of the European Parliament and of the Council of 26 June 2013 on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (electromagnetic fields):
  Electromagnetic intolerance symptoms:
  Article 2(b) (ii) *"Non-thermal effects, such as the stimulation of muscles, nerves or sensory organs. These effects might have a detrimental effect on the mental and physical health of exposed workers. Moreover, the stimulation of sensory organs may lead to transient symptoms, such as vertigo or phosphenes. These effects might create temporary annoyance or affect cognition or other brain or muscle functions, and may thereby affect the ability of a worker to work safely (i.e. safety risks)."*
- Gandhi OP et al.: "Exposure limits: the underestimation of absorbed cell phone radiation, especially in children" *Electromagn Biol Med.* (2012) PMID: 21999884. Article.

(b) Biological safety guidelines

Biological guidelines are provided by the expert groups in this field, such as Bioinitiative, Building Biology, EUROPAEM, Seletun, Salzburg, etc.

Typical values for sensitive people are:

- *10 nanoTesla (magnetic fields, 50 Hz),*
- *0.006 Volts/metre (peak electric fields, microwave frequencies),*
- *1 Volt/metre (electric fields, 50 Hz).*

Power Flux Density and SAR are heating metrics, not directly relevant to non-thermal ES/EHS.

- BioInitiative Report: "A Rationale for Biologically-based Public Exposure Standards for Electromagnetic Fields (ELF and RF)" (2012).
- Building Biology: Guidelines (2008).
- EUROPAEM EMF Guidelines (ELF and RF) (2016).
- Fragopoulou A et al.: "Scientific panel on electromagnetic field health risks: consensus points, recommendations, and rationales" *Rev Environ Health.* (2010) PMID: 21268443.
- Salzburg: "Precautionary limits" (2002).

(c) Objective biological safety guidelines

Safety guidelines should be based on objective biological measures, such as DNA fragmentation, cell hydration, miRNA effects, oogenesis, VGCC effects and nitric oxide (NO). Some are especially suited to either radiofrequency or ELF.

The outdated and invalidated heating hypothesis by Schwan of 1953 with its modelling of tissue heating qualities (SAR: Specific Absorption Rate) is irrelevant to most health outcomes, such as cancers, cardiovascular effects, DNA damage, EHS, fertility impairment and neurological effects.

(i) Radiofrequency safety guideline markers

- Ayrapetyan S et al: "Cell hydration as a biomarker for estimation of biological effects of nonionizing radiation on cells and organisms" *Scientific World Journal.* (2014) PMID: 25587574.
- Belyaev IY: "Dependence of non-thermal biological effects of microwaves on physical and biological variables: implications for reproducibility and safety standards" *Eur J Oncol Library.* (2010) article.
- Belyaev I: "Non-thermal biological effects of microwaves" *Mikrotalasna revija. [Microwave Rev.]* (2005) article.
- Blank M et al.: "Electromagnetic fields and health: DNA-based dosimetry" *Electromagn Biol Med.* (2012) PMID: 22676645.
- Margaritis LH et al: "Drosophila oogenesis as a bio-marker responding to EMF sources" *Electromagn Biol Med.* (2014) PMID: 23915130.
- Pall ML: "How to Approach the Challenge of Minimizing Non-Thermal Health Effects of Microwave Radiation from Electrical Devices" *Int J Innovat Res Engin Management (IJIREM).* (2015) pdf.

(ii) Power line safety guideline markers

- Ayrapetyan S et al: "Cell hydration as a biomarker for estimation of biological effects of nonionizing radiation on cells and organisms" *Scientific World Journal.* (2014) PMID: 25587574.
- Blank M et al.: "Electromagnetic fields and health: DNA-based dosimetry" *Electromagn Biol Med.* (2012) PMID: 22676645.
- Li H et al.: "Exosomal Small RNA Sequencing Uncovers the microRNA Dose Markers for Power Frequency Electromagnetic Field Exposure" *Biomarkers.* (2018) PMID: 29297241.
- Liu Y et al.: "Overexpression of miR-26b-5p regulates the cell cycle by targeting CCND2 in GC-2 cells under exposure to extremely low frequency electromagnetic fields" *Cell Cycle.* (2016) PMID: 26637059. PMC4943694.

(d) Criticism of heating safety guidelines: FCC, WHO and ICNIRP

The ICNIRP 1998 Guidelines are for short-term 6-minute heating effects only and not long-term non-thermal effects:
"These guidelines are based on short-term, immediate health effects such as stimulation of peripheral nerves and muscles, shocks and burns … and elevated tissue temperatures resulting from absorption of energy during exposure to EMF"
and they do not protect against *"potential long-term effects of exposure, such as an increased risk of cancer".*
(ICNIRP: Guidelines, 1998)
The Guidelines are for short-term measurements averaged over 0.1 hour (6 minutes). This was established in the USA in 1966, for 10 mW/cm^2 [100,000,000 μW/m^2] for frequencies 10 MHz to 100 GHz, the heating limit suggested by Herman Schwan in 1953.

- ANSI (American National Standards Institute) C95.1-1966: "Safety Level of Electromagnetic Radiation With Respect to Personnel"

The heating metric SAR was introduced in 1982 in the USA in response to Schwan's mistaken heating hypothesis of 1953.

- ANSI C95.1-1982: "American National Standard safety levels with respect to human exposure to radio frequency electromagnetic fields, 300 kHz to 100 GHz" Standard.

In 1991 in the USA the IEEE adopted 0.08 W/kg for whole body exposure and 1.6 W/kg for a 1cm cube of tissue.

- ANSI/IEEE C95.1-1991: "IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 KHz to 300 GHz" Standard.
- IEEE C95.1–2005: "Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz" Standard.

In comparison, in 1970 the USSR limits were:

0.1 W/m^2 [100,000 μW/m^2] up to 8 hours,
10 W/m2 [10,000,000 μW/m^2] up to 20 minutes, but 0.1 W/m^2 must not be exceeded at any other time during the day.

In comparison, in 2012 the Bioinitiative guidelines were:

6 μW/m^2 for the general population
3 μW/m^2 for children and sensitive people within the general population.

The ICNIRP Guidelines, like the FCC's in the USA, do not protect against any effects of EM energy except acute heating of one degree within 6 minutes:

"The FCC's current exposure guidelines, as well as those of the Institute of Electrical and Electronics Engineers (IEEE) and the International Commission on Non-ionizing Radiation Protection, are thermally based, and do not apply to chronic, nonthermal exposure situations. They are believed to protect against injury that may be caused by acute exposures that result in tissue heating or electric shock and burn. The FCC's exposure guideline is considered protective of effects arising from a thermal mechanism but not from all possible mechanisms. Therefore, the generalization by many that the guidelines protect human beings from harm by any or all mechanisms is not justified." (US, EPA: Norbert Hankin: Letter to Janet Newton, July 6 2002)

The long-invalidated heating-only hypothesis, used by the small clique of regulators adopting this minority viewpoint, has been frequently criticised by the leading experts, now that non-thermal effects are well established.

There are also five common misconceptions about heating-only guidelines:

(i) Heating-only proponents, like ICNIRP, accept adverse non-thermal affects at ELF; since WiFi and mobile phones emit ELF as well as RF, this means that ICNIRP should also accept that WiFi and mobile phones can have adverse non-thermal effects.

(ii) Some heating-only proponents claim that ICNIRP's heating guidelines, defined by SAR or temperature rise, relate also to homeostasis or thermoregulation. Homeostasis or thermoregulation, however, where there is no significant temperature rise, are biological processes which are different from a rise in temperature. ICNIRP guidelines do not aim to prevent these biological processes, but only a rise in temperature.

(iii) Many biological processes produce much greater temperature rises in the body than the one degree rise which is used as the maximum permissible by ICNIRP's heating hypothesis. If ICNIRP's heating hypothesis is correct, ICNIRP would also need to ban all human exercise which produces a temperature rise of more than one degree averaged over 6 minutes.

(iv) Established non-thermal biological processes are non-linear, unlike the heating hypothesis using SAR and power density. Thus biological effects depend on frequency, modulation and temporal exposure pattern, not necessarily on a dose-dependent or linear response. This makes these biological effects different from common dose-response models used in many areas of toxicology, since the body relies on its own EM signalling pathways which can be influenced by exogenous radiation.

(v) Heating-only proponents, like ICNIRP, accept that "certain sensitive people" need biological safety guidelines below ICNIRP's heating-only guidelines. See above Section 4(a).

- Bailey WH ET AL.: "Accounting for human variability and sensitivity in setting standards for electromagnetic fields" *Health Phys.* (2007) PMID: 17495668.
- Bandara P et al.: "Letter to the Editor [Wifi exposure in Australian schools]" *Rad Prot Dosimetry* (2017) doi.org/10.1093/rpd/ncx108; pdf.
- Bandara P et al.: "Cardiovascular disease: Time to identify emerging environmental risk factors" *Eur J Prev Cardiol.* (2017) PMID: 28969497; pdf.
- Frey AH: "Is a toxicology model appropriate as a guide for biological research with electromagnetic fields?" *J Bioelect.* (1990) pdf.
- Frey AH: "Biological function as influenced by low power modulated RF energy" *IEEE Trans Microwave Theory and Techniques.* (1971) pdf.
- Grigoriev Y: "Methodology of Standards Development for EMF RF in Russia and by International Commissions: Distinctions in Approaches" in Markov M (ed.) (2017) *Dosimetry in Bioelectromagnetics* (2017) ISBN: 978-1498774130; pdf.
- Hardell L et al.: "Biological effects from electromagnetic field exposure and public exposure standards" *Biomed Pharmacother.* (2008) PMID: 18242044.
- Hardell L: "World Health Organization, radiofrequency radiation and health – a hard nut to crack (Review)" *Int J Oncology.* (2017) PMID: 28656257. PMC5504984.
- Hensinger P et al.: "Wireless communication technologies: New study findings confirm risks of nonionizing radiation" *umwelt-medizin-gesellschaft.* (2016) pdf.
- Iakimenko IL et al.: [Metabolic changes in cells under electromagnetic radiation of mobile communication systems] *Ukr Biokhim Zh (1999).* (2011) PMID: 21851043.
- Johansson O: "Disturbance of the immune system by electromagnetic fields - A potentially underlying cause for cellular damage and tissue repair reduction which could lead to disease and impairment" *Pathophysiology.* (2009) PMID: 19398310.
- Lan JQ et al.: "On the effects of glasses on the SAR in human head resulting from wireless eyewear devices at phone call state" *Prog Biophys Mol Biol.* (2018) PMID: 29428220.
- Leszczynski D ET AL.: "Mobile phone radiation health risk controversy: the reliability and sufficiency of science behind the safety standards" *Health Res Policy Syst.* (2010) PMID: 20205835; pdf.
- Marino AA et al.: "Trigeminal neurons detect cellphone radiation: Thermal or nonthermal is not the question" *Electromagn Biol Med.* (2017) PMID: 27419655.
- Markov M et al.: "Protect children from EMF" *Electromagn Biol Med.* (2015) PMID: 26444201.
- Markovà E et al.: "Microwaves from GSM mobile telephones affect 53BP1 and gamma-H2AX foci in human lymphocytes from hypersensitive and healthy persons" *Environ Health Perspect.* (2005) PMID: 16140623. PMC1280397.
- Pall ML: "Scientific evidence contradicts findings and assumptions of Canadian Safety Panel 6: microwaves act through voltage-gated calcium channel activation to induce biological impacts at non-thermal levels, supporting a paradigm shift for microwave/lower frequency electromagnetic field action" *Rev Environ Health.* (2015) PMID: 25879308.
- Panagopoulos DJ et al.: "Evaluation of specific absorption rate as a dosimetric quantity for electromagnetic fields bioeffects" *PLoS One.*(2013) PMID: 23750202.
- Redmayne M: "International policy and advisory response regarding children's exposure to radio frequency electromagnetic fields (RF-EMF)" *Electromagn Biol Med.* (2015) PMID: 26091083.

- Rubtsova N et al.: "Intensity-time dependence dosing criterion in the EMF exposure guidelines in Russia" *Electromagn Biol Med.* (2018) PMID: 29493302.
- Sage C et al.: "Comments on SCENIHR: Opinion on potential health effects of exposure to electromagnetic fields, Bioelectromagnetics 36:480-484 (2015)" *Bioelectromagnetics.* (2015) PMID: 26688202; RG.
- Sagioglou NE et al: "Apoptotic cell death during Drosophila oogenesis is differentially increased by electromagnetic radiation depending on modulation, intensity and duration of exposure" *Electromagn Biol Med.* (2016) PMID: 25333897.
- Sarkar S et al.: "Effect of low power microwave on the mouse genome: a direct DNA analysis" *Mutat Res.* (1994) PMID: 7506381.
- Starkey SJ: "Inaccurate official assessment of radiofrequency safety by the Advisory Group on Non-ionising Radiation" *Rev Environ Health.* (2016) PMID: 27902455; pdf.
- Steneck NH et al.: "The origins of U.S. safety standards for microwave radiation" *Science.* (1980) PMID: 6990492.
- Webster PC: "Federal Wi-Fi safety report is deeply flawed, say experts" *CMAJ.*(2014) PMID: 24756628; pdf.
- Yakymenko I et al.: "Long-term exposure to microwave radiation provokes cancer growth: evidences from radars and mobile communication systems" *Exp Oncol.* (2011) PMID: 21716201.

(e) Appeal to UN and WHO for biological safety guidelines

The EMF Scientist Appeal, to the Secretary-General of the United Nations and the Director-General of the WHO, is now signed by over 200 experts in this field who accept the majority non-thermal viewpoint. It shows how urgently governments should adopt biological guidelines, like the USSR and a growing number of other countries since the 1950s, and not align with minority viewpoint represented by ICNIRP and a small clique of industry and pro-wireless activists.

- The International Electromagnetic Field Scientist Appeal, submitted on May 11 2015 to His Excellency Ban Ki-moon, Secretary-General of the United Nations; Honorable Dr. Margaret Chan, Director-General of the World Health Organization; Honorable Achim Steiner, Executive Director of the U.N. Environmental Programme; U.N. Member Nations.

(f) Biological long-term safety guidelines

EUROPAEM EMF Guideline 2016: international biological safety guidelines:
for EHS and sensitive people:
0.1 uW/m2 = 0.006 V/m *for: WiFi 2.45 GHz WiFi 5.6 GHz, DAB+ (10 Hz pulsing)*
1 uW/m2 = 0.019 V/m *for: DECT cordless phones, GMS (2G), UMTS (3G), LTE (4G):*
EUROPAEM 2016 international safety guidelines: Table 3; Table 4.

- *Belyaev I et al.: "EUROPAEM EMF Guideline 2016 for the prevention, diagnosis and treatment of EMF-related health problems and illnesses" *Rev Environ Health* (2016) PMID: 27454111. Article.

Bioinitiative 2012 international biological safety guidelines:
3 uW/m2 *for: sensitive population*
6 uW/m2 *for: general population* Bioinitiative 2012

Seletun Scientific Panel (2010)

- Fragopoulou A et al.: "Scientific panel on electromagnetic field health risks: consensus points, recommendations, and rationales" *Rev Environ Health.* (2010) PMID: 21268443; pdf.

The guidelines below are for the general population, not people sensitive to EM exposure.

New buildings:	ELF:	100 nT
Environment:	RF:	0.000033 W/kg whole body
	RF:	170 uW/m2 (precautionary)

International Institute for Building-Biology and Ecology (2008)

"Building Biology Evaluation Guidelines for Sleeping Areas" 7th edition (2008):

No concern:	ELF:	<20 nT	
	RF:	<0.006 V/m	
	RF:	<0.1 uW/m2	BB Guidelines (2008), (website)

Salzburg, new (2002):

Outdoors:	RF:	10 uW/m2	
Indoors:	RF:	1.0 uW/m2	"Precautionary limits"; list

(g) Heating short-term guidelines (6 minutes)

The WHO/ICNIRP short-term heating guidelines are to prevent a temperature rise of one degree in six minutes:

200,000 nT (50 Hz), 400,000,000 nT (static)
4.0 W/kg (limbs); 2.0 W/kg (head); 0.08 W/kg (average whole body)
4,500,00 uW/m2 (900 MHz); 9,200,000 (1,800 MHz)
61 V/m (1,952 V/m peaks allowed) ICNIRP 1998

(h) Natural levels

0.0013 nT
<0.00002 W/kg
0.00000 uW/m2
0.00002 V/m

(i) Typical exposure levels

- Bhatt CR et al.: "Radiofrequency-electromagnetic field exposures in kindergarten children" *J Expo Sci Environ Epidemiol.* (2016) PMID: 27759027.
  In 20 ***kindergartens,*** *over 16 frequency bands between 88 MHz and 5.8 GHz,*
  the median environmental exposure was 0.179 V/m
  and the median personal exposure of children was 0.081 V/m.

- Hardell L et al: "Radiofrequency radiation at Stockholm Central Railway Station in Sweden and some medical aspects on public exposure to RF fields" *Int J Oncol.* (2016) PMID: 27633090.
  In a ***railway station*** *there was*
  a mean of 921 uW/m2 with outliers up to 95,500 uW/m2
  and mean total for walkabouts of 2,800 to 4,900 uW/m2.

- Hedendahl LK at al.: "Measurements of Radiofrequency Radiation with a Body-Borne Exposimeter in Swedish Schools with Wi-Fi" *Front Public Health.* (2017) PMID: 29214149. PMC5703119.

Among 18 teachers from 7 ***schools*** *for RF:*
mean: 1.1 to 66.1 μW/m²
highest mean: 397 μW/m² (during 5 min when students watched YouTube videos)
maximum peaks, from mobile phone uplink: 82,857 μW/m².

- Kurnaz C et al.: "Monitoring of RF/Microwave field strength at schools in a pilot district in Samsun/Turkey" *IEEE 16th Mediterranean Microwave Symposium (MMS),* (2016) abstract.
  In 92 ***schools***
  the maximum electric fields were 5.39 V/m and 3.04 V/m,
  while the maximum averages were 2.22 and 2.25 V/m.

- Mamrot P et al.: "Electromagnetic fields in the vicinity of DECT cordless telephones and mobile phones" *Med Pr.* (2015) PMID: 26674167.
  DECT cordless phone handsets:
  0.26-2.30 V/m (at 0.05 m); 0.18-0.26 V/m (at 1 m).
  DECT cordless telephones base units:
  1.78-5.44 V/m (at 0.05 m); 0.19-0.41 V/m (at 1 m).
  Mobile phones (GSM with voice):
  2.34-9.14 V/m (at 0.05 m); 0.18-0.47 V/m (at 1 m).
  Mobile phones (WCDMA):
  0.22-1.83 V/m (at 0.05 m); 0.18-0.20 V/m (at 1 m).

- Peyman A et al.: "Exposure to electromagnetic fields from smart utility meters in GB; part I) laboratory measurements" *Bioelectromagnetics.* (2017) PMID: 28324620.
  Smart Meters:
  15,000 uWm2 (max.) (at ≥0.5m);
  one outlier: 91,000 uWm2 (max.).

- Sagar S et al.: "Radiofrequency electromagnetic field exposure in everyday microenvironments in Europe: A systematic literature review" *J Expo Sci Environ Epidemiol.* (2018) PMID: 28766560.
  21 studies on the everyday microenvironments in Europe, 2000-2015:
  Mean total RF-EMF spot measurements: Homes: 0.29 V/m; Outdoor: 0.54 V/m
  Personal (trained researchers): Home: 0.24 V/m; Outdoor: 0.76 V/m.
  Personal (volunteers): Homes: 0.16 V/m; Outdoor: 0.20 V/m
  Transportation: highest mean total:
  1.96 V/m trains (Belgium 2007, >95% of exposure from uplink)

- Sagar S et al.: "Comparison of radiofrequency electromagnetic field exposure levels in different everyday microenvironments in an international context" *Envir Intern.* (2018) Abstract.
  RF-EMF exposure in 94 outdoor worldwide microenvironments and 18 public transport vehicles. Taken either by walking with a backpack for 30 min, or driving a car with roof-mounted for 15–20 min, with a sampling rate of once every 4 s (ExpoM-RF) and 5 s (EME Spy 201).
  Mean total RF-EMF exposure:
  Outdoors:
  from 0.23 V/m (non-central residential, Switzerland) to 1.85 V/m (university, Australia),
  Public transport:
  from 0.32 V/m (bus, rural, Switzerland) to 0.86 V/m (auto rickshaw, urban, Nepal).
  In most outdoor areas: major contribution: mobile phone base stations.
  Otherwise: broadcasting dominant.
  Mobile phone uplink generally very small, except in Swiss trains and some Swiss buses.

- Urbinello D et al.: "Radio-frequency electromagnetic field (RF-EMF) exposure levels in different European outdoor urban environments in comparison with regulatory limits" *Environ Int.* (2014) PMID: 24704639.

  In 2011-12, on 12 different days, every 4s for 15-30 min per area, repeated 12 times over 1 year:

  Basel, Switzerland (limit: 4-6 V/m):

  outdoor areas for mobile phone base stations: 0.22 V/m (mean)

  Amsterdam, Netherlands (limit: 41-61 V/m):

  outdoor areas for mobile phone base stations: 0.41 V/m (mean)

- Verloock L et al.: "Assessment of radio frequency exposures in schools, homes, and public places in Belgium" *Health Phys.* (2014) PMID: 25353235.

Schools:	*0.2 V/m average; 3.2 V/m maximal (WiFi).*
Homes:	*0.1 V/m average; 1.1 V/m maximal (telecommunication).*
Public places:	*0.6 V/m average; 2.4 V/m maximal (telecommunication).*
Offices:	*0.9 V/m average; 3.3 V/m maximal (telecommunication).*

(j) Risk assessment for EHS and related EM effects

- Aalam N: "Radio frequency radiation exposure, health hazards and risk assessment strategies" IEEExplore (2017) abstract.

(k) Utilitarian 'cost' argument: difference between:
(i) Stochastic cancer death risk from ionising radiation, and
(ii) Deterministic EHS 'living death' risk from non-ionising radiation

Governments typically consider potential lifetime excess cancer risks, as from nuclear plants, of between 1 and 10 per million as "acceptable" for non-occupational exposures. EHS, however, is not essentially a cancer condition but can result in a 'living death' for the persons affected. Since there is up to 100% certainty of EM exposure causing this 'living death' for those affected, it is inappropriate to consider as similar (i) stochastic cancer death risks from ionising radiation, and (ii) deterministic EHS 'living death' risks from non-ionising radiation.

In 2007 the International Commission on Radiological Protection (ICRP) suggested that a death rate of one in 1 million exposed individuals may be considered acceptable to society. The ICRP defines 'justification' by whether

> *"… a planned activity involving radiation is, overall, beneficial, i.e. whether the benefits to individuals and to society … outweigh the harm (including radiation detriment) resulting from the activity … i.e., whether the benefits to individuals and to society (including the reduction in radiation detriment) from introducing or continuing the remedial action outweigh its cost and any harm or damage it causes."* ["The 2007 Recommendations of the International Commission on Radiological Protection" *ICRP Publication 103* (extract). p.25]

The UK's Health & Safety Executive allows an expected death rate of one in 1 million from environmental pollution such as atomic radiation:

> *"HSE's practice is to advise against homes being built in places where any individual's chance of receiving a dangerous dose [of chemicals] was greater than 1 in 10^5 (1 in 100 000) per year." [HSE, section 69] "the measures taken for nuclear installations mean that the risk borne on average by members of the public in the vicinity of a plant from its normal operation will generally be no more than 1 in 1 million (1 in 10^6) per annum."* [HSE 1992, section 174]

HSE: *"… does not advise against granting planning permission on safety grounds for developments where such individual risk is less than 1 in a million a year. (Somewhat different criteria are applied to sensitive developments where those exposed to the risk are more vulnerable, e.g. schools, hospitals or old peoples' homes, or to industrial or leisure developments, reflecting the different characteristics of the hypothetical person used to assess individual risk)."* [HSE 2001, paragraph 138]

- Busby C: "Child health and ionizing radiation: Science, Politics and European Law" *Pediatr Dimensions.* (2017) abstract; pdf.
- Health and Safety Executive: (2001) "Reducing risks, protecting people" HSE; pdf.
  Rimington JD (chair) et al: "The Tolerability of Risk from Nuclear Power Stations" HSE, 1988, rev.1992; pdf.
- Setton E et al.: "Risk-based indicators of Canadians' exposures to environmental carcinogens" *Environ Health.* (2013) PMID: 23398723; pdf.
- Valentin J: "The 2007 Recommendations of the International Commission on Radiological Protection" ICRP; no.103; pdf of extract.

(l) Subservience of WHO to IAEA:

Since 1959 the World Health Organization (WHO) has been subservient to the International Atomic Energy Agency (IAEA) on all matters to do with radiation:

- "Agreement Between the International Atomic Energy Agency and the World Health Organization" (1959) Agreement.

  "… it is recognized by the World Health Organization that the International Atomic Energy Agency has the primary responsibility for encouraging, assisting and co-ordinating research and development and practical application of atomic energy for peaceful uses throughout the world …"
  (Article 1.2)
  "Whenever either organization proposes to initiate a program or activity on a subject in which the other organization has or may have a substantial interest, the first party shall consult the other with a view to adjusting the matter by mutual agreement."
  (Article 1.3)

(m) UK's switch from AGNIR to COMARE:

In 1990 the UK government founded AGNIR (Advisory Group On Non-Ionising Radiation). This was an attempt to quash concerns about cancers and other adverse effects caused by non-ionising radiation, such as from power lines and wireless radio frequency from mobile phones. It was at first chaired by Sir Richard Doll, famous for linking smoking and cancer, but later notorious for switching sides and supporting industries and governments involved in environmental pollution.

In 2016 a peer-reviewed study showed that AGNIR's 2016 Radio Frequency Report, which was not peer-reviewed, was 'inaccurate' and 'unsafe'.

- Starkey SJ: "Inaccurate official assessment of radiofrequency safety by the Advisory Group on Non-ionising Radiation" *Rev Environ Health.* (2016) PMID: 27902455. Article.

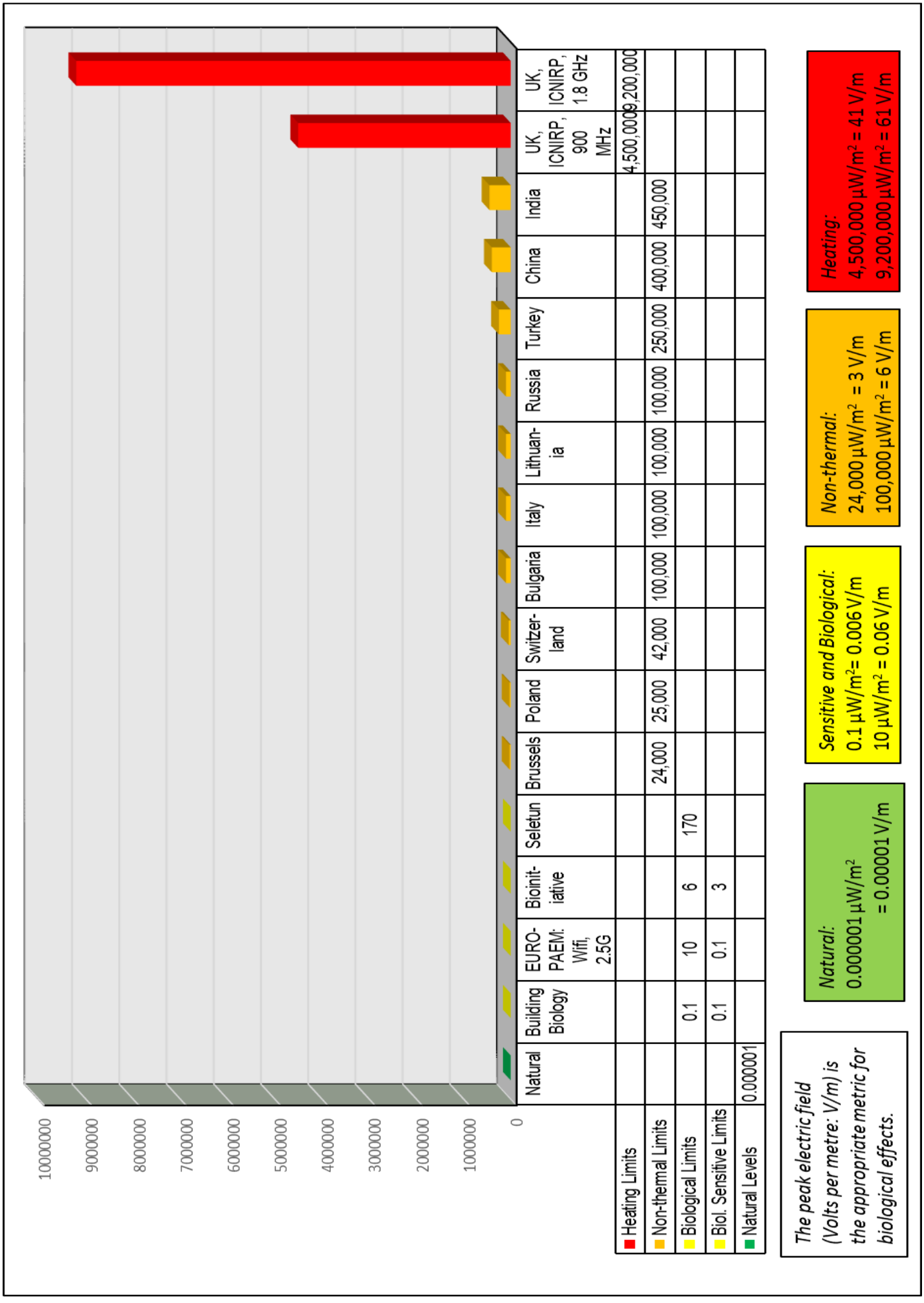
In 2017 the UK government disbanded AGNIR (Advisory Group On Non-Ionising Radiation) and transferred AGNIR's role in giving advice on non-ionising radiation to COMARE (Committee on Medical Aspects of Radiation in the Environment). This group was established in 1985 to quash concerns about

cancer clusters discovered near Sellafield and other nuclear plants with non-ionizing radiation. COMARE is a committee which accepts the utilitarian approach of ICRP (International Commission on Radiological Protection).

(n) Radio frequency radiation safety guidelines

Figure on next page: **RADIO FREQUENCY RADIATION SAFETY GUIDELINES**
for: Power Flux Density (a heating metric) – micro Watt per metre squared *($\mu W/m^2$)*
This shows:

Natural levels	0.000001 $\mu W/m^2$
Biological safety guidelines	0.1 $\mu W/m^2$ and 10 $\mu W/m^2$
UK 6-minute heating guidelines	4,500,000 $\mu W/m^2$ and 9,200,000 $\mu W/m^2$


10000000
9000000
8000000
7000000
6000000
5000000
4000000
3000000
2000000
1000000
0
Natural
Building Biology
EURO-PAEM: Wifi, 2.5G
Bioinit-iative
Seletun
Brussels
Poland
Switzer-land
Bulgaria
Italy
Lithuan-ia
Russia
Turkey
China
India
UK, ICNIRP, 900 MHz
UK, ICNIRP, 1.8 GHz
Heating Limits
Non-thermal Limits
Biological Limits
Biol. Sensitive Limits
Natural Levels
0.000001
0.1
10
6
3
170
24,000
25,000
42,000
100,000
100,000
100,000
100,000
250,000
400,000
450,000
4,500,000
9,200,000
The peak electric field (Volts per metre: V/m) is the appropriate metric for biological effects.
Natural:
0.000001 µW/m²
= 0.00001 V/m
Sensitive and Biological:
0.1 µW/m²= 0.006 V/m
10 µW/m² = 0.06 V/m
Non-thermal:
24,000 µW/m² = 3 V/m
100,000 µW/m² = 6 V/m
Heating:
4,500,000 µW/m² = 41 V/m
9,200,000 µW/m² = 61 V/m

11. (a) Cancer Risks and (b) Cancer Classification (WHO/IARC)

(a) Cancer Risks

Cancer is the second leading cause of death worldwide. It accounts for 15% of deaths. There are some 200 different types of cancer, some of which are rare.

There are many risks for cancers, both intrinsic and external, with many estimates, including diet and obesity (30-35%), smoking (25-30%), infections (15-20%), environmental pollution and stress (5-25%), and genetics (5-10%) (e.g. Anand P et al., 2008; Wu S et al., 2016). Another study found 38% of cancers can be attributed to known risk factors, with the two highest modifiable risk factors at 15% for smoking and 6% for obesity (Brown KF et al., 2018)

The biophysical effects of electromagnetic exposure can be cumulative, so the duration is relevant as well as the intensity, frequency, modulation and amplitude of exposure. For most cancers it takes years for symptoms to appear.

Studies listed in this 'Selected Studies' show:

- *Living within about 500 metres of a phone mast has been show to increase the risk of genetic damage, immune damage and cancers, typically by up to 3 and sometimes by up to 5 times, compared with living further away. This also applies to radio and TV masts and was suspected in 1994 [62] and confirmed in 1996.*
  (e.g. Dode AC et al., 2010; Eger H et al., 2004; Gandhi G et al., 2015; Ghosh PM et al., 2015; Gulati S et al., 2018; Hocking B et al., 1996; Hocking B et al., 2003; Houshyari M et al., 2015; Khurana VG et al., 2010; Kundi M et al., 2009; Levitt BB et al., 2010; Taheri M et al., 2017; Wolf R et al., 2004; Zothansiama et al., 2017).

- *Living within about 600 metres of power lines has been known since 1979 to increase the risk of cancers, often by 1.3 to 1.5 or up to 3 times compared with living further away. In some countries and for some voltages the risk for children has been shown to be over 10 times.*
  (e.g. Sohrabi MR et al., 2010; see many more studies listed under, e.g., Leukaemia)

- *Use of a mobile phone and similar wireless devices has been linked with brain tumours since 1999 (analogue) and 2009 (digital). Since 1953 brain tumours have been associated with various electromagnetic exposures, especially for exposures of 10 years or more. Some cases, however, have been reported within 5 years of using a mobile phone or working with radar. Typically, heavy long-term mobile phone users have up to 3 times the risk of brain tumours compared with light users, and up to 5 times if starting aged under 20 years.*
  (e.g. Carlberg M et al., 2014; see many more studies listed under, e.g., Brain Tumours, Cancer, Glioma, etc.)

In comparison, for lung cancer, which is caused by smoking in 85% of cases (NHS), typically, light smokers aged 35-49 have a 3 (males) to 5 (females) times higher risk of lung cancer than non-smokers. Heavy smokers are up to 13 (women) to 24 (men) times more likely to die from lung cancer than non-smokers (Schane RE et al., 2010; see also Taghizadeh N et al., Table 2, 2016). At age 60 a smoker has a 10% risk of lung cancer by age 75, compared with a 0.5% risk for a non-smoker (Netdoctor). Passive smoking accounts for about 20% of lung cancers in non-smokers (CRUK).

[62] Maskarinec G et al.: "Investigation of increased incidence in childhood leukemia near radio towers in Hawaii: preliminary observations" *J Environ Pathol Toxicol Oncol.* (1994) PMID: 7823291.

(b) Cancer Classification

(i) World Health Organization's International Agency for Research on Cancer WHO / IARC

Much of the Electromagnetic spectrum, including frequencies at (a) ELF (Extremely Low Frequency, MW (Microwave Frequency) and RF (Radio Frequency), (b) the visible spectrum, and (c) ionising frequencies, is now regarded as a possible, probable or certain human carcinogen.

These carcinogenic outcomes are non-thermal effects and thus outside the scope of ICNIRP's safety guidelines, which are based on Schwan's mistaken hypothesis of 1953 that heating is the only adverse effect of EM exposure. The ICNIRP heating limits prevent a rise in body temperature of one degree within 6 minutes, although the same temperature rise can be achieved through exercise but without the known consequences from EM exposure of cardiovascular, fertility and neurological harm and cancers.

(a) Electromagnetic energy (ELF, RF):

WHO/IARC:

- *Radio Frequency (RF):* *2B (possible) human carcinogen (2011)*
- *Extremely Low Frequency (ELF):* *2B (possible) human carcinogen (2002)*

The following studies confirm ELF and RF as a class 2B (possible) human carcinogen.

RF:

- Baan R et al.: "Carcinogenicity of radiofrequency electromagnetic fields" *Lancet Oncol.* (2011) PMID: 21845765. Article.
- International Agency for Research on Cancer (IARC), World Health Organization (WHO): "IARC Classifies radiofrequency electromagnetic fields as possibly carcinogenic to humans" Press Release no. 208 (2011). Article (2013).

ELF:

- International Agency for Research on Cancer (IARC), World Health Organization (WHO): "Non-Ionizing Radiation, Part 1: Static and ELF Electric and Magnetic Fields" *IARC Monographs on the Evaluation of Carcinogenic Risks to Humans.* 80 (2002).
- Mild KH et al.: "Occupational carcinogens: ELF MFs" *Environ Health Perspect.* (2005) PMID: 16263490. PMC1310936.

See below at the end of this section for studies arguing that the evidence now requires that ELF and RF should be reclassified as a class 2A (probable) or class 1 (certain) human carcinogen.

(b) Electromagnetic energy: visible blue light (in visible light, the colour blue has the shortest wavelength and highest frequency) at night, as in shift-work, disrupts the body's circadian rhythm and reduces melatonin, a cancer suppressor.

WHO/IARC:

- *Visible blue light at night:* *2A (probable) human carcinogen (2007)*

- Brainard GC et al.: "Action spectrum for melatonin regulation in humans: evidence for a novel circadian photoreceptor" *J Neurosci.* (2001) PMID: 11487664.
- Canadian Union of Public Employees: "Shiftwork" Health & Safety Factsheet.
- Giachello CN et al.: "Magnetic Fields Modulate Blue-Light-Dependent Regulation of Neuronal Firing by Cryptochrome" *J Neurosci.* (2016) PMID: 27798129.
- International Agency for Research on Cancer (IARC), World Health Organization (WHO): "IARC Monographs Programme finds cancer hazards associated with shiftwork, painting and firefighting" Press Release no. 180 (2007);

- International Agency for Research on Cancer (IARC), World Health Organization (WHO): "Shiftwork"*IARC Monographs on the Evaluation of Carcinogenic Risks to Humans.* 98(2010).
- Portnov BA et al.: "Light at night and breast cancer incidence in Connecticut: An ecological study of age group effects" *Sci Total Environ.* (2016)PMID: 27531467.
- Sasseville A et al.: "Blue blocker glasses impede the capacity of bright light to suppress melatonin production" *J Pineal Res.*(2006) PMID: 16842544.
- Wright HR et al.: "Effect of light wavelength on suppression and phase delay of the melatonin rhythm" *Chronobiol Int.* (2001)PMID: 11763987.
- Yoshii T et al.: "Cryptochrome mediates light-dependent magnetosensitivity of Drosophila's circadian clock" *PLoS Biol.* (2009) PMID: 19355790.

(c) Electromagnetic ionising frequencies, as in x-rays and gamma (γ) rays

WHO/IARC:

- *X-rays and gamma rays: 1 (certain) human carcinogen (1999)*

- International Agency for Research on Cancer (IARC), World Health Organization (WHO): "Ionizing Radiation, Part 1: X- and Gamma (γ)-Radiation and Neutrons" *IARC Monographs on the Evaluation of Carcinogenic Risks to Humans.*75(2000).
- IARC: "5. Summary of Data Reported and Evaluation" (2000).

(ii) WHO/IARC: System of cancer classification:

The IARC classifies human and animal evidence as one of the following four categories:

- no evidence
- inadequate
- limited
- sufficient

WHO/IARC CLASS		*Level of evidence required*
Group 2		(i) Humans: almost sufficient evidence or (ii) no Human data but Animal: sufficient evidence. (The terms 'probably' and 'possibly' have no quantitative significance; they are descriptors of different levels of Human evidence, higher or lower.)
	Class 2B (possible) human carcinogen	based on 3 possible combinations: (i) Humans: limited evidence + Animals: insufficient evidence or (ii) Humans: inadequate evidence + Animals: sufficient evidence or (iii) Humans: inadequate evidence + Animals: insufficient evidence + Mechanistic evidence etc.
	Class 2A (probable) human carcinogen	based on 2 possible combinations: (i) Humans: limited evidence + Animals: sufficient evidence or (ii) Humans: inadequate evidence + Animals: sufficient evidence + Mechanistic evidence etc. (or as member of class of agents in 1/2A)
Group / Class 1		Humans: sufficient evidence.

(iii) WHO/IARC: Current classification and current evidence requiring reclassification:

WHO/IARC Class 2B (possible):
In 2002 IARC classified ELF as a 2B (possible) human carcinogen,[63]
and in 2011 IARC classified RF as 2B (possible) human carcinogen,
from "limited" evidence in humans and animals.[64]
2B: *"'Limited evidence of carcinogenicity': A positive association has been observed between exposure to the agent and cancer for which a causal interpretation is considered by the Working Group to be credible, but chance, bias or confounding could not be ruled out with reasonable confidence."* [65]

WHO/IARC Class 2A (probable): adequate animal evidence?
IARC's requirements for 2A (probable): [66] *(i) two species of animals*
(ii) reproducibility.
These now seem fulfilled. There are numerous studies, including:
RF as a carcinogen:
1980-82: $4.5 USAF: 0.15-0.4 W/kg at 2.45 GHz (OR=4.27 primary malignancies).[67]
1993-99: $28.5m WTR
1999-2018: $25m National Toxicology Program:
significantly increased glioma (brain) and schwannoma (heart) in rats from mobile phone radiation under heating limits.[68]
2001-18: €5m Ramazzini Institute:
significantly increased schwannoma (heart) in rats from phone mast radiation under heating limits.[69]
Comparison of NTP and RI studies: EHT, 2018.
2016: Confirmation of RF as a tumour-promoter.[70]
ELF as a co-carcinogen or tumour-promoter:
2016: Sinusoidal-50 Hz prenatal to death and acute 0.1 Gy γ radiation at 6 weeks:
carcinogenic effects for the mammary gland, and increased malignant schwannomas of the heart (female and male rats);
increased lymphomas / leukemias (male rats).[71]
2016: Sinusoidal-50 Hz MF and formaldehyde in drinking water from 6 weeks:
increased malignant tumours, thyroid C-cell carcinomas and hemolymphoreticular neoplasias (male rats).[72]

---

[63] IARC, WHO: "Non-Ionizing Radiation, Part 1: Static and ELF Electric and Magnetic Fields" *IARC Monographs on the Evaluation of Carcinogenic Risks to Humans.* 80 (2002).

[64] Baan R et al.: "Carcinogenicity of radiofrequency electromagnetic fields" *Lancet Oncol.* (2011) PMID: 21845765.

[65] IARC Mongraphs on the Evaulation of Carcinogenic Risks to Humans: Preamble (2006).

[66] IARC Mongraphs on the Evaulation of Carcinogenic Risks to Humans: Preamble (2006).

[67] Chou CK et al.: "Long-term, low-level microwave irradiation of rats" *Bioelectromagnetics.* (1992) PMID: 1482413. Article.
[Guy AW (1984) Study Findings (presented by Chou CK, Kunz L at the Bioelectromagnetics Society (BEMS) Conference, Atlanta, July 1984) Bioelectromagnetics Research Laboratory, University of Washington School of Medicine, Seattle; sponsored by the U.S. Air Force. "Microwaves Promote Cancer" *Microwave News*, July/August 1984, iv(6): 1, 4-5.].

[68] Lin JC: "Potential Game Changer for Mobile-Phone Radio-Frequency Radiation Carcinogenesis" *Rad Sci Bull. IEEE.* (2016); pdf.
Hardell L et al.: "Comment on NTP study" (2018) Article.

[69] Falcioni L et al.: "Report of final results regarding brain and heart tumors in Sprague-Dawley rats exposed from prenatal life until natural death to mobile phone radiofrequency field representative of a 1.8 GHz GSM base station environmental emission" *Environ Res.* (2018) PMID: 29530389. Article.

[70] Lerchl A et al: "Tumor promotion by exposure to radiofrequency electromagnetic fields below exposure limits for humans" *Biochem Biophys Res Commun.* (2015) PMID: 25749340.

[71] Soffitti M et al: "Life-span exposure to sinusoidal-50 Hz magnetic field and acute low-dose γ radiation induce carcinogenic effects in Sprague-Dawley rats" *Int J Radiat Biol* (2016) PMID: 26894944.

[72] Soffritti M et al.: "Synergism between sinusoidal-50 Hz magnetic field and formaldehyde in triggering carcinogenic effects in male Sprague-Dawley rats" *Am J Ind Med.* (2016) PMID: 27219869.

WHO/IARC Class 1 (certain): adequate human evidence?
WHO/IARC's requirements for class 1 (certain) are sufficient (reproducible) human evidence. These now seem fulfilled. There are numerous studies, including the following.
[OR=Odds Ratio]

RF as a carcinogen:

1953: Hughes Aircraft Corporation:
internal bleeding (75-100 cases out of 6,000 workers), brain tumours (2 out of 5), and leukaemia (2 out of 600) from EM microwave exposure.[73]

1969-82: Maryland, USA:
951 brain tumour cases: OR=2.15 glioma and astrocytoma for definite EM exposure.[74]

1971-85: Poland:
3,700 EM exposed out of 128,000 non-exposed: OR=2.0 all cancers; OR=3.19-3.24 alimentary tract; OR=1.91 brain tumours; OR=6.31 haemopoietic and lymphatic (OR=13.9 chronic myelocytic leukaemia, OR=8.62 acute myeloblastic leukaemia, OR=5.82 non-Hodgkin lymphomas).[75]

1972-1990: Australia:
Within a radius of <4km compared with >12 km for 3 TV towers:
all ages: OR= 1.24 for leukaemia;
children: OR=1.58 for leukaemia, OR=1.55 for childhood lymphatic leukaemia.[76]

1974-1986: UK:
TV and FM radio masts: OR=1.83 for adult leukemia <2 km.[77]

1977: brain tumours: 2 cases of astrocytoma (glioma) in 18 radar EM exposed.[78]

1999- Nordic countries:
ipsilateral mobile phone: OR=2.4 acoustic neuroma and OR=2.0 (1.2 to 3.4) glioma ≥10 years;[79]
for 1,251 glioma astrocytoma: OR=2.7 mobile phone >10 year and OR=1.8 cordless phone >10 year; astrocytoma 1st use wireless phone <age 20: OR=4.9 mobile phone and OR=3.9 cordless phone;[80]
of 593 analogue mobile: OR=1.8 and >25 years OR=3.3; 2G OR=1.6 and >15-20 years OR=2.1; cordless phones OR=1.7 and 15-20 years OR=2.1.[81]

---

[73] McLaughlin JT: "A Study of Possible Health Hazards from Exposure to Microwave Radiation" *Hughes Aircraft Copr., Culver City, Calif.* (1953) MS.

[74] Lin RS et al.: "Occupational exposure to electromagnetic fields and the occurrence of brain tumors. An analysis of possible associations" *J Occup Med.* (1985) PMID: 4020499.

[75] Szmigielski S: "Cancer morbidity in subjects occupationally exposed to high frequency (radiofrequency and microwave) electromagnetic radiation" *Sci Total Environ.* (1996) PMID: 8717316.

[76] Hocking B et al.: "Cancer incidence and mortality and proximity to TV towers" *Med J Aust.* (1996) PMID: 8985435. Article.

[77] Dolk H et al.: "Cancer incidence near radio and television transmitters in Great Britain. I. Sutton Coldfield transmitter" *Am J Epidemiol.* (1997) PMID: 8982016.

[78] Zaret MM: "Potential hazards of hertzian radiation and tumors" *N Y State J Med.* (1977) PMID: 264612.

[79] E.g.: Hardell L et al.: "Long-term use of cellular phones and brain tumours: increased risk associated with use for > or =10 years" *Occup Environ Med.* (2007) PMID: 17409179. PMC2092574.

[80] Hardell L et al.: "Pooled analysis of case-control studies on malignant brain tumours and the use of mobile and cordless phones including living and deceased subjects" *Int J Oncol.* (2011) PMID: 21331446.

[81] Hardell L et al.: "Case-control study of the association between malignant brain tumours diagnosed between 2007 and 2009 and mobile and cordless phone use" *Int J Oncol.* (2013) PMID: 24064953. PMC3834325.

2000-12: Interphone:
OR 2.8 to 6.9 for gliomas in most exposed areas;[82]
OR=up to 1.8 for tumour distance from ear for all users.[83]

2004-14: France, CERENAT:
for 253 gliomas and 194 meningiomas: life-long cumulative duration ≥896 h, OR=2.89 gliomas, OR=2.57 meningiomas and OR=2.10 gliomas ≥18,360 calls.[84]

2018: Meta-analysis of CERENAT, Interphone and Nordic studies:
glioma ≥896 h/≥1,640 h OR=1.9 all, OR=2.54 ipsilateral;
meningioma ≥896 h/≥1,640 h OR=1.27 all, OR=1.49 ipsilateral.[85]

ELF as a carcinogen and/or co-carcinogen:

1979: USA:
childhood leukaemia in proximity to wiring (OR=2.35)[86]
and many subsequent studies (see under e.g. Leukaemia).

1986-1996: Norway:
Residential exposure and malignant melanoma for 0.05-0.2 and >0.2 compared with <0.05 microT: OR= 2.01 and OR=2.68 (women); OR=1.70and OR=1.37 (men) respectively.[87]

1986-1996: Norway:
Breast cancer in women with residential exposure OR=1.58.
Exposed women versus unexposed women with estrogen receptor (ER)-positive and ER-negative breast cancer OR=1.33 and OR=1.40 respectively.
Women with highest occupational exposure OR=1.13 compared with unexposed.[88]

1997-2009: Sweden:
ELF cumulative exposure: tumour promotion/progression: astrocytoma grade IV (glioblastoma multiforme) 1-14 years OR=1.9 p linear trend <0.001, and p linear trend 0.44 in highest exposure categories 2.75+ and 6.59+ μT years.[89]

2002: Canada:
ELF occupational exposure >0.6 microT glioblastoma multiforme: OR=5.36.[90]

2010: Iran:
300 children aged 1-18 years with acute lymphoblastic leukemia (ALL) living near overhead high voltage power lines during ≥past 2 years:
OR=2.61 for <600 meters from nearest lines against >600 meters,
OR=9.93 for 123 KV lines, OR=10.78 for 230 KV lines, OR=2.98 for 400 KV lines;
OR of ALL decreased 0.61 for every 600 meters from the nearest power line.[91]

---

[82] Cardis E et al.: "Risk of brain tumours in relation to estimated RF dose from mobile phones: results from five Interphone countries" *Occup Environ Med.* (2011) PMID: 21659469. PMC3158328.

[83] Grell K et al.: "The Intercranial Distribution of Gliomas in Relation to Exposure From Mobile Phones: Analyses From the INTERPHONE Study" *Am J Epidemiol.* (2016) PMID: 27810856. PMC5152665.

[84] Coureau G et al.: "Mobile phone use and brain tumours in the CERENAT case-control study" *Occup Environ Med.* (2014) PMID: 24816517.

[85] Hardell L et al.: "Comment on NTP study" (2018) Article.

[86] Wertheimer N et al: "Electrical wiring configurations and childhood cancer" *Am J Epidemiol.* (1979) PMID: 453167.

[87] Tynes T et la.: "Residential and occupational exposure to 50 Hz magnetic fields and malignant melanoma: a population based study" *Occup Environ Med.* (2003) PMID: 12709519. PMC1740536.

[88] Kliukiene J et al.: "Residential and occupational exposures to 50-Hz magnetic fields and breast cancer in women: a population-based study" *Am J Epidemiol.* (2004) PMID: 15105178.

[89] Carlberg M et al.: "Case-control study on occupational exposure to extremely low-frequency electromagnetic fields and glioma risk" *Am J Ind Med.* (2017) PMID: 28394434.

[90] Villeneuve PJ et al.: "Brain cancer and occupational exposure to magnetic fields among men: results from a Canadian population-based case-control study" *Int J Epidemiol.* (2002) PMID: 11914323.

[91] Sohrabi MR et al.: "Living near overhead high voltage transmission power lines as a risk factor for childhood acute lymphoblastic leukemia: a case-control study" *Asian Pac J Cancer Prev.* (2010) PMID: 20843128. Article.

2013: Pooled OR=1.32 increased risk of male breast cancer with EMF exposure.[92]
2014: Meta-analysis: non-menopausal women: OR(MH)=1.25.[93]
2016: Canada:
115 cases of breast cancer in men:
OR=1.80 exposed to ≥0.6 μT compared with <0.3 μT.
OR=2.77 for men exposed to occupational MF fields ≥30 years compared with background levels.[94]

Some studies which argue that recent evidence now requires reclassification by WHO/IARC of RF and ELF as class 2A (probable) or class 1 (certain) human carcinogens:

RF:

- Carlberg M et al.: "Decreased survival of glioma patients with astrocytoma grade IV (glioblastoma multiforme) associated with long-term use of mobile and cordless phones" *Int J Environ Res Public Health* (2014) PMID: 25325361.
- Carlberg M et al.: "Evaluation of Mobile Phone and Cordless Phone Use and Glioma Risk Using the Bradford Hill Viewpoints from 1965 on Association or Causation" *Biomed Res Int.* (2017) PMID: 28401165. PMC5376454.
- Falcioni L et al.: "Report of final results regarding brain and heart tumors in Sprague-Dawley rats exposed from prenatal life until natural death to mobile phone radiofrequency field representative of a 1.8 GHz GSM base station environmental emission" *Environ Res.* (2018) PMID: 29530389. Article.
- Hardell L et al: "Using the Hill viewpoints from 1965 for evaluating strengths of evidence of the risk for brain tumors associated with use of mobile and cordless phones" *Rev Environ Health* (2013) PMID: 24192496.
- Lin JC: "Potential Game Changer for Mobile-Phone Radio-Frequency Radiation Carcinogenesis" *Rad Sci Bull. IEEE.* (2016); pdf.
- Morgan LL et al: "Mobile phone radiation causes brain tumors and should be classified as a probable human carcinogen (2A) (review)" *Int J Onc.* (2015) PMID: 25738972.
- Peleg M et al.: "Radio frequency radiation-related cancer: assessing causation in the occupational/military setting" *Environ Res.* (2018) PMID: 29433020.

ELF

- Carlberg M et al.: "Case-control study on occupational exposure to extremely low-frequency electromagnetic fields and glioma risk" *Am J Ind Med.* (2017) PMID: 28394434.
- Soffritti M et al.: "Life-span exposure to sinusoidal-50 Hz magnetic field and acute low-dose γ radiation induce carcinogenic effects in Sprague-Dawley rats" *Int J Radiat Biol.* (2016) PMID: 26894944.

[92] Sun JW et al.: "Electromagnetic field exposure and male breast cancer risk: a meta-analysis of 18 studies" *Asian Pac J Cancer Prev.* (2013) PMID: 23534787. Article.

[93] Zhao G et al.: "Relationship between exposure to extremely low-frequency electromagnetic fields and breast cancer risk: a meta-analysis" *Eur J Gynaecol Oncol.* (2014) PMID: 24984538.

[94] Grundy A et al.: "Occupational exposure to magnetic fields and breast cancer among Canadian men" *Cancer Med.* (2016) PMID: 26792203. PMC4799956.

12. Electrophobia, radiophobia, the nocebo effect and IEI-EMF

Electrophobia *and* ***radiophobia*** *are psychological fears, often described as the* ***nocebo effect****. At first, from 1903, electrophobia was known as radiophobia (see below under 'radiophobia'). When radiophobia became used exclusively for ionising radiation, the term electrophobia was used, from 1990, for fear of non-ionising radiation and was later identified with the nocebo effect, a term coined by Walter Kennedy in 1961. In 2004 the World Health Organization renamed electrophobia as* ***Idiopathic Environmental Intolerance attributed to Electromagnetic Fields****, stating that it was not caused by EM energy, to prevent it being confused with a real physical sensitivity, such as electromagnetic sensitivity and electromagnetic hyper-sensitivity. The condition has also been named the* ***environmental somatization syndrome****. This condition is most commonly studied by psychologists and not by physiological medical doctors or molecular biologists. The term IEI-EMF tends to be favoured by the wireless and electricity industries and by some regulators.*

- Anon.: "Electromagnetic fields and public health: Electromagnetic hypersensitivity" *World Health Organization* (2005) Backgrounder 296 [not peer-reviewed].
- Baliatsas C et al.: "Comparing non-specific physical symptoms in environmentally sensitive patients: prevalence, duration, functional status and illness behaviour" *J Psychosom Res.* (2014) PMID: 24745783.
- Baliatsas C et al.: "Idiopathic environmental intolerance attributed to electromagnetic fields (IEI-EMF): a systematic review of identifying criteria" *BMC Public Health.* (2012) PMID: 22883305. PMC3504528.
- Bonneux L: [Electromagnetic fields: damage to health due to the nocebo effect] *Ned Tijdschr Geneeskd.* (2007) PMID: 17520846.
- Boyd I et al.: "Taking refuge from modernity: 21st century hermits" *J R Soc Med.* (2012) PMID: 23288087.
- Dömötör Z et al.: "Dispositional aspects of body focus and idiopathic environmental intolerance attributed to electromagnetic fields (IEI-EMF)" *Scand J Psychol.* (2016) PMID: 26861662.
- Dömötör Z et al: "Nature relatedness is connected with modern health worries and electromagnetic hypersensitivity" *J Health Psychol.* (2017) PMID: 28810440.
- Eltiti S et al.: "Aggregated data from two double-blind base station provocation studies comparing individuals with idiopathic environmental intolerance with attribution to electromagnetic fields and controls" *Bioelectromagnetics.* (2015) PMID: 25644455.
- Eltiti S et al.: "Does short-term exposure to mobile phone base station signals increase symptoms in individuals who report sensitivity to electromagnetic fields? A double-blind randomized provocation study" *Environ Health Perspect.* (2007) PMID: 18007992; pfd.
- Kjellqvist A et al.: "Psychological symptoms and health-related quality of life in idiopathic environmental intolerance attributed to electromagnetic fields" *J Psychosom Res.* (2016) PMID: 27095153.
- Nilsson CG et al.: [Environmental somatization syndrome. How to deal with the external milieu syndrome?] *Nord Med.* (1994) PMID: 8170802.
- Oftedal G et al.: "Mobile phone headache: a double blind, sham-controlled provocation study" *Cephalalgia.* (2007) PMID: 17359515.
- Rubin GJ et al.: "Are some people sensitive to mobile phone signals? Within participants double blind randomised provocation study" *BMJ.* (2006) PMID: 16520326.
- Rubin GJ et al.: "Electromagnetic hypersensitivity: a systematic review of provocation studies" *Psychosom Med.* (2005) PMID: 15784787.
- Rubin GJ et al.: "Do people with idiopathic environmental intolerance attributed to electromagnetic fields display physiological effects when exposed to electromagnetic fields? A systematic review of provocation studies" *Bioelectromagnetics.* (2011) PMID: 21769898.

- Rubin GJ et al.: "Idiopathic environmental intolerance attributed to electromagnetic fields (formerly 'electromagnetic hypersensitivity'): An updated systematic review of provocation studies" *Bioelectromagnetics.* (2010) PMID: 19681059.
- Stovner LJ et al.: "Nocebo as headache trigger: evidence from a sham-controlled provocation study with RF fields" *Acta Neurol Scand Suppl.* (2008) PMID: 18439225.
- Szemerszky R et al.: "Attribution-Based Nocebo Effects. Perceived Effects of a Placebo Pill and a Sham Magnetic Field on Cognitive Performance and Somatic Symptoms" *Int J Behav Med.* (2016) PMID: 26420517.
- van Rongen E et al.: "Effects of radiofrequency electromagnetic fields on the human nervous system" *J Toxicol Environ Health B Crit Rev.* (2009) PMID: 20183535.
- Verrender A et al.: "IEI-EMF provocation case studies: A novel approach to testing sensitive individuals" *Bioelectromagnetics.* (2018) PMID: 29125197.
- Wallace D et al.: "Cognitive and physiological responses in humans exposed to a TETRA base station signal in relation to perceived electromagnetic hypersensitivity" *Bioelectromagnetics.* (2012) PMID: 21647932.
- Wallace D et al.: "Do TETRA (Airwave) base station signals have a short-term impact on health and well-being? A randomized double-blind provocation study" *Environ Health Perspect.* (2010) PMID: 20075020. PMC2898847.

***Prevalence of electophobia, IEI-EMF or the nocebo effect**, and not real physiological EHS, may reflect media reports on electrophobia and real EHS. These studies typically did not screen subjects for whether they suffered, in addition to electrophobia or the nocebo effect, from real physiological EHS. Hospitals and centres specialising in diagnosing real physiological EHS estimate that about 1% of people suffering real physiological EHS also suffer from electrophia or the nocebo effect.*

- Bräscher AK et al.: "Are media reports able to cause somatic symptoms attributed to WiFi radiation? An experimental test of the negative expectation hypothesis" *Environ Res.* (2017) PMID: 28371755.
- Huang PC et al.: "Association between media coverage and prevalence of idiopathic environmental intolerance attributed to electromagnetic field in Taiwan" *Environ Res.* (2018) PMID: 29182909.
- Huang PC et al.: "Representative survey on idiopathic environmental intolerance attributed to electromagnetic fields in Taiwan and comparison with the international literature" *Environ Health.* (2018) PMID: 29334987. PMC5769530.
- Witthöft M et al.: "Are media warnings about the adverse health effects of modern life self-fulfilling? An experimental study on idiopathic environmental intolerance attributed to electromagnetic fields (IEI-EMF)" *J Psychosom Res.* (2013) PMID: 23438710.
- Witthöft M et al.: "On the origin of worries about modern health hazards: Experimental evidence for a conjoint influence of media reports and personality traits" *Psychol Health.* (2017) PMID: 28758796.

***Radiophobia:** At first, rather than 'electrophobia', the term 'radiophobia' was first used for fear of non-ionising radiation. This began in 1903, in a paper by Dr Albert Soiland at a conference on June 2 1903 in Los Angeles, California, USA at a meeting of the Southern California Electro-Medical Society.[95] From 1951 radiophobia was used to describe fear of, or opposition to, nuclear radiation, soon after the development of nuclear radiation weapons and reactors, with the Chernobyl Syndrome sometimes used as a synonym since 1986. Radiophilia is the opposite attitude. Like electrophobia, radiophobia depends on prior cognitive conditioning.*

[95] Anon.: "Medicos Meet: Doctors Have Banquet, Speak About Electricity and Show up Their Theories by Various Machines" Los Angeles Times, (California, USA), June 3 1903, p.11.

- Abdollahi H et al.: "Radiophilia: A Common Case of Excessive Radiation Exposure in Healthcare" *OMICS J Radiol.* (2016) abstract; pdf.
- Ment de J: "Radiophobia; a new psychological syndrome" *West J Surg Obstet Gynecol.* (1951) PMID: 14877113.
- Novikau A: "What is "Chernobyl Syndrome?" The Use of Radiophobia in Nuclear Communications" *Env Comm.* (2017) Abstract.
- Pastel RH: "Collective behaviors: mass panic and outbreaks of multiple unexplained symptoms" *Mil Med.* (2002) PMID: 11778431.
- Pastel RH: "Radiophobia: long-term psychological consequences of Chernobyl" *Mil Med.* (2002) PMID: 11873498.
- Ropeik D: "The dangers of radiophobia" *Bull Atom Scientist.* (2016) abstract.
- Sacks B et al.: "Preserving the Anti-Scientific Linear No-Threshold Myth: Authority, Agnosticism, Transparency, and the Standard of Care" *Dose Response.* (2017) PMID: 28814947; pdf.
- Stawkowski ME: "Radiophobia had to be reinvented" *Culture, Theory and Critique*. (2017) abstract.

In contrast to psychological electrophobia, ***real Electromagnetic Hypersensitivity (EHS)****, also called Electrosensitivity, Electrical Sensitivity or Intolerance, El-Allergy, Microwave Sickness, Radio Wave Sickness, was first described in 1932 in Germany. It was confirmed as a real physical condition in the USSR and Poland in the 1960s and has been accepted in the west by international groups since 2000. There are now studies on hundreds of people with real EHS as diagnosed using objective and environmental markers, including genetic tests, 3d MRI scans, blood perfusion measurements, blood and cardiovascular markers. Some degree of electromagnetic sensitivity has been identified in up to 40% of the population, as confirmed by environmental surveys and geomagnetic surveys, with a much smaller proportion having electromagnetic hyper-sensitivity.*

Studies show that real EHS can be distinguished from Electrophobia or a nocebo effect.

- Augner C et al.: "Are people living next to mobile phone base stations more strained? Relationship of health concerns, self-estimated distance to base station, and psychological parameters" *Indian J Occup Environ Med.* (2009) PMID: 20442833.
- Chevalier G: "The effect of grounding the human body on mood" *Psychol Rep.* (2015) PMID: 25748085.
- Dieudonne M: "Does electromagnetic hypersensitivity originate from nocebo responses? Indications from a qualitative study" *Bioelectromagnetics* (2016) PMID: 26369906.

- Leszczynski D: "Open Letter on the Electromagnetic Hyper-Sensitivity Research" (BRHP, February 4 2018) [not peer-reviewed]

Confusion over EHS and electrophobia or IEI-EMF by WHO, ICNIRP, AGNIR, etc.
There is still a confusion in the literature of some regulators over these two different conditions of EHS and electrophia or IEI-EMF. Since about 2004, the World Health Organization (in its Backgrounder 296 of 2005), ICNIRP and related groups, such as the UK's AGNIR, Public Health England, the Royal Society of Canada's Report on Health Canada's Safety Code 6 and SCENIHR, all composed of a small clique of pro-wireless activists, tried to identify EM sensitivity with electrophobia or IEI-EMF, which they then defined as psychological and not caused by EM energy. Confusion over these two different conditions is apparent in that, since 2002, groups like ICNIRP have accepted that some members of the general population are especially sensitive to environmental EM energy, while simultaneously, since 2004, also stating that such sensitivity

is in fact a result of psychological cognitive conditioning, although the WHO also says that EHS is not a known psychological condition.

Cognitive conditioning, however, cannot include children, unaware adults and animals, all of which can show hyper-sensitivity to EM energy, so these three groups cannot suffer psychological IEI-EMF but only real EHS.
Cognitive conditioning cannot explain established human sensitivity among the general population to low-level EM sferics and other solar and geomagnetic phenomena.
Congitive conditioning cannot explain therapeutic uses of low-level EM energy among the general population.
Congitive conditioning cannot explain uses of EM energy in electromagnetic warfare.
Congitive conditioning cannot explain the established link between low-level EM energy and cancers and neurological illnesses.

Some Electrophobia studies using conscious provocation tests have identified people with conscious Electrophobia, but so far (i) they have failed to replicate this with young children, unaware or unconditioned adults and animals, and (ii) they have not explained the specific ES symptoms caused by environmental exposure in unaware adults. Many conscious provocation tests claiming the power to identify real EHS as well as Electrophobia have been invalidated (a) by not screening the subjects beforehand as to whether they have real EHS, and (b) by averaging the results, when real EHS is known to be an idiopathic response which varies between individuals, (c) by testing under 1,000 subjetcs, if hyper-sensitive individuals count for 0.1% of the general population and the study does not screen subjects for being EHS beforehand (to find ten EHS subjects from an unsceened population, at least 10,000 subjects would be needed), and (d) by assuming that only immediated conscious symptoms reveal EHS, whereas molecular, MRI and genetic tests show that there can be many long term outcomes from sensitivity including neurological damage and cancers.

- Hardell L: "World Health Organization, radiofrequency radiation and health – a hard nut to crack (Review)" *Int J Oncology.* (2017) PMID: 28656257. Article.
- Sage C et al.: "Comments on SCENIHR: Opinion on potential health effects of exposure to electromagnetic fields, Bioelectromagnetics 36:480-484 (2015)" *Bioelectromagnetics.* (2015) PMID: 26688202; RG.
- Starkey SJ: "Inaccurate official assessment of radiofrequency safety by the Advisory Group on Non-ionising Radiation" *Rev Environ Health.* (2016) PMID: 27902455. Article.
- Webster PC: "Federal Wi-Fi safety report is deeply flawed, say experts" *CMAJ.*(2014) PMID: 24756628. Article.

Doctors' attitudes *to patients linking symptoms to EM exposures: surveys showed that in 2009 29-58% of doctors in Germany accepted that EM exposure could cause ill health and 54% in Switzerland in 2006.*

- Huss A et al.: "Consultations in primary care for symptoms attributed to electromagnetic fields - a survey among general practitioners" *BMC Public Health.* (2006) PMID: 17074080.
- Kowall B et al.: "German wide cross-sectional survey on health impacts of electromagnetic fields in the view of general practitioners" *Int J Public Health.* (2010) PMID: 20020175.
- Kowall B et al.: "General practitioners using complementary and alternative medicine differ from general practitioners using conventional medicine in their view of the risks of electromagnetic fields: a postal survey from Germany" *J Prim Care Community Health.* (2015) PMID: 25142575.

13. Some historical evidence (1873 on)

- T. Springle, August 26 1873; in: Snape J: *Electro-dentistry: facts and observations*; London Simpson Marshall (c. 1874); pdf:
  "The difference of feeling expressed in the ten different statements submitted in your treatise, arises from the fact that electricity acts differently upon different individuals, or is differently expressed by them. I have watched people grasp the handles of a small electric battery such as yours, and some will laugh and stand it quite a while and say, "How nice!" Others will let the handles drop and say, 'How very unpleasant, it is a dreadful sensation."

- O'Neill JJ: *Prodigal Genius: The Life of Nikola Tesla* (1944) pdf.
  Nikola Tesla, 1856-1943, is sometimes regarded as one of the first people to suffer from electromagnetic hyper-sensitivity when he was aged 25, in 1881:

  "The peculiar malady that now affected him was never diagnosed by the doctors who attended him. It was, however, an experience that nearly cost him his life. To doctors he appeared at death's door. The strange manifestations he exhibited attracted the attention of a renowned physician, who declared that medical science could do nothing to aid him.
  One of the symptoms of the illness was an acute sensitivity of all the sense organs. His senses had always been extremely keen, but this sensitivity was now so tremendously exaggerated that the effects were a form of torture. The ticking of a watch three rooms away sounded like the beat of hammers on an anvil. The vibration of ordinary city traffic, when transmitted through a chair or bench, pounded through his body. It was necessary to place the legs of his bed on rubber pads to eliminate the vibrations. Ordinary speech sounded like thunderous pandemonium. The slightest touch had the mental effect of a tremendous blow. A beam of sunlight shining on him produced the effect of an internal explosion. In the dark he could sense an object at a distance of a dozen feet by a peculiar creepy sensation in his forehead. His whole body was constantly wracked by twitches and tremors. His pulse, he said, would vary from a few feeble throbs per minute to more than a hundred and fifty. Throughout this mysterious illness he was fighting with a powerful desire to recover his normal condition."

- Anon. "The telephone as a cause of ear troubles" *BMJ.* (1889). JSTOR:
  "M. Gellé has observed, not in women only, but in strong-minded and able-bodied men, symptoms of what we may call " aural overpressure" … In some cases, also, the ear seemed to be irritated … into a state of over-sensitiveness which made it intolerant of sound … The patients suffered … with buzzing noises in the ear, giddiness, and neuralgic pains … M. Gellé in some cases found objective lesions, such as a subinflammatory condition of the membrana tympani. … the victims of " telephone tinnitus"."

- Thompson SP: "A physiological effect of an alternating magnetic field" *Proc Roy Soc.* (1910) CrossRef:
  "I have, however, recently succeeded in demonstrating a real physiological effect due to magnetism … I observed a faint visual effect when my forehead was placed close to the magnet … I have found a means of producing the visual effect (which is physiological and subjective) in a way that succeeds with every person on whom it has yet been tried … it has been noted by several observers that a sensation of taste in the mouth is excited after exposing the head for two or three minutes to the action of the alternating magnetic field."

- Schliephake E: "Arbeitsgebiete auf dem Kurzwellengebiet" ["Fields of the Short-wave region"] *Dtsch Med Wochenschr.* (1932): [trans.]

"The symptoms of people working close to a short-wave radio station / mast were: first tiredness in day time and restless sleep in night time. Thereafter a feeling of "pull/pressure" on forehead and on top of head, developing to headaches, even intolerable ones. Eventually, depression and un-normal excitability / nervousness. Here, too, in our experience the wavelength is of a significant influence."

- Audiat J: "Action des ondes hertziennes sur l'excitabilite e1ectrique des nerfs," (andes amorties, entretenus, counrtes) *Rev. d'actionol.* 8: 227. (1932).
  This study showed that, because excitability of the nerve-muscle preparation diminished under the action of RF waves, it had to be a "specific" effect, since heating supposedly would have an opposite effect.

- Reiter T: *Ann. d'Inst Actinologie.* 7: 195-198. (1932)
  This study showed that biological effects could occur as a result of the wavelength or frequency and not from heating.

- Likhterman BV et al.: "Terapevticheskom primenenil korotkikh voln" ["On the Therapeutic Application of Short Waves"] Sevastopol (1936), in Kholodov YuA: "Vliyaniye elektromagnitnykh i magnitnykh poley na tsentral'nuyu nervnuyu sistemu" ["The Effect of Electromagnetic and Magnetic Fields on the Central Nervous System"] Academy of Sciences USSR, Moscow, (1966). Trans.: NASA TT F-465]:
  "People subjected to the systematic influence of a UHF field complained of somnolence, headaches, fatigability and irascibility … the reactions to a UHF field … depend on the individual characteristics of the organism and upon the initial functional state."

- McLaughlin JT "Tissue destruction and death from microwave radiation (radar)" *Calif. Med.* (1957) Article.
  [Unusual thermal or athermal effects in the abdomen]

- Letavet AA, Gordon ZV (eds) "O biologitcheskom vozdeistvii sverchvysokich tchastot." *Izd.Akad. Med. Nauk.*, SSSR, Moscow (1960) vol.1. ["The biological action of ultrahigh frequencies" (1962) Office of Technical Services, US Department of Commerce, JPRS-1271; summarized in: NIOSH 210-76-0145; "Radiofrequency/Microwave Radiation Biological Effects and Safety Standards: A Review" RL-TE-94-53; pdf, p.9]
  "*The researchers reported that several CNS related disorders were discovered among 525 workers exposed to RF/MW radiation. The symptoms were listed as: hypotension, slower than normal heart rates, an increase in the histamine content of the blood, an increase in the activity of the thyroid gland, disruption of the endocrine-hormonal process, alterations in the sensitivity to smell, headaches, irritability, and increased fatigue. Other researchers have acknowledged similar biological responses."*

- Marha K: "Biologicke ucinky elektromagnetickyeh vln o vysoke frekvenci" ["Biological effects of high-frequency electromagnetic waves"] *Prac Lek.* (1963) PMID: 14108751; ATDRep. trans.:
  "about 1,000 studies have been published on this subject up to the present time [1963] … Low-intensity EM waves cause difficulties … These include headaches, pain in the eyes, tiredness and general weakness, dizziness after standing for a period of time, fitful sleep at night, sleepiness in the daytime, changing moods,

irritability, hypochondriacal attitudes, fear, depressions, reduced intellectual capacity, and reduced memory. With longer exposure, laziness and an inability to make decisions result. Complaints are voiced regarding sensations of tension in the skin, head, and forehead, loss of hair, muscle aches, and pain around the heart … Such people experience slight eyelid, tongue, and finger tremors accompanied by increased perspiration. During work in a higher field a marked reduction in blood pressure has been observed which leads to collapse … women in general are more susceptible to such influence than men."

- Mohr GC et al.: "Effects of low frequency and infrasonic noise on man" *Aerosp Med.* (1965) PMID: 14332329. [Bridges JE, 1975: p.157-158]
  "In the very low infrasonic frequency range, chest wall vibration, gag sensations and respiratory changes were regularly observed. In the 50 to 100 Hz range responses included headaches, choking, coughing, visual blurring, and fatigue."

- Asanova TP et al.: "Health Conditions of Workers Exposed to an Electrical Field of 400-500 Kilovolt Open Distributing Installations" *Soviet Biotechnology and Bioastronautics.* (1966) Translation (1969). [Bridges JE, 1975, p.32]
  "41 of the 45 subjects suffered some discomfort as a result of exposure to electric fields. Most prevalent among subjective complaints were headache, fatigability, weakness, and drowsiness (37 subjects). Other complaints included disruption GI tract or cardiovascular activity. Neurological disruptions were unstable and usually most noticeable during the working day. As an example, headache intensity corresponded to the duration of exposure. In general, nervous system pathology was diagnosed in 28 subjects. In 26 of these, CNS disorders primarily took the form of autonomic dysfunction characterized by dermographism, pulse and arterial pressure lability, hyperhydrosis, and hand tremors."

- Bridges JE: "Biological Effects of High Voltage Electric Fields: Bibliography and Survey of Ongoing Work" (1975) *Electric Power Research Institute*. 313 pages. Copy.

- Sudokov KV: "A modulated electromagnetic field as a factor of selective influence upon the mechanisms of goal-orientated behaviour in animals" *Zhurnal Vysshey Nervnoy Deyatel'Nosti, Moscow.* (1976) Declassified 2012/05/10. CIA-RPD88B01125R000300120008-3.

- Faytel'berg-Blank VR et al.: "Selective action of decimetre waves on central structures of the brain" *Fiziologichekiy Zhurnal SSR, Leningrad.* (1977) Declassified in Part 2012/05/10. CIA-RPD88B01125R000300120006-5. In "Translations on USSR Science and Technology Biomedical and Behavioral Sciences (GUO 38/77) Effects of NonIonizing Electromagnetic Radiation" *General CIA Records*.

- Marino AA et al.: "Biological effects of extremely low frequency electric and magnetic fields: a review" *Physiol Chem Phys.* (1977) PMID: 414240. Article.
  "With few exceptions, ELF field research did not exist prior to about 1967."
  "as early as 1970 the Soviet literature contained more than 100 reports of the influence of ELF electric fields on biological systems"
  Yu I et al.: "Radio frequencies and microwaves; magnetic and electrical fields," in "Foundations of Space Biology and Medicine" 2(1) Academy of Sciences, USSR, Moscow, 1970. National Aeronautics and Space Administration, Washington, D. C., Technical Translation TT F-14, 021, (1971).

- Sudakov KV: "Hypnogenic effects of a modulated electromagnetic field" *Byulleten' Eskperimental'noy Biologii I Meditsiny, Moscow.* (1977) Declassified in Part 2012/05/10. CIA-RPD88B01125R000300120006-5. In "Translations on USSR Science and Technology Biomedical and Behavioral Sciences (GUO 38/77) Effects of NonIonizing Electromagnetic Radiation" *General CIA Records*.

- Justesen DR: "Behavioral and psychological effects of microwave radiation" *Bull N Y Acad Med.* (1979) PMID: 120208. PMC1807730.

- McRee DI: "Review of Soviet/Eastern European research on health aspects of microwave radiation" *Bull N Y Acad Med.* (1979) PMID: 295246. PMC1807746.

- Kinn JB. Postow E: "Index Of Publications On Biological Effects Of Electromagnetic Radiation (0-100 GHz)" US Environmental Protection Agency. (1981) copy. pdf. 3,627 references; 574 pages.

- Michaelson SM: "Health implications of exposure to radiofrequency/microwave energies" *Br J Ind Med.* (1982) PMID: 7039662. PMC1008955.
  Other reports *"implicate non-thermal or "specific" effects at the molecular and cellular level". "Clinical and laboratory studies of workers in the Soviet Union and other Eastern European countries employed in the operation, testing, maintenance, and manufacture of microwave-generating equipment are reported to have shown central nervous and cardiovascular reactions to MW/RF exposure. Functional disturbances of the central nervous system have been described as "radiowave sickness" - the neurasthenic or asthenic syndrome. The symptoms and signs include headache, fatigability, irritability, loss of appetite, sleepiness, sweating, thyroid gland enlargement, difficulties in concentration or memory, depression, and emotional instability. The clinical syndrome is generally reversible if exposure is discontinued. Another frequently described manifestation is a set of labile functional cardiovascular changes including bradycardia (or occasional tachycardia), arterial hypertension (or hypotension), and changes in cardiac conduction. This form of neurocirculatory asthenia is also attributed to nervous system influence. Effects indicated by hypotonus, bradycardia, delayed auricular and ventricular conduction, decreased blood pressure, ECG alterations in workers in RF or microwave fields have been reported."*

Reviews of the history of EM research:

- Bonnell JA: "Effects of electric fields near power-transmission plant" *J R Soc Med.* (1982) PMID: 6757432. PMC1438464.
- Carpenter DO: "The microwave syndrome or electro-hypersensitivity: historical background" *Rev Environ Health* (2015) PMID: 26556835. Article.
- Cook HJ et al.: "Early research on the biological effects of microwave radiation: 1940-1960" *Ann Sci.* (1980) PMID: 11610730. Article.

14. Mechanisms, pathways and other effects of low-level EM exposure

Many studies show biological effects at low-level or non-thermal levels of EM exposure, many times lower than current ICNIRP heating guidelines. Some of these effects produce immediate conscious symptoms, but others do not, even for people with ES/EHS who may be more susceptible to such effects.

(1) Acute myeloid leukemia, chronic myeloid leukemia

- Feychting M et al.: "Magnetic fields, leukemia, and central nervous system tumors in Swedish adults residing near high-voltage power lines" *Epidemiology.* (1994) PMID: 7986864.

(2) Adaptive response

- He Q et al.: "Adaptive response in mouse bone marrow stromal cells exposed to 900MHz radiofrequency fields: Impact of poly (ADP-ribose) polymerase (PARP)" *Mutat Res.* (2017) PMID: 28676262.
- Vijayalaxmi et al.: "Adaptive response in mammalian cells exposed to non-ionizing radiofrequency fields: A review and gaps in knowledge" *Mutat Res Rev Mutat Res.* (2014) PMID: 24548818.

(3) Adrenaline, adrenal system, norepinephrine, epinephrine

- Aboul Ezz HS et al.: "The effect of pulsed electromagnetic radiation from mobile phone on the levels of monoamine neurotransmitters in four different areas of rat brain" *Eur Rev Med Pharmacol Sci.* (2013) PMID: 23852905. Article.
- Laszlo AM et al.: "Effects of extremely low frequency electromagnetic fields on turkeys" *Poult Sci.* (2017) PMID: 29077912.
- Mahdavi SM et al.: "Effects of electromagnetic radiation exposure on stress-related behaviors and stress hormones in male wistar rats" *Biomol Ther (Seoul).* (2014) PMID: 25489427; pdf.
- Megha K et al.: "Effect of Low-Intensity Microwave Radiation on Monoamine Neurotransmitters and Their Key Regulating Enzymes in Rat Brain" *Cell Biochem Biophys.* (2015) PMID: 25672490.
- Singh S et al.: "Occupational EMF exposure from radar at X and Ku frequency band and plasma catecholamine levels" *Bioelectromagnetics.* (2015) PMID: 26058851.
- Torres-Rosas R et al.: "Dopamine mediates vagal modulation of the immune system by electroacupuncture" *Nat Med.* (2014) PMID: 24562381; pdf.

(4) Age related effects

- Redmayne M et al.: "Radiofrequency exposure in young and old: different sensitivities in light of age-relevant naturaldifferences" *Rev Environ Health.* (2015) PMID: 26613328.
- Sangün Ö et al.: "The Effects of Electromagnetic Field on the Endocrine System in Children and Adolescents" *Pediatr Endocrinol Rev.* (2015) PMID: 26841641.

(5) Akt.PKB/Pl3/mTOR/ERK/MMP-9 singaling pathways; *see also: MARK/ERK, ROS*

- Domènech-Estévez E et al.: "Akt Regulates Axon Wrapping and Myelin Sheath Thickness in the PNS" *J Neurosci.* (2016) PMID: 27098694. PMC4837684.
- Patruno A et al.: "Extremely low-frequency electromagnetic fields accelerates wound healing modulating MMP-9 and inflammatory cytokines" *Cell Prolif.* (2018) PMID: 29357406.
- Patruno A et al.: "mTOR Activation by PI3K/Akt and ERK Signaling in Short ELF-EMF Exposed Human Keratinocytes" *PLoS One.* (2015) PMID: 26431550. PMC4592237.

- Tang R et al.: "Extremely low frequency magnetic fields regulate differentiation of regulatory T cells: Potential role for ROS-mediated inhibition on AKT" *Bioelectromagnetics.* (2016) PMID: 26807660.

(6) Alpha amylase

- Andrianome S et al.: "Increasing levels of saliva alpha amylase in electrohypersensitive (EHS) patients" *Int J Radiat Biol.* (2017) PMID: 28466664.
- Augner C et al.: "Effects of exposure to GSM mobile phone base station signals on salivary cortisol, alpha-amylase, and immunoglobulin A" *Biomed Environ Sci.* (2010) PMID: 20708499.

(7) Alzheimer's Disease, dementia

- Capelli E et al.: "Low-Frequency Pulsed Electromagnetic Field Is Able to Modulate miRNAs in an Experimental Cell Model of Alzheimer's Disease" *J Healthc Eng.* (2017) PMID: 29065581. PMC5434238.
- García AM et al.: "Occupational exposure to extremely low frequency electric and magnetic fields and Alzheimer disease: a meta-analysis" *Int J Epidemiol.* (2008) PMID: 18245151.
- Jalilian H et al.: "Occupational exposure to extremely low frequency magnetic field and risk of Alzheimer disease: A systematic review and meta-analysis" *Neurotoxicology.* (2017) PMID: 29278690.
- Maes A et al.: "Can cytogenetics explain the possible association between exposure to extreme low-frequency magnetic fields and Alzheimer's disease?" *J Appl Toxicol.* (2012) PMID: 21935970.
- Zhang X et al.: "Microwaves and Alzheimer's disease" *Exp Ther Med.* (2016) PMID: 27698682. PMC5038365.

(8) Amyotrophic lateral sclerosis (ALS), Motor Neuron Disease

- Consales C et al.: "Electromagnetic fields, oxidative stress, and neurodegeneration" *Int J Cell Biol.* (2012) PMID: 22991514.
- Deapen DM et al.: "A case-control study of amyotrophic lateral sclerosis" *Am J Epidemiol.* (1986) PMID: 3962963.
- Huss A et al.: "Occupational exposure to magnetic fields and electric shocks and risk of ALS: the Swiss National Cohort" *Amyotroph Lateral Scler Frontotemporal Degener.* (2015) PMID: 25229273.
- Huss A et al.: "Occupational exposure to extremely low-frequency magnetic fields and the risk of ALS: A systematic review and meta-analysis" *Bioelectromagnetics.* (2018) PMID: 29350413.
- Johansen C: "Electromagnetic fields and health effects--epidemiologic studies of cancer, diseases of the central nervous system and arrhythmia-related heart disease" *Scand J Work Environ Health.* (2004) PMID: 15255560. Article.
- Koeman T et al.: "Occupational exposure and amyotrophic lateral sclerosis in a prospective cohort" *Occup Environ Med.* (2017) PMID: 28356332.
- Li CY et al.: "Association between occupational exposure to power frequency electromagnetic fields and amyotrophic lateral sclerosis: a review" *Am J Ind Med.* (2003) PMID: 12541277.
- Zhou H et al.: "Association between extremely low-frequency electromagnetic fields occupations and amyotrophic lateral sclerosis: a meta-analysis" *PLoS One.* (2012) PMID: 23189129. PMC3506624.

(9) Antibiotic resistance in bacteria

- Soghomonyan D et al.: "Millimeter waves or extremely high frequency electromagnetic fields in the environment: what are their effects on bacteria?" *Appl Microbiol Biotechnol.* (2016) PMID: 27087527.
- Taheri M et al.: "Evaluation of the Effect of Radiofrequency Radiation Emitted From Wi-Fi Router and Mobile Phone Simulator on the Antibacterial Susceptibility of Pathogenic Bacteria Listeria monocytogenes and Escherichia coli" *Dose Response.* (2017) PMID: 28203122. PMC5298474.

- Torgomyan H et al.: "Electromagnetic irradiation of Enterococcus hirae at low-intensity 51.8- and 53.0-GHz frequencies: changes in bacterial cell membrane properties and enhanced antibiotics effects" *FEMS Microbiol Lett.* (2012) PMID: 22288948. Article.
- Torgomyan H et al.: "The enhanced effects of antibiotics irradiated of extremely high frequency electromagnetic fieldon Escherichia coli growth properties" *Cell Biochem Biophys.* (2015) PMID: 25164112.

(10) Antioxidant, anti-inflammatory, Nrf2

- Arbabi-Kalati F et al.: "Effect of mobile phone usage time on total antioxidant capacity of saliva and salivary immunoglobulin a" *Iran J Public Health.* (2014) PMID: 26005658.
- Cao H et al.: "Circadian rhythmicity of antioxidant markers in rats exposed to 1.8 GHz radiofrequency fields" *Int J Environ Res Public Health.* (2015) PMID: 25685954. PMC4344711.
- Pall ML et al.: "Nrf2, a master regulator of detoxification and also antioxidant, anti-inflammatory and other cytoprotective mechanisms, is raised by health promoting factors" *Sheng Li Xue Bao. [Acta Physiologica Sinica]* (2015) PMID: 2567262.

(11) Anxiety, depression, suicide

- Djordjevic NZ et al.: "Anxiety-like behavioural effects of extremely-low-frequency electromagnetic field in rats" *Environ Sci Pollut Res Int.* (2017) PMID: 28756602.
- Kitaoka K et al.: "Exposure to an Extremely-Low-Frequency Magnetic Field Stimulates Adrenal Steroidogenesis via Inhibition of Phosphodiesterase Activity in a Mouse Adrenal Cell Line" *PLoS One.* (2016) PMID: 27100201. PMC4839720.
- Oshima N et al.: "The suicidal feelings, self-injury, and mobile phone use after lights out in adolescents" *J Pediatr Psychol.* (2012) PMID: 22728900.
- Pall ML: "Microwave frequency electromagnetic fields (EMFs) produce widespread neuropsychiatric effects including depression" *J Chem Neuroanat.* (2015) PMID: 26300312.
- Shehu A et al.: "Exposure to mobile phone electromagnetic field radiation, ringtone and vibration affects anxiety-like behaviour and oxidative stress biomarkers in albino wistar rats" *Metab Brain Dis.* (2016) PMID: 26546224.
- Twenge JM et al.: "Decreases in Psychological Well-Being Among American Adolescents After 2012 and Links to Screen Time During the Rise of Smartphone Technology" *Emotion.* (2018) PMID: 29355336.
- Varghese R et al.: "Rats exposed to 2.45GHz of non-ionizing radiation exhibit behavioral changes with increased brain expression of apoptotic caspase 3" *Pathophysiology.* (2018) PMID: 29153770.
- Zhang JP et al.: "Effects of 1.8 GHz Radiofrequency Fields on the Emotional Behavior and Spatial Memory of Adolescent Mice" *Int J Environ Res Public Health.* (2017) PMID: 29113072; pdf.

(12) Asthma

- Cui Y et al.: "Exposure to extremely low-frequency electromagnetic fields inhibits T-type calcium channels via AA/LTE4 signaling pathway" *Cell Calcium.* (2014) PMID: 24360572; pdf.
- Li DK et al.: "Maternal exposure to magnetic fields during pregnancy in relation to the risk of asthma in offspring" *Arch Pediatr Adolesc Med.* (2011) PMID: 21810627.

(13) Atopic

- Del Signore A et al.: "Combined effects of traffic and electromagnetic fields on the immune system of fertile atopic women" *Ind Health.* (2000) PMID: 1094307. Article.

(14) ATP; *see also: Metabolic theory, Mitochondrial dysfunction, Phosphorylation*

- Ocal I et al.: "ATP sensitive K+ channel subunits (Kir6.1, Kir6.2) are the candidate mediators regulating ameliorating effects of pulsed magnetic field on aortic contractility in diabetic rats" *Bioelectromagnetics.* (2018) PMID: 29446477.

- Shi Z et al.: "The Energy Metabolism in Caenorhabditis elegans under The Extremely Low-Frequency Electromagnetic Field Exposure" *Sci Rep.* (2015) PMID: 25683579. PMC4329544.

(15) Attention Deficit Hyperactivity Disorder (ADHD), Autism

- Alsaeed I et al.: "Autism-relevant social abnormalities in mice exposed perinatally to extremely low frequency electromagnetic fields" *Int J Dev Neurosci.* (2014) PMID: 24970316.
- Byun YH et al.: "Mobile phone use, blood lead levels, and attention deficit hyperactivity symptoms in children: a longitudinal study" *PLoS One.* (2013) PMID: 23555766. PMC3605379.
- Herbert MR et al.: "Autism and EMF? Plausibility of a pathophysiological link - Part I" *Pathophysiology.* (2013) PMID: 24095003; Part II PMID: 24113318.
- Kim Y et al.: "Personality Factors Predicting Smartphone Addiction Predisposition: Behavioral Inhibition and Activation Systems, Impulsivity, and Self-Control" *PLoS One.* (2016) PMID: 27533112. PMC4988723.
- Kushlev K et al.: "'Silence your phones': Smartphone notifications increase inattention and hyperactivity symptoms" *Proc CHI.* (2016) Article.
- Lissak G: "Adverse physiological and psychological effects of screen time on children and adolescents: Literature review and case study" *Environ Res.* (2018) PMID: 29499467.
- Milham S: (2011) "Attention deficit hyperactivity disorder and dirty electricity" *J Dev Behav Pediatr.* (2011) PMID: 21904211; copy.
- Zheng F et al.: "Association between mobile phone use and inattention in 7102 Chinese adolescents: a population-based cross-sectional study" *BMC Public Health.* (2014) PMID: 25273315.

(16) Auditory effects, Microwave Hearing; see also Tinnitus

- Das S et al.: "A study on the effect of prolonged mobile phone use on pure tone audiometry thresholds of medical students of Sikkim" *J Postgrad Med.* (2017) PMID: 28272071. PMC5664865.
- Frey AH: "Auditory system response to radio frequency energy: Technical Note" *Aerospace Med.* (1961) PMID: 13895080; pdf.
- Frey AH: "Human auditory system response to modulated electromagnetic energy" *J Appl Physiol.* (1962) PMID: 13895081.
- Kerekhanjanarong V et al.: "The effect of mobile phone to audiologic system" *J Med Assoc Thai.* (2005) PMID: 16623034.
- Meriç F et al.: "Do radiofrequency radiation affect the auditory system of people with occupational exposure?" *Environ Health Prev Med.* (1998) PMID: 21432509. PMC2723273.
- Oktay MF et al.: "Occupational safety: effects of workplace radiofrequencies on hearing function" *Arch Med Res.* (2004) PMID: 15631877.
- Panda NK et al.: "Audiologic disturbances in long-term mobile phone users" *J Otolaryngol Head Neck Surg.* (2010) PMID: 20122338.
- Velayutham P et al.: "High-frequency hearing loss among mobile phone users" *Indian J Otolaryngol Head Neck Surg.* (2014) PMID: 24533378. PMC3918279.

(17) Aurora Disturbance Sensitive People (ADSP)

- Chernouss S et al.: "Geophysical hazard for human health in the circumpolar Auroral belt: Evidence of a relationship between heart rate variation and electromagnetic disturbances" Nat Hazards. (2001) Abstract.

(18) Auto-immune effects, immune system, inflammation

- Belpomme D et al: "Reliable disease biomarkers characterizing and identifying electrohypersensitivity and multiple chemical sensitivity as two etiopathogenic aspects of a unique pathological disorder" *Rev Environ Health* (2015) PMID: 26613326; pdf.

- El-Gohary OA et al.: "Effect of electromagnetic waves from mobile phone on immune status of male rats: possible protective role of vitamin D" *Can J Physiol Pharmacol.* (2017) PMID: 27901344.
- Johansson O: "Disturbance of the immune system by electromagnetic fields- A potentially underlying cause for cellular damage and tissue repair reduction which could lead to disease and impairment" *Pathophysiology.* (2009) PMID: 19398310.
- Marshall TG et al.: "Electrosmog and autoimmune disease" *Immunol Res.* (2017) PMID: 27412293; pdf.
- Taheri M et al.: "The effect of Base Transceiver Station waves on some immunological and hematological factors in exposed persons" *Hum Antibodies.* (2017) PMID: 27911288.

(19) Autonomic nervous system

- Hideaki W et al.: "Effect of 100 Hz electroacupuncture on salivary immunoglobulin A and the autonomic nervous system" *Acupunct Med.* (2015) PMID: 26449884; pdf.

(20) Autophagy suppressed (ageing, cancer, infections, neurodegeneration)

- Kim JH et al: "Induction of Autophagy in the Striatum and Hypothalamus of Mice after 835 MHz Radiofrequency Exposure" *PLoS One.* (2016) PMID: 27073885.
- Kim JH et al: "Long-term exposure to 835 MHz RF-EMF induces hyperactivity, autophagy and demyelination in the cortical neurons of mice" *Sci Rep.* (2017) PMID: 28106136.
- Marchesi N et al: "Autophagy is modulated in human neuroblastoma cells through direct exposition to low frequency electromagnetic fields" *J Cell Physiol.* (2014) PMID: 24676932.

(21) Bacteria effects

- Adebayo EA et al.: "Effect of radiofrequency radiation from telecommunication base stations on microbial diversity and antibiotic resistance" *J Appl Sci Environ Manage.* (2014) abstract. Article.
- Akan Z et al.: "Extremely low-frequency electromagnetic fields affect the immune response of monocyte-derived macrophages to pathogens" *Bioelectromagnetics.* (2010) PMID: 20809504.
- Crabtree DPE et al.: "The response of human bacteria to static magnetic field and radiofrequency electromagnetic field" *J Microbiol.* (2017) PMID: 28956351.
- [Emery DC et al.: "16S rRNA Next Generation Sequencing Analysis Shows Bacteria in Alzheimer's Post-Mortem Brain" *Front Aging Neurosci.* (2017) PMID: 28676754.]
- Janković SM et al.: "The Effects of Microwave Radiation on Microbial Cultures" *Hosp Pharmacology*. (2014) pdf.
- Taheri M et al.: "Evaluation of the Effect of Radiofrequency Radiation Emitted From Wi-Fi Router and Mobile Phone Simulator on the Antibacterial Susceptibility of Pathogenic Bacteria Listeria monocytogenes and Escherichia coli" *Dose Response.* (2017) PMID: 28203122. PMC5298474.
- Taheri M et la.: "Exposure to Visible Light Emitted from Smartphones and Tablets Increases the Proliferation of Staphylococcus aureus: Can this be Linked to Acne?" *J Biomed Phys Eng.* (2017) PMID: 28580338. PMC5447253.

(22) Bioelectrical signalling, endogenous EM fields, biomagnetism, EM homeostasis

- Adams DS et al.: "Endogenous voltage gradients as mediators of cell-cell communication: strategies for investigating bioelectrical signals during pattern formation" *Cell Tissue Res.* (2013) PMID: 22350846.
- Cervera J et al.: "The interplay between genetic and bioelectrical signaling permits a spatial regionalisation of membrane potentials in model multicellular ensembles" *Sci Rep.* (2016) PMID: 27731412.
- De Ninno A et al.: "Electromagnetic homeostasis and the role of low-amplitude electromagnetic fields on life organization" *Electromagn Biol Med.* (2017) PMID: 27399207.
- Goldwyn JH et al.: "Neuronal coupling by endogenous electric fields: cable theory and applications to coincidence detector neurons in the auditory brain stem" *J Neurophysiol.* (2016) PMID: 26823512.

- Hales CG: "The origins of the brain's endogenous electromagnetic field and its relationship to provision of consciousness" *J Integr Neurosci.* (2014) PMID: 25012714.
- Law R et al.: "Bioelectric memory: modeling resting potential bistability in amphibian embryos and mammalian cells" *Theor Biol Med Model.* (2015) PMID: 26472354.
- Levin M et al.: "Endogenous Bioelectric Signaling Networks: Exploiting Voltage Gradients for Control of Growth and Form" *Annu Rev Biomed Eng.* (2017) PMID: 28633567.
- Levin M: "Endogenous bioelectrical networks store non-genetic patterning information during development and regeneration" *J Physiol.* (2014) PMID: 24882814.
- Levin M: "Reprogramming cells and tissue patterning via bioelectrical pathways: molecular mechanisms and biomedical opportunities" *Wiley Interdiscip Rev Syst Biol Med.* (2013) PMID: 23897652.
- Liboff AR: "A human source for ELF magnetic perturbations" *Electromagn Biol Med.* (2016) PMID: 27355315.
- Liboff AR: "The electromagnetic basis of social interactions" *Electromagn Biol Med.* (2017) PMID: 27786565.
- McCraty R: "New Frontiers in Heart Rate Variability and Social Coherence Research: Techniques, Technologies, and Implications for Improving Group Dynamics and Outcomes" *Front Public Health.* (2017) PMID: 29075623. PMC5643505.
- Pai VP et al.: "Local and long-range endogenous resting potential gradients antagonistically regulate apoptosis and proliferation in the embryonic CNS" *Int J Dev Biol.* (2015) PMID: 26198142.
- Scholkmann F et al: "Non-chemical and non-contact cell-to-cell communication: a short review" *Am J Transl Res.* (2013) PMID: 24093056; pdf.
- Tseng A et al.: "Cracking the bioelectric code: Probing endogenous ionic controls of pattern formation" *Commun Integr Biol.* (2013) PMID: 23802040.
- Tyler SEB: "Nature's Electric Potential: A Systematic Review of the Role of Bioelectricity in Wound Healing and Regenerative Processes in Animals, Humans, and Plants" *Front Physiol.* (2017) PMID: 28928669.

(23) Biofield; *see also: Earthing & Grounding, Subtle Energy*

- Gronowicz G et al.: "Challenges for Preclinical Investigations of Human Biofield Modalities" *Glob Adv Health Med.* (2015) PMID: 26665042. PMC4654781.
- Gronowicz G et al.: "Human biofield therapy does not affect tumor size but modulates immune responses in a mouse model for breast cancer" *J Integr Med.* (2016) PMID: 27641610.
- Hammerschlag R et al.: "Biofield Physiology: A Framework for an Emerging Discipline" *Glob Adv Health Med.* (2015) PMID: 26665040. PMC4654783.
- Jain S et al.: "Clinical Studies of Biofield Therapies: Summary, Methodological Challenges, and Recommendations" *Glob Adv Health Med.* (2015) PMID: 26665043. PMC4654788.
- Kafatos MC et al.: "Biofield Science: Current Physics Perspectives" *Glob Adv Health Med.* (2015) PMID: 26665039. PMC4654779.
- Muehsam D et al.: "An Overview of Biofield Devices" *Glob Adv Health Med.* (2015) PMID: 26665041. PMC4654784.
- Nourbakhsh MR et al.: "The Effects of Oscillatory Biofield Therapy on Pain and Functional Limitations Associated with Carpal Tunnel Syndrome: Randomized, Placebo-Controlled, Double-Blind Study" *J Altern Complement Med.* (2016) PMID: 27487406. PMC5116698.

(24) Biophotons; *see also: Photons*

- Bajpai RP: "Quantum coherence of biophotons and living systems" *Indian J Exp Biol.* (2003) PMID: 15244274.
- Cacha LA et al.: "Genomic instantiation of consciousness in neurons through a biophoton field theory" *J Integr Neurosci.* (2014) PMID: 25012712.
- Gu Q et al.: "Nonlinear response of biophoton emission to external perturbations" *Experientia.* (1992) PMID: 1473570.

- Li Z et al.: "Biophotons Contribute to Retinal Dark Noise" *Neurosci Bull.* (2016) PMID: 27059222. PMC5563773.
- Popp FA et al.: "Biophoton emission. New evidence for coherence and DNA as source" *Cell Biophys.* (1984) PMID: 6204761.
- Popp FA: "Properties of biophotons and their theoretical implications" *Indian J Exp Biol.* (2003) PMID: 15244259.

(25) Blood effects; *see also: Rouleaux formation, Cardiovascular, Blood-brain barrier*

- Lippi G et al.: "Acute effects of 30 minutes of exposure to a smartphone call on in vitro platelet function" *Blood Transfus.* (2017) PMID: 27177410. PMC5448831.

(26) Blood-brain barrier leakage

- Belpomme D et al: "Reliable disease biomarkers characterizing and identifying electrohypersensitivity and multiple chemical sensitivity as two etiopathogenic aspects of a unique pathological disorder" *Rev Environ Health* (2015) PMID: 26613326; pdf.
- Leszczynski D et al.: "Non-thermal thermal activation of the hsp27/p38MAPK stress pathway by mobile phone radiation in human endothelial cells: molecular mechanism for cancer- and blood-brain barrier-related effects" *Differentiation.* (2002) PMID: 12076339.
- Nittby H et al.: "Increased blood-brain barrier permeability in mammalian brain 7 days after exposure to the radiation from a GSM-900 mobile phone" *Pathophysiology.*(2009) PMID: 19345073.
- Tang J et al.: "Exposure to 900 MHz electromagnetic fields activates the mkp-1/ERK pathway and causes blood-brain barrier damage and cognitive impairment in rats" *Brain Res.* (2015) PMID: 25598203.
- Zhang SL et al.: "A Circadian Clock in the Blood-Brain Barrier Regulates Xenobiotic Efflux" *Cell.* (2018) Abstract.

(27) Bone development, bone tumours

- Erkut A et al.: "The effect of prenatal exposure to 1800 MHz electromagnetic field on calcineurin and bone development in rats" *Acta Cir Bras.* (2016) PMID: 26959616; pdf.
- Gujjalapudi M et al.: "Effect of Magnetic Field on Bone Healing around Endosseous Implants - An In-vivo Study" *J Clin Diagn Res.* (2016) PMID: 27891492. PMC5121830.
- Hong JM et al.: "Electromagnetically controllable osteoclast activity" *Bone.* (2014) PMID: 24556539.
- Kunt H et al.: "Effects of electromagnetic radiation exposure on bone mineral density, thyroid, and oxidative stress index in electrical workers" *Onco Targets Ther.* (2016) PMID: 26929645. PMC4758783.
- McElhaney JH et al.: "Electric fields and bone loss of disuse" *J Biomech.* (1968) PMID: 16329309.
- Ross CL et al.: "The effect of low-frequency electromagnetic field on human bone marrow stem/progenitor cell differentiation" *Stem Cell Res.* (2015) PMID: 26042793. PMC4516580.
- Zhang J et al.: "Regulation of osteoclast differentiation by static magnetic fields" *Electromagn Biol Med.* (2017) PMID: 27355421.
- Zhu BY et al.: "Exposure Duration Is a Determinant of the Effect of Sinusoidal Electromagnetic Fields on Peak Bone Mass of Young Rats" *Calcif Tissue Int.* (2018) PMID: 29362823.

(28) Brain development, differences, processing, cerebral effects

- Adey WR: "Frequency and power windowing in tissue interactions with weak electromagnetic fields" *Proc. IEEE.* (1980) abstract.
- Deshmukh PS et al.: "Effect of Low Level Subchronic Microwave Radiation on Rat Brain" *Biomed Environ Sci.* (2016) PMID: 28081746.

- Heuser G et al.: "Functional brain MRI in patients complaining of electrohypersensitivity after long term exposure to electromagnetic fields" *Rev Environ Health.* (2017) PMID: 28678737; pdf. Heuser G et al.: "Corrigendum" *Rev Environ Health.* (2017) PMID: 29206645.
- Huber R et al: "Exposure to pulse-modulated radio frequency electromagnetic fields affects regional cerebral blood flow" *Eur J Neurosci.* (2005) PMID: 15787706.
- Megha K et al.: "Microwave radiation induced oxidative stress, cognitive impairment and inflammation in brain of Fischer rats" *Indian J Exp Biol.* (2012) PMID: 23986973.
- Rouleau N et al.: "Focal attenuation of specific electroencephalographic power over the right parahippocampal region during transcerebral copper screening in living subjects and hemispheric asymmetric voltages in fixed brain tissue" *Brain Res.* (2016) PMID: 27211475.
- Sage C et al.: "Electromagnetic Fields, Pulsed Radiofrequency Radiation, and Epigenetics: How Wireless Technologies May Affect Childhood Development" *Child Dev.* (2017) PMID: 28504324.
- Seo CH et al.: "Preliminary Investigation of Pain-Related Changes in Cerebral Blood Volume in Patients With Phantom Limb Pain" *Arch Phys Med Rehabil.* (2017) PMID: 28392326.

(29) Brain tumours; *see also: Tumour promotion, Glioma*

- Bates MN: "Extremely low frequency electromagnetic fields and cancer: the epidemiologic evidence" *Environ Health Perspect.* (1991) PMID: 1821368. PMC1568419.
- Bortkiewicz A et al.: "Mobile phone use and risk for intracranial tumors and salivary gland tumors - A meta-analysis" *Int J Occup Med Environ Health.* (2017) PMID: 28220905.
- Carlberg M et al.: "Case-control study on occupational exposure to extremely low-frequency electromagnetic fields and glioma risk" *Am J Ind Med.* (2017) PMID: 28394434.
- Carlberg M et al.: "Decreased survival of glioma patients with astrocytoma grade IV (glioblastoma multiforme) associatedwith long-term use of mobile and cordless phones" *Int J Environ Res Public Health* (2014) PMID: 25325361.
- Coureau G et al.: "Mobile phone use and brain tumours in the CERENAT case-control study" *Occup Environ Med.* (2014) PMID: 24816517.
- Fear NT et al.: "Cancer in electrical workers: an analysis of cancer registrations in England, 1981-87" *Br J Cancer.* (1996) PMID: 8611410. PMC2074257.
- Floderus B et al.: "Occupational exposure to electromagnetic fields in relation to leukemia and brain tumors: a case-control study in Sweden" *Cancer Causes Control.* (1993) PMID: 8218879.
- Grayson JK: "Radiation exposure, socioeconomic status, and brain tumor risk in the US Air Force: a nested case-control study" *Am J Epidemiol.* (1996) PMID: 8610663.
- Grell K et al.: "The Intercranial Distribution of Gliomas in Relation to Exposure From Mobile Phones: Analyses From the INTERPHONE Study" *Am J Epidemiol.* (2016) PMID: 27810856. PMC5152665.
- Guénel P et al.: "Exposure to 50-Hz electric field and incidence of leukemia, brain tumors, and other cancers among French electric utility workers" *Am J Epidemiol.* (1996) PMID: 8956623.
- Hardell L et al.: "Long-term use of cellular phones and brain tumours: increased risk associated with use for > or =10 years" *Occup Environ Med.* (2007) PMID: 17409179. PMC2092574.
- Hardell L et al.: "Meta-analysis of long-term mobile phone use and the association with brain tumours" *Int J Oncol.* (2008) PMID: 18425337.
- Hardell L et al: "Epidemiological evidence for an association between use of wireless phones and tumor diseases" Pathophysiology (2009) PMID: 19268551.
- Hardell L et al.: "Pooled analysis of case-control studies on malignant brain tumours and the use of mobile and cordless phones including living and deceased subjects" *Int J Oncol.* (2011) PMID: 21331446.
- Hardell L et al.: "Case-control study of the association between malignant brain tumours diagnosed between 2007 and 2009 and mobile and cordless phone use" *Int J Oncol.* (2013) PMID: 24064953. PMC3834325.
- Hardell L et al: "Mobile phone and cordless phone use and the risk for glioma - Analysis of pooled case-control studies in Sweden, 1997-2003 and 2007-2009" *Pathophysiology* (2016) PMID: 25466607.

- Hardell L et al.: "Mobile phones, cordless phones and rates of brain tumors in different age groups in the Swedish National Inpatient Register and the Swedish Cancer Register during 1998-2015" *PLoS One.* (2017) PMID: 28976991. PMC5627905.
- Hardell L et al: "Using the Hill viewpoints from 1965 for evaluating strengths of evidence of the risk for brain tumors associated with use of mobile and cordless phones" *Rev Environ Health* (2013) PMID: 24192496.
- Leece R et al.: "Global incidence of malignant brain and other central nervous system tumors by histology, 2003-2007" *Neuro Oncol.* (2017) PMID: 28482030.
- Levis AG et al.: [Mobile phones and head tumours: it is time to read and highlight data in a proper way] *Epidemiol Prev.* (2011) PMID: 21914915.
- Levis AG et al: "Mobile phones and head tumours. The discrepancies in cause-effect relationships in the epidemiological studies - how do they arise?" *Environ Health.* (2011) PMID: 21679472.
- Lin RS et al.: "Occupational exposure to electromagnetic fields and the occurrence of brain tumors. An analysis of possible associations" *J Occup Med.* (1985) PMID: 4020499.
- Loomis DP et al.: "Mortality from brain cancer and leukaemia among electrical workers" *Br J Ind Med.* (1990) PMID: 2207035. PMC1035250.
- Morgan LL: "Estimating the risk of brain tumors from cellphone use: Published case-control studies" *Pathophysiology.* (2009) PMID: 19356911.
- Morgan LL et al: "Mobile phone radiation causes brain tumors and should be classified as a probable human carcinogen (2A) (review)" *Int J Onc.* (2015) PMID: 25738972.
- Ostrom QT et al.: "American Brain Tumor Association Adolescent and Young Adult Primary Brain and Central Nervous System Tumors Diagnosed in the United States in 2008-2012" *Neuro Oncol.* (2016) PMID: 26705298; pdf.
- Philips A et al.: "Brain tumours: rise in Glioblastoma Multiforme incidence in England 1995–2015 suggests an adverse environmental or lifestyle factor" *J Envir Pub Health.* (2018). Article.
- Prasad M et al.: "Mobile phone use and risk of brain tumours: a systematic review of association between study quality, source of funding, and research outcomes" *Neurol Sci.* (2017) PMID: 28213724.
- Savitz DA et al.: "Magnetic field exposure in relation to leukemia and brain cancer mortality among electric utility workers" *Am J Epidemiol.* (1995) PMID: 7817968.
- Törnqvist S et al.: "Incidence of leukaemia and brain tumours in some "electrical occupations"" *Br J Ind Med.* (1991) PMID: 1911402.
- Turner MC et al.: "Occupational exposure to extremely low-frequency magnetic fields and brain tumor risks in the INTEROCC study" *Cancer Epidemiol Biomarkers Prev.* (2014) PMID: 24935666. PMC4154968.
- Villeneuve PJ et al.: "Brain cancer and occupational exposure to magnetic fields among men: results from a Canadian population-based case-control study" *Int J Epidemiol.* (2002) PMID: 11914323.
- Zaret MM: "Potential hazards of hertzian radiation and tumors" *N Y State J Med.* (1977) PMID: 264612.

(30) Breast cancer:

(i) Breast cancer: female

- Chen Q et al.: "A meta-analysis on the relationship between exposure to ELF-EMFs and the risk of female breast cancer" *PLoS One.* (2013) PMID: 23869239. PMC3712018.
- Feychting M et al.: "Magnetic fields and breast cancer in Swedish adults residing near high-voltage power lines" *Epidemiology.* (1998) PMID: 9647902.
- Forssén UM et al.: "Occupational and residential magnetic field exposure and breast cancer in females" *Epidemiology.* (2000) PMID: 10615839.
- Kliukiene J et al.: "Residential and occupational exposures to 50-Hz magnetic fields and breast cancer in women: a population-based study" *Am J Epidemiol.* (2004) PMID: 15105178.

- Loomis DP et al.: "Breast cancer mortality among female electrical workers in the United States" *J Natl Cancer Inst.* (1994) PMID: 8196082.
- Wertheimer N et al.: "Adult cancer related to electrical wires near the home" *Int J Epidemiol.* (1982) PMID: 7152787.
- Zhao G et al.: "Relationship between exposure to extremely low-frequency electromagnetic fields and breast cancer risk: a meta-analysis" *Eur J Gynaecol Oncol.* (2014) PMID: 24984538.

(ii) Breast cancer: male

- Demers PA et al.: "Occupational exposure to electromagnetic fields and breast cancer in men" *Am J Epidemiol.* (1991) PMID: 1877594.
- Grundy A et al.: "Occupational exposure to magnetic fields and breast cancer among Canadian men" *Cancer Med.* (2016) PMID: 26792203. PMC4799956.
- Sun JW et al.: "Electromagnetic field exposure and male breast cancer risk: a meta-analysis of 18 studies" *Asian Pac J Cancer Prev.* (2013) PMID: 23534787. Article.
- Tynes T et al.: "Electromagnetic fields and male breast cancer" *Lancet.* (1990) PMID: 1979420.

(31) Calcitonin Gene-Related Peptide (CGRP)

- Johansson O et al.: "A screening of skin changes, with special emphasis on neurochemical marker antibody evaluation, in patients claiming to suffer from "screen dermatitis" as compared to normal healthy controls" *Exp Dermatol.* (1996) PMID: 8981027.

(32) Calcium flux, VGCC, cell membrane permeability, phospholipids

- Banerjee J et al.: "Immediate Effects of Repetitive Magnetic Stimulation on Single Cortical Pyramidal Neurons" *PLoS One.* (2017) PMID: 28114421. PMC5256952.
- Bellono NW et al.: "Molecular basis of ancestral vertebrate electroreception" *Nature.* (2017) PMID: 28264196.
- Doyon PR et al.: "Electromagnetic fields may act via calcineurin inhibition to suppress immunity, thereby increasing risk for opportunistic infection: Conceivable mechanisms of action" *Med Hypoth.* (2017) abstract.
- Lu XW et al.: "Effects of moderate static magnetic fields on the voltage-gated sodium and calcium channel currents in trigeminal ganglion neurons" *Electromagn Biol Med.* (2015) PMID: 24712748.
- Pall ML: "Electromagnetic fields act via activation of voltage-gated calcium channels to produce beneficial or adverse effects" *J Cell Mol Med.* (2013) PMID: 23802593.
- Sun ZC et al.: "Extremely Low Frequency Electromagnetic Fields Facilitate Vesicle Endocytosis by Increasing Presynaptic Calcium Channel Expression at a Central Synapse" *Sci Rep.* (2016) PMID: 26887777; pdf.
- Tolstykh GP et al.: "600ns pulse electric field-induced phosphatidylinositol4,5-bisphosphate depletion" *Bioelectrochemistry.* (2014) PMID: 24530104.
- Ulku R et al.: "Extremely low-frequency magnetic field decreased calcium, zinc and magnesium levels in costa of rat" *Biol Trace Elem Res.* (2011) PMID: 20872091.
- Zhang H et al.: "Influence of extremely low frequency magnetic fields on Ca2+ signaling and double messenger system in mice hippocampus and reversal function of procyanidins extracted from lotus seedpod" *Bioelectromagnetics.* (2017) PMID: 28570746.
- Zhang J et al.: "Pulsed electromagnetic field inhibits RANKL-dependent osteoclastic differentiation in RAW264.7 cells through the Ca2+-calcineurin-NFATc1 signaling pathway" *Biochem Biophys Res Commun.* (2017) PMID: 27856256.

(33) Cancers, immunodeficiency;
see also: brain tumour, breast cancer, colon cancer, DNA fragmentation, glioma, leukaemia, lung cancer, lymphoma, melanoma, melatonin, oxidative stress Schwannoma, skin cancer, testicular cancer, thyroid cancer, tumour promotion

- Balcer-Kubiczek EK et al.: "Evidence for microwave carcinogenesis in vitro" *Carcinogenesis.* (1985) PMID: 4006071.
- Carpenter DO: "Electromagnetic fields and cancer: the cost of doing nothing" *Rev Environ Health.* (2010) PMID: 20429163.
- Carpenter DO: "Human disease resulting from exposure to electromagnetic fields" *Rev Environ Health.* (2013) PMID: 24280284.
- Chernet B et al.: "Endogenous Voltage Potentials and the Microenvironment: Bioelectric Signals that Reveal, Induce and Normalize Cancer" *J Clin Exp Oncol.* (2013) PMID: 25525610.
- Chou CK et al.: "Long-term, low-level microwave irradiation of rats" *Bioelectromagnetics.* (1992) PMID: 1482413. Article.
- Dode A et al.: "Mortality by neoplasia and cellular telephone base stations in the Belo Horizonte municipality, Minas Gerais state, Brazil"*Sci Total Environ.* (2011) PMID: 21741680.
- Dolk H et al.: "Cancer incidence near radio and television transmitters in Great Britain. II. All high power transmitters" *Am J Epidemiol.* (1997) PMID: 8982017.
- Eger H et al.: "Cancer incidence from residents within a mobile phone base station in Westphalia - interview-based pilot survey and risk assessment" *Umwelt Medizin Gesellschaft* (2009) article [German].
- Falone S et al.: "Extremely Low-Frequency Magnetic Fields and Redox-Responsive Pathways Linked to Cancer Drug Resistance: Insights from Co-Exposure-Based In Vitro Studies" *Front Public Health.* (2018) PMID: 29527520. PMC5829633.
- Havas M: "When theory and observation collide: Can non-ionizing radiation cause cancer?" *Environ Pollut.* (2016) PMID: 27903411.
- IARC, WHO: "Non-Ionizing Radiation, Part 1: Static and ELF Electric and Magnetic Fields" *IARC Monographs on the Evaluation of Carcinogenic Risks to Humans.* 80 (2002).
- IARC, WHO: "IARC Classifies radiofrequency electromagnetic fields as possibly carcinogenic to humans" Press Release no. 208 (2011); pdf (2013).
- Johansson O: "Disturbance of the immune system by electromagnetic fields-A potentially underlying cause for cellular damage and tissue repair reduction which could lead to disease and impairment" *Pathophysiology.* (2009) PMID: 19398310.
- Kocaman A et al.: "Genotoxic and carcinogenic effects of non-ionizing electromagnetic fields" *Environ Res.* (2018) PMID: 29427953.
- Li Y et al.: "Extra-low-frequency magnetic fields alter cancer cells through metabolic restriction" *Electromagn Biol Med.* (2014) PMID: 23915261.
- Lin JC: "Potential Game Changer for Mobile-Phone Radio-Frequency Radiation Carcinogenesis" *Rad Sci Bull. IEEE.* (2016) pdf.
- Lowenthal RM et al.: "Residential exposure to electric power transmission lines and risk of lymphoproliferative and myeloproliferative disorders: a case-control study" *Intern Med J.* (2007) PMID: 17543004.
- Mangiacasale R et al.: "Normal and cancer-prone human cells respond differently to extremely low frequency magnetic fields" *FEBS Lett.* (2001) PMID: 11163365.
- Martínez MA et al.: "Power Frequency Magnetic Fields Affect the p38 MAPK-Mediated Regulation of NB69 Cell Proliferation Implication of Free Radicals" *Int J Mol Sci.* (2016) PMID: 27058530.
- Milham S et al.: "A new electromagnetic exposure metric: high frequency voltage transients associated with increased cancer incidence in teachers in a California school" *Am J Ind Med.* (2008) PMID: 18512243.
- Omura Y et al.: "Electro-magnetic fields in the home environment (color TV, computer monitor, microwave oven, cellular phone, etc) as potential contributing factors for the induction of oncogen C-fos Ab1, oncogen C-fos Ab2, integrin alpha 5 beta 1 and development of cancer, as well as effects of microwave on amino acid composition of food and living human brain" *Acupunct Electrother Res.* (1993) PMID: 7684553.
- Peleg M et al.: "Radio frequency radiation-related cancer: assessing causation in the occupational/military setting" *Environ Res.* (2018) PMID: 29433020.

- Soffritti M et al.: "Life-span exposure to sinusoidal-50 Hz magnetic field and acute low-dose γ radiation induce carcinogenic effects in Sprague-Dawley rats" *Int J Radiat Biol.* (2016) PMID: 26894944.
- Soffritti M et al.: "Synergism between sinusoidal-50 Hz magnetic field and formaldehyde in triggering carcinogenic effects in male Sprague-Dawley rats" *Am J Ind Med.* (2016) PMID: 27219869.
- Szadkowska-Stańczyk I et al.: [Occupational exposure to electromagnetic fields and its health effects in electric energy workers] *Med Pr.* (2000) PMID: 11288692.
- Szmigielski S et al.: "Accelerated development of spontaneous and benzopyrene-induced skin cancer in mice exposed to 2450-MHz microwave radiation" *Bioelectromagnetics.* (1982) PMID: 7126270. Abstract.
- Szmigielski S: "Cancer morbidity in subjects occupationally exposed to high frequency (radiofrequency and microwave) electromagnetic radiation" *Sci Total Environ.* (1996) PMID: 8717316.
- Szudziński A et al.: "Acceleration of the development of benzopyrene-induced skin cancer in mice by microwave radiation" *Arch Dermatol Res.* (1982) PMID: 6299207.
- Thériault G: "Electromagnetic fields and cancer risks" *Rev Epidemiol Sante Publique.* (1992) PMID: 1626106.
- West JG et al.: "Multifocal Breast Cancer in Young Women with Prolonged Contact between Their Breasts and Their Cellular Phones" *Case Rep Med.* (2013) PMID: 24151509.
- Wolf R, Wolf D: "Increased incidence of cancer near a cell-phone transmitter station" *Int J Cancer Prev.* (2004) article.
- Yakymenko I et al.: "Risks of carcinogenesis from electromagnetic radiation of mobile telephony devices" *Exp Oncol.* (2010) PMID: 20693976.
- Yakymenko I et al.: "Long-term exposure to microwave radiation provokes cancer growth: evidences from radars and mobile communication systems" *Exp Oncol.* (2011) PMID: 21716201.

(34) Cardiovascular effects and cerebral blood flow, hypoperfusion

- Ahamed VI et al.: "Effect of mobile phone radiation on heart rate variability" *Comput Biol Med.* (2008) PMID: 18486937.
- Alhusseiny A et al.: "Electromagnetic energy radiated from mobile phone alters electrocardiographic records of patients with ischemic heart disease" *Ann Med Health Sci Res.* (2012) PMID: 23440607.
- Andrzejak R et al.: "The influence of the call with a mobile phone on heart rate variability parameters in healthy volunteers" *Ind Health.* (2008) PMID: 18716391.
- Bandara P et al.: "Cardiovascular disease: Time to identify emerging environmental risk factors" *Eur J Prev Cardiol.* (2017) PMID: 28969497; pdf.
- Bellieni CV et al.: "Electromagnetic fields produced by incubators influence heart rate variability in newborns" *Arch Dis Child Fetal Neonatal Ed.* (2008) PMID: 18450804.
- Belpomme D et al: "Reliable disease biomarkers characterizing and identifying electrohypersensitivity and multiple chemical sensitivity as two etiopathogenic aspects of a unique pathological disorder" *Rev Environ Health* (2015) PMID: 26613326; pdf.
- Bortkiewicz A et al.: "Ambulatory ECG monitoring in workers exposed to electromagnetic fields" *J Med Eng Technol.* (1997) PMID: 9131446.
- Bortkiewicz A et al.: [Exposure to electromagnetic fields with frequencies of 50 Hz and changes in the circulatory system in workers at electrical power stations] *Med Pr.* (1998) PMID: 9760436.
- Bortkiewicz A et al.: "Heart rate variability (HRV) analysis in radio and TV broadcasting stations workers" *Int J Occup Med Environ Health.* (2012) PMID: 23224733.
- Bortkiewicz A et al.: "Neurovegetative disturbances in workers exposed to 50 Hz electromagnetic fields" *Int J Occup Med Environ Health.* (2006) PMID: 16881599.

- Derkacz A et al.: "Effect of electromagnetic field accompanying the magnetic resonance imaging on human heart rate variability - a pilot study" *Int J Inj Contr Saf Promot.* (2017) PMID: 28853316.
- Ekici B et al.: "The effects of the duration of mobile phone use on heart rate variability parameters in healthysubjects" *Anatol J Cardiol.* (2016) PMID: 27109242.
- Esmekaya MA et al.: "900 MHz pulse-modulated radiofrequency radiation induces oxidative stress on heart, lung, testis and liver tissues" *Gen Physiol Biophys.* (2011) PMID: 21460416.
- Fang Q et al.: "An Investigation on the Effect of Extremely Low Frequency Pulsed Electromagnetic Fields on Human Electrocardiograms (ECGs)" *Int J Environ Res Public Health.* (2016) PMID: 27886102.
- Gadzicka E et al.: [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 (ABP)] *Med Pr.* (1997) PMID: 9198713.
- Hänninen O et al: "Cardiovascular Responses to Electromagnetic Radiation" *J. Afr. Ass. Physiol. Sci.* (2013) pdf.
- Havas M: "Radiation from wireless technology affects the blood, the heart, and the autonomic nervous system" *Rev Environ Health.* (2013) PMID: 24192494; pdf.
- Havranek S et al.: "Electromuscular incapacitating devices discharge and risk of severe bradycardia" *Am J Forensic Med Pathol.* (2015) PMID: 25710795. PMC4927311.
- Huber R et al.: "Electromagnetic fields, such as those from mobile phones, alter regional cerebral blood flow and sleep and waking EEG" *J Sleep Res.* (2002) PMID: 12464096. Article.
- Kerimoğlu G et al.: "Effects of long-term exposure to 900 megahertz electromagnetic field on heart morphology and biochemistry of male adolescent rats" *Biotech Histochem.* (2016) PMID: 27715326.
- Komeili G et al.: "Studying the effects of mobile phone waves on electro cardiogram parameters of students in Zahedan University of medical sciences" *Int J High Risk Behav Addict.* (2012) PMID: 24971237.
- Misek J et al.: "Heart rate variability affected by radiofrequency electromagnetic field in adolescent students" *Bioelectromagnetics.* (2018) PMID: 29469164.
- Nishimura T et al.: "A 1-μT extremely low-frequency electromagnetic field vs. sham control for mild-to-moderate hypertension: a double-blind, randomized study" *Hypertension Res.* (2011) Article.
- Otsuka K et al.: "Alternating light-darkness-influenced human electrocardiographic magnetoreception in association with geomagnetic pulsations" *Biomed Pharmacother.* (2001) PMID: 11774870.
- Parazzini M et al.: "Electromagnetic fields produced by GSM cellular phones and heart rate variability" *Bioelectromagnetics.* (2007) PMID: 17004239.
- Pulgar VM: "Direct electric stimulation to increase cerebrovascular function" *Front Syst Neurosci.* (2015) PMID: 25870543. PMC4378276.
- Rezk AY et al.: "Fetal and neonatal responses following maternal exposure to mobile phones" *Saudi Med J.* (2008) PMID: 18246230.
- Schwartz JL et al.: "Exposure of frog hearts to CW or amplitude-modulated VHF fields: selective efflux of calcium ions at 16 Hz" *Bioelectromagnetics.* (1990) PMID: 2285418.
- Shuvy M et al.: "Electromagnetic fields promote severe and unique vascular calcification in an animal model of ectopic calcification" *Exp Toxicol Pathol.* (2014) PMID: 24882371.
- Szmigielski S et al.: "Alteration of diurnal rhythms of blood pressure and heart rate to workers exposed to radiofrequency electromagnetic fields" *Blood Press Monit.* (1998) PMID: 10212373.
- Tenforde TS "Magnetically induced electric fields and currents in the circulatory system" *Prog Biophys Mol Biol.* (2005) PMID: 15556666.
- Trivedi DP et al.: "Electric fields caused by blood flow modulate vascular endothelial electrophysiology and nitric oxide production" *Bioelectromagnetics.* (2013) PMID: 22674251. PMC3522793.

- Türedi S et al.: "The effects of prenatal exposure to a 900-MHz electromagnetic field on the 21-day-old male rat heart" *Electromagn Biol Med.* (2015) PMID: 25166431.
- Yılmaz D et al.: "Analysis of the mobile phone effect on the heart rate variability by using the largest Lyapunov exponent" *J Med Syst.* (2010) PMID: 20703598.
- Zhu W et al.: "[The cardiac injury effect of microwave radiation on rabbit and its mechanism]" *Wei Sheng Yan Jiu.* (2015) PMID: 26591782.

(35) Cell apoptosis

- Xing F et al.: "1800MHz Microwave Induces p53 and p53-Mediated Caspase-3 Activation Leading to Cell Apoptosis In Vitro" PLoS One. (2016) PMID: 27689798. PMC5045209.

(36) Cell proliferation

- Liu C et al.: "Effect of 1 mT sinusoidal electromagnetic fields on proliferation and osteogenic differentiation of rat bone marrow mesenchymal stromal cells" *Bioelectromagnetics.* (2013) PMID: 23589052.
- Sul AR et al.: "Effects of sinusoidal electromagnetic field on structure and function of different kinds of cell lines" *Yonsei Med J.* (2006) PMID: 17191316. PMC2687827.

(37) Cellular membrane

- Lewicka M et al.: "Impact of electromagnetic radiation emitted by monitors on changes in the cellular membrane structure and protective antioxidant effect of vitamin A - In vitro study" *Int J Occup Med Environ Health.* (2017) PMID: 28584329.

(38) Central nervous system tumours

- Georgakis MK et al.: "Central nervous system tumours among adolescents and young adults (15-39 years) in Southern and Eastern Europe: Registration improvements reveal higher incidence rates compared to the US" *Eur J Cancer.* (2017) PMID: 28961466.

(39) Chemical sensitivities and electrosensitivity

- Belpomme D et al: "Reliable disease biomarkers characterizing and identifying electrohypersensitivity and multiple chemical sensitivity as two etiopathogenic aspects of a unique pathological disorder" *Rev Environ Health* (2015) PMID: 26613326; pdf.
- Blackman CF: "Can EMF exposure during development leave an imprint later in life?" *Electromagn Biol Med.* (2006) PMID: 17178582.
- Hardell L et al.: "Increased concentrations of certain persistent organic pollutants in subjects with self-reported electromagnetic hypersensitivity - a pilot study" *Electromagn Biol Med.* (2008) PMID: 18568937.
- Rea WJ: "History of chemical sensitivity and diagnosis" *Rev Environ Health.* (2016) PMID: 27383867; pdf.
- Sage C: "The implications of non-linear biological oscillations on human electrophysiology for electrohypersensitivity (EHS) and multiple chemical sensitivity (MCS)" *Rev Environ Health.* (2015) PMID: 26368042.
- Tran MT et al.: "A randomised, placebo-controlled trial of transcranial pulsed electromagnetic fields in patients with multiple chemical sensitivity" *Acta Neuropsychiatr.* (2016) PMID: 27919300.

(40) Chondrogenesis

- Chen CH et al.: "Electromagnetic fields enhance chondrogenesis of human adipose-derived stem cells in a chondrogenic microenvironment in vitro" *J Appl Physiol.* (1985) PMID: 23239875.
- Parate D et al.: "Enhancement of mesenchymal stem cell chondrogenesis with short-term low intensity pulsed electromagnetic fields" *Sci Rep.* (2017) PMID: 28842627. PMC5572790.

- Xia P et al.: "TGF-β1-induced chondrogenesis of bone marrow mesenchymal stem cells is promoted by low-intensity pulsed ultrasound through the integrin-mTOR signaling pathway" *Stem Cell Res Ther.* (2017) PMID: 29237506. PMC5729425.

(41) Chromosomal alterations

- Balamuralikrishnan B et al.: "Evaluation of chromosomal alteration in electrical workers occupationally exposed to low frequency of electro magnetic field (EMFs) in Coimbatore population, India" *Asian Pac J Cancer Prev.* (2012) PMID: 22938490. Article.
- Celikler S et al.: "A biomonitoring study of genotoxic risk to workers of transformers and distribution line stations" *Int J Environ Health Res.* (2009) PMID: 20183199.

(42) Chronic Fatigue Syndrome, ME

- Maisch D et al.: "Chronic Fatigue Syndrome: Is prolonged exposure to environmental level powerline frequency electromagnetic fields a co-factor to consider in treatment?" *JACNEM.* (1998) Article.
- Maisch D et al.: "Changes in Health Status in a Group of CFS and CF Patients Following Removal of Excessive 50 Hz Magnetic Field Exposure" *JACNEM.* (2002) Article.

(43) Cilia, primary cilia, sensory cilia, intracellular calcium signalling

- Cai S et al.: "Primary cilia are sensors of electrical field stimulation to induce osteogenesis of human adipose-derived stem cells" *FASEB J.* (2017) PMID: 27825103.
- Delling M et al.: "Primary cilia are specialized calcium signalling organelles" *Nature.* (2013) PMID: 24336288; pdf.
- Insinna C et al.: "Intraflagellar transport and the sensory outer segment of vertebrate photoreceptors" *Dev Dyn.* (2008) PMID: 18489002; pdf.
- McCullen SD et al.: "Application of low-frequency alternating current electric fields via interdigitated electrodes: effects on cellular viability, cytoplasmic calcium, and osteogenic differentiation of human adipose-derived stem cells" *Tissue Eng Part C Methods.* (2010) PMID: 20367249; pdf.
- Moorman SJ et al.: "The primary cilium as a gravitational force transducer and a regulator of transcriptional noise" *Dev Dyn.* (2008) PMID: 18366139.

(44) Coherence

- McCraty R: "New Frontiers in Heart Rate Variability and Social Coherence Research: Techniques, Technologies, and Implications for Improving Group Dynamics and Outcomes" *Front Public Health.* (2017) PMID: 29075623. PMC5643505.

(45) Colon cancer

- Mokarram P et al.: "Effect of Exposure to 900 MHz GSM Mobile Phone Radiofrequency Radiation on Estrogen Receptor Methylation Status in Colon Cells of Male Sprague Dawley Rats" *J Biomed Phys Eng.* (2017) PMID: 28451581. PMC5401136.

(46) Connexins, gap junction transmembrane proteins

- Cervellati F et al.: "Effect of high-frequency electromagnetic fields on trophoblastic connexins" *Reprod Toxicol.* (2009) PMID: 19490996.

(47) Cortisol changes

- Evers S et al.: "The impact of repetitive transcranial magnetic stimulation on pituitary hormone levels and cortisol in healthy subjects" *J Affect Disord.* (2001) PMID: 11532537.
- Kitaoka K et al.: "Chronic exposure to an extremely low-frequency magnetic field induces depression-like behavior and corticosterone secretion without enhancement of the hypothalamic-pituitary-adrenal axis in mice" *Bioelectromagnetics.* (2013) PMID: 22753092.

- Mortazavi SM et al.: "Occupational exposure of dentists to electromagnetic fields produced by magnetostrictive cavitrons alters the serum cortisol level" *J Nat Sci Biol Med.* (2012) PMID: 22690053.

(48) Cryptochromes, radical pairs; *see also: Tryptophan*

- Close J: "Are stress responses to geomagnetic storms mediated by the cryptochrome compass system?" *Proc Biol Sci.* (2012) PMID: 22418257. PMC3321722.
- Foley LE et al.: "Human cryptochrome exhibits light-dependent magnetosensitivity" *Nat Commun.* (2011) PMID: 21694704. PMC3128388.
- Kattnig DR et al.: "The sensitivity of a radical pair compass magnetoreceptor can be significantly amplified by radical scavengers" *Sci Rep.* (2017) PMID: 28912470. PMC5599710.
- Maeda K et al.: "Magnetically sensitive light-induced reactions in cryptochrome are consistent with its proposed role as a magnetoreceptor" *Proc Natl Acad Sci U S A.* (2012) PMID: 22421133. PMC3323948.
- Nohr D et al.: "Determination of Radical-Radical Distances in Light-Active Proteins and Their Implication for Biological Magnetoreception" *Angew Chem Int Ed Engl.* (2017) PMID: 28627073.
- Paul S et al.: "Magnetic field effect in natural cryptochrome explored with model compound" *Sci Rep.* (2017) PMID: 28928466. PMC5605708.
- Ritz T et al.: "A model for photoreceptor-based magnetoreception in birds" *Biophys J.* (2000) PMID: 10653784. PMC1300674.
- Sheppard DM et al.: "Millitesla magnetic field effects on the photocycle of an animal cryptochrome" *Sci Rep.* (2017) PMID: 28176875. PMC5296725.
- Vanderstraeten J: [Magnetic fields and health: from epidemiology to cryptochrome chemistry] *Rev Med Brux.* (2017) PMID: 28525248.
- Worster S et al.: "A light-dependent magnetoreception mechanism insensitive to light intensity and polarization" *J R Soc Interface.* (2017) PMID: 28878033. PMC5636276.

(49) Dehydration

- Ayrapetyan S et al.: "Cell hydration as a biomarker for estimation of biological effects of nonionizing radiation on cells and organisms" *ScientificWorldJournal.* (2014) PMID: 25587574.
- Ayrapetyan S: "The role of cell hydration in realization of biological effects of non-ionizing radiation (NIR)" *Electromagn Biol Med.* (2015) PMID: 26444193.
- Danielyan AA et al.: "Changes of hydration of rats' tissues after in vivo exposure to 0.2 Tesla steady magnetic field" *Bioelectromagnetics.* (1999) PMID: 10029139.
- Lankosz J et al.: "[Health status of the workers exposed to strong, constant magnetic fields]" *Med Pr.* (1983) PMID: 6865739.

(50) Differences in EHS subjects; *see also: Individual and inter-individual variability*

- Belyaev IY et al.: "Microwaves from UMTS/GSM mobile phones induce long-lasting inhibition of 53BP1/gamma-H2AX DNA repair foci in human lymphocytes" *Bioelectromagnetics.* (2009) PMID: 18839414.

(51) DNA damage

- Belyaev IY et al.: "Microwaves from UMTS/GSM mobile phones induce long-lasting inhibition of 53BP1/gamma-H2AX DNA repair foci in human lymphocytes" *Bioelectromagnetics.* (2009) PMID: 18839414.
- Blank M et al.: "DNA is a fractal antenna in electromagnetic fields" *Int J Radiat Biol.* (2011) PMID: 21457072.
- Blank M et al.: "Electromagnetic fields and health: DNA-based dosimetry" *Electromagn Biol Med.* (2012) PMID: 22676645.
- Çam ST et al.: "Single-strand DNA breaks in human hair root cells exposed to mobile phone radiation" *Int J Radiat Biol.* (2012) PMID: 22348707.

- Campisi A et al.: "Reactive oxygen species levels and DNA fragmentation on astrocytes in primary culture after acute exposure to low intensity microwave electromagnetic field" *Neurosci Lett.* (2010) PMID: 20156525.
- Chavdoula ED et al.: "Comparison of biological effects between continuous and intermittent exposure to GSM-900-MHz mobile phone radiation: Detection of apoptotic cell-death features" *Mutat Res.* (2010) PMID: 20472095.
- De Iuliis GN et al.: "Mobile phone radiation induces reactive oxygen species production and DNA damage in human spermatozoa in vitro" *PLoS One.* (2009) PMID: 19649291. PMC2714176.
- Diem E et al.: "Non-thermal DNA breakage by mobile-phone radiation (1800 MHz) in human fibroblasts and in transformed GFSH-R17 rat granulosa cells in vitro" *Mutat Res.* (2005) PMID: 15869902.
- D'Silva MH et al.: "Effect of Radiofrequency Radiation Emitted from 2G and 3G Cell Phone on Developing Liver of Chick Embryo – A Comparative Study" *J Clinic Diagnostic Res.* (2017) PMID: 28892876. PMC5583901.
- Franzellitti S et al.: "Transient DNA damage induced by high-frequency electromagnetic fields (GSM 1.8 GHz) in the human trophoblast HTR-8/SVneo cell line evaluated with the alkaline comet assay" *Mutat Res.* (2010) PMID: 19822160.
- Ibitayo AO et al.: "RAPD Profiling, DNA Fragmentation, and Histomorphometric Examination in Brains of Wistar Rats Exposed to Indoor 2.5 Ghz Wi-Fi Devices Radiation" *Biomed Res Int.* (2017) PMID: 28904975.
- Ivancsits S et al.: "Induction of DNA strand breaks by intermittent exposure to extremely-low-frequency electromagnetic fields in human diploid fibroblasts" *Mutat Res.* (2002) PMID: 12160887.
- Lai H et al.: "Acute low-intensity microwave exposure increases DNA single-strand breaks in rat brain cells" *Bioelectromagnetics.* (1995) PMID: 7677797.
- Lai H et al.: "Magnetic-field-induced DNA strand breaks in brain cells of the rat" *Environ Health Perspect.* (2004) PMID: 15121512.
- Lai H et al.: "Single- and double-strand DNA breaks in rat brain cells after acute exposure to radiofrequency electromagnetic radiation" *Int J Radiat Biol.* (1996) PMID: 8627134.
- Liboff AR et al.: "Time-varying magnetic fields: effect on DNA synthesis" *Science.* (1984) PMID: 6695183.
- Liu C et al.: "Exposure to 1800 MHz radiofrequency electromagnetic radiation induces oxidative DNA base damage in a mouse spermatocyte-derived cell line" *Toxicol Lett.* (2013) PMID: 23333639.
- Liu C et al.: "Mobile phone radiation induces mode-dependent DNA damage in a mouse spermatocyte-derived cell line: a protective role of melatonin" *Int J Radiat Biol.* (2013) PMID: 23952262.
- Markovà E et al.: "Microwaves from Mobile Phones Inhibit 53BP1 Focus Formation in Human Stem Cells More Strongly Than in Differentiated Cells: Possible Mechanistic Link to Cancer Risk" *Environ Health Perspect.* (2010) PMID: 20064781. PMC2854769.
- Megha K et al.: "Low intensity microwave radiation induced oxidative stress, inflammatory response and DNA damage in rat brain" *Neurotoxicology.* (2015) PMID: 26511840.
- Miyakoshi J et al.: "Mutation induction by high-density, 50-Hz magnetic fields in human MeWo cells exposed in the DNA synthesis phase" *Int J Radiat Biol.* (1997) PMID: 9020966.
- Phillips JL et al.: "Electromagnetic fields and DNA damage" *Pathophysiology.* (2009) PMID: 19264461.
- Sarkar S et al.: "Effect of low power microwave on the mouse genome: a direct DNA analysis" *Mutat Res.* (1994) PMID: 7506381.
- Sun LX et al.: "[DNA damage and repair induced by acute exposure of microwave from mobile phone on cultured human lens epithelial cells]" *Zhonghua Yan Ke Za Zhi.* (2006) PMID: 17415965.

(52) Dopamine

- Aboul Ezz HS et al.: "The effect of pulsed electromagnetic radiation from mobile phone on the levels of monoamine neurotransmitters in four different areas of rat brain" *Eur Rev Med Pharmacol Sci.* (2013) PMID: 23852905. Article.
- Jing J et al.: "The influence of microwave radiation from cellular phone on fetal rat brain" *Electromagn Biol Med.* (2012) PMID: 22268709.
- Megha K et al.: "Effect of Low-Intensity Microwave Radiation on Monoamine Neurotransmitters and Their Key Regulating Enzymes in Rat Brain" *Cell Biochem Biophys.* (2015) PMID: 25672490.
- Sandyk R: "Effect of weak electromagnetic fields on the amplitude of the pattern reversal VEP response in Parkinson's disease" *Int J Neurosci.* (1996) PMID: 8707479.
- Zawilska JB et al.: "Suppression of melatonin biosynthesis in the chicken pineal gland by retinally perceived light - involvement of D1-dopamine receptors" *J Pineal Res.* (2004) PMID: 14962058.

(53) Duration of exposure: protective or adverse

- Hidisoglu E et al.: "2100-MHz electromagnetic fields have different effects on visual evoked potentials and oxidant/antioxidant status depending on exposure duration" *Brain Res.* (2016) PMID: 26776477.

(54) Electroanaesthania

- Francis J et al.: "Electroanaesthesia - from torpedo fish to TENS" *Anaesthesia.* (2015) PMID: 25348076.
- Zuck D: "Joseph Snape and electroanaesthesia" *Anaesthesia.* (2015) PMID: 25764417. DOI: 10.1111/anae.13048.

(55) Electrokinesis, mechanoelectrical transduction, piezoelectric, tectorial membrane

- Fettiplace R: "Hair Cell Transduction, Tuning, and Synaptic Transmission in the Mammalian Cochlea" *Compr Physiol.* (2017) PMID: 28915323. PMC5658794.
- Fettiplace R et al.: "The physiology of mechanoelectrical transduction channels in hearing" *Physiol Rev.* (2014) PMID: 24987009. PMC4101631.
- Ghaffari R et al.: "Electrokinetic properties of the mammalian tectorial membrane" *Proc Natl Acad Sci U S A.* (2013) PMID: 23440188. PMC3600501.
- Jones GP et al.: "Modified protein expression in the tectorial membrane of the cochlea reveals roles for the striated sheet matrix" *Biophys J.* (2015) PMID: 25564867. PMC4286592.
- Lee HY et al.: "Noninvasive in vivo imaging reveals differences between tectorial membrane and basilar membrane traveling waves in the mouse cochlea" *Proc Natl Acad Sci U S A.* (2015) PMID: 25737536. PMC4364183.
- Sellon JB et al.: "Longitudinal spread of mechanical excitation through tectorial membrane traveling waves" *Proc Natl Acad Sci U S A.* (2015) PMID: 26438861. PMC4620894.

(56) Electroreception, electrosensory organs, ampullae of Lorenzini

- Baker CV et al.: "The evolution and development of vertebrate lateral line electroreceptors" *J Exp Biol.* (2013) PMID: 23761476. PMC4988487.
- Bellono NW et al.: "Molecular basis of ancestral vertebrate electroreception" *Nature.* (2017) PMID: 28264196. PMC5354974.
- Freitas R et al.: "Developmental origin of shark electrosensory organs" *Evol Dev.* (2006) PMID: 16409384.
- Modrell MS et al.: "Insights into electrosensory organ development, physiology and evolution from a lateral line-enriched transcriptome" *Elife.* (2017) PMID: 28346141. PMC5429088.
- Modrell MS et al.: "Notch and Fgf signaling during electrosensory versus mechanosensory lateral line organ development in a non-teleost ray-finned fish" *Dev Biol.* (2017) PMID: 28818669. PMC5650464.

(57) Electrotaxis, galvanotaxis

- Cao L et al.: "Endogenous electric currents might guide rostral migration of neuroblasts" *EMBO Rep.* (2013) PMID: 23328740. PMC3596136.
- Cortese B et al.: "Influence of electrotaxis on cell behaviour" *Integr Biol (Camb).* (2014) PMID: 25058796.
- Gao R et al.: "A large-scale screen reveals genes that mediate electrotaxis in Dictyostelium discoideum" *Sci Signal.* (2015) PMID: 26012633. PMC4470479.
- Huang Y et al.: "Electrical Stimulation Elicits Neural Stem Cells Activation: New Perspectives in CNS Repair" *Front Hum Neurosci.* (2015) PMID: 26539102. PMC4610200.
- Krecioch I et al.: "The role of microtubules in electrotaxis of rat Walker carcinosarcoma WC256 cells" *Acta Biochim Pol.* (2015) PMID: 26217950. Article.
- Li L et al.: "Caveolin-1-mediated STAT3 activation determines electrotaxis of human lung cancer cells" *Oncotarget.* (2017) PMID: 29221162. PMC5707056.
- Liu J et al.: "Electric signals regulate directional migration of ventral midbrain derived dopaminergic neural progenitor cells via Wnt/GSK3β signalling" *Exp Neurol.* (2015) PMID: 25265211.
- Liu Q et al.: "Electric field regulated signaling pathways" *Int J Biochem Cell Biol.* (2014) PMID: 25256684.
- McCaig CD et al.: "Physiological electrical fields modify cell behaviour" *Bioessays.* (1997) PMID: 9297973.
- Shibib K et al.: "Polarization of nerve regeneration (electrotaxis)" *Surg Neurol.* (1988) PMID: 3363474.
- Sroka J et al.: "Electrotaxis: Cell Directional Movement in Electric Fields" *Methods Mol Biol.* (2018) PMID: 29526007.
- Sroka J et al.: "Lamellipodia and Membrane Blebs Drive Efficient Electrotactic Migration of Rat Walker Carcinosarcoma Cells WC 256" *PLoS One.* (2016) PMID: 26863616. PMC4749172.
- Sukul NC et al.: "Influence of potential difference and current on the electrotaxis of Caenorhaditis elegans" *J Nematol.* (1978) PMID: 19305860. PMC2617915.
- Zhang G et al.: "Kindlin-1 Regulates Keratinocyte Electrotaxis" *J Invest Dermatol.* (2016) PMID: 27427485. PMC5756539.
- Zhang G et al.: "The Role of Kv1.2 Channel in Electrotaxis Cell Migration" *J Cell Physiol.* (2016) PMID: 26580832. PMC4832312.
- Zhao H et al.: "Specific Intensity Direct Current (DC) Electric Field Improves Neural Stem Cell Migration and Enhances Differentiation towards βIII-Tubulin+ Neurons" *PLoS One.* (2015) PMID: 26068466. PMC4466259.
- Zhao M et al.: "Electrical signals control wound healing through phosphatidylinositol-3-OH kinase-gamma and PTEN" *Nature.* (2006) PMID: 16871217.
- Zhao M et al.: "Genetic analysis of the role of G protein-coupled receptor signaling in electrotaxis" *J Cell Biol.* (2002) PMID: 12045182. PMC2174050.
- Zhu B et al.: "Electric Signals Regulate the Directional Migration of Oligodendrocyte Progenitor Cells (OPCs) via β1 Integrin" *Int J Mol Sci.* (2016) PMID: 27879672. PMC5133942.

(58) Encephalomyelitis

- Cook LL et al.: "Suppression of experimental allergic encephalomyelitis is specific to the frequency and intensity of nocturnally applied, intermittent magnetic fields in rats" *Neurosci Lett.* (2000) PMID: 11018304.
- Persinger MA et al.: "Suppression of experimental allergic encephalomyelitis in rats exposed nocturnally to magnetic fields" *Int J Neurosci.* (2000) PMID: 10512552.

(59) Endocrine system

- Liboff AR: "A human source for ELF magnetic perturbations" *Electromagn Biol Med.* (2016) PMID: 27355315.

- Minkina NA et al.: "[Effect of discontinuous short-wave electromagnetic field irradiation on the state of the endocrine glands]" *Radiobiologiia.* (1985) PMID: 4080993.
- Nikitina VN et al.: "[Characteristics of the response of animals of different typological groups to the action of electromagnetic irradiation in the high and superhigh frequency ranges]" *Radiobiologiia.* (1989) PMID: 2587707.
- Zagorskaia EA: "[Reaction of the endocrine system to continuous and intermittent electromagnetic fields]" *Kosm Biol Aviakosm Med.* (1989) PMID: 2696838.

(60) Endogenous electric currents

- Cao L et al.: "Endogenous bioelectric currents promote differentiation of the mammalian lens" *J Cell Physiol.* (2018) PMID: 28661005. PMC5724684.
- Krüger J et al.: "Bioelectric patterning during oogenesis: stage-specific distribution of membrane potentials, intracellular pH and ion-transport mechanisms in Drosophila ovarian follicles" *BMC Dev Biol.* (2015) PMID: 25591552. PMC4302609.
- Reid B et al.: "Modulating endogenous electric currents in human corneal wounds--a novel approach of bioelectric stimulation without electrodes" *Cornea.* (2011) PMID: 21099404. PMC3061552.
- Shen Y et al.: "Diabetic cornea wounds produce significantly weaker electric signals that may contribute to impaired healing" *Sci Rep.* (2016) PMID: 27283241. PMC4901296.
- Tyler SEB: "Nature's Electric Potential: A Systematic Review of the Role of Bioelectricity in Wound Healing and Regenerative Processes in Animals, Humans, and Plants" *Front Physiol.* (2017) PMID: 28928669. PMC5591378.

(61) Entaglement

- Dotta BT et al.: "Incremental Shifts in pH spring water can be stored as "space-memory": encoding and retrieval through the application of the same rotating magnetic field" *NeuroQuantology.* (2013) abstract; pdf.

(62) Enzyme effects, lysozyme, calcineurin

- Barteri M et al.: "Structural and kinetic effects of mobile phone microwaves on acetylcholinesterase activity" *Biophys Chem.* (2005) PMID: 15620509.
- Doyon PR et al.: "Electromagnetic fields may act via calcineurin inhibition to suppress immunity, thereby increasing risk for opportunistic infection: Conceivable mechanisms of action" *Med Hypoth.* (2017) abstract.
- English NJ et al.: "Denaturation of hen egg white lysozyme in electromagnetic fields: a molecular dynamics study" *J Chem Phys.* (2007) PMID: 17362097.
- Erkut A et al.: "The effect of prenatal exposure to 1800 MHz electromagnetic field on calcineurin and bone development in rats" *Acta Cir Bras.* (2016) PMID: 26959616; pdf.
- Gulati S et al.: "Phenotypic and genotypic characterization of antioxidant enzyme system in human population exposed to radiation from mobile towers" *Mol Cell Biochem.* (2017) PMID: 28819931.
- Letuta UG et al.: "Enzymatic mechanisms of biological magnetic sensitivity" *Bioelectromagnetics.* (2017) PMID: 28715606.
- Nandi PK et al.: "Perturbation of hydration layer in solvated proteins by external electric and electromagnetic fields: Insights from non-equilibrium molecular dynamics" *J Chem Phys.* (2016) PMID: 27908109.
- Syalima PR et al.: "Mobile phone radiation induces sedation in Periplaneta americana" *Curr Sci.* (2017) Article.

(63) Epidermal growth factor receptor (EGFR)

- Wu X et al.: "Weak power frequency magnetic field acting similarly to EGF stimulation, induces acute activations of the EGFR sensitive actin cytoskeleton motility in human amniotic cells" *PLoS One.* (2014) PMID: 24505297. PMC3914819.

(64) Epigenetic effects

- Consales C et al.: "Fifty-Hertz Magnetic Field Affects the Epigenetic Modulation of the miR-34b/c in Neuronal Cells" *Mol Neurobiol.* (2017) PMID: 29039021.
- Manser M et al.: "ELF-MF exposure affects the robustness of epigenetic programming during granulopoiesis" *Sci Rep.* (2017) PMID: 28266526. PMC5339735.
- Mokarram P et al.: "Effect of Exposure to 900 MHz GSM Mobile Phone Radiofrequency Radiation on Estrogen Receptor Methylation Status in Colon Cells of Male Sprague Dawley Rats" *J Biomed Phys Eng.* (2017) PMID: 28451581. PMC5401136.

(65) Erythrocyte changes, echinocytes, calcium

- Henszen MM et al.: "Electric field pulses induce reversible shape transformation of human erythrocytes" *Mol Membr Biol.* (1997) PMID: 9491371.
- Jeican II et al., "Changes observed in erythrocyte cells exposed to an alternating current" *Clujul Med.* (2017) PMID: 28559698.
- Kretchman JM et al.: "Erythrocyte shape transformation associated with calcium accumulation" *Am J Med Technol.* (1981) PMID: 7025629.

(66) Estrogen beta receptors

- Bernal-Mondragón C et al.: "Effects of repeated 9 and 30-day exposure to extremely low-frequency electromagnetic fields on social recognition behavior and estrogen receptors expression in olfactory bulb of Wistar female rats" *Neurol Res.* (2017) PMID: 27892794.
- Reyes-Guerrero G et al.: "Extremely low-frequency electromagnetic fields differentially regulate estrogen receptor-alpha and -beta expression in the rat olfactory bulb" *Neurosci Lett.* (2010) PMID: 20085801.

(67) Fertility reduced:

(i) Female fertility

- Ahmadi SS et al.: "Effect of non-ionizing electromagnetic field on the alteration of ovarian follicles in rats" *Electron Physician.* (2016) PMID: 27123226.
- Khaki AA et al.: "The effect of Non-ionizing electromagnetic field with a frequency of 50 Hz in Rat ovary: A transmission electron microscopy study" *Int J Reprod Biomed (Yazd).* (2016) PMID: 27200427; pdf.
- Krüger J et al.: "Bioelectric patterning during oogenesis: stage-specific distribution of membrane potentials, intracellular pH and ion-transport mechanisms in Drosophila ovarian follicles" *BMC Dev Biol.* (2015) PMID: 25591552. PMC4302609.
- Manta AK et al.: "Mobile-phone radiation-induced perturbation of gene-expression profiling, redox equilibrium and sporadic-apoptosis control in the ovary of Drosophila melanogaster" *Fly (Austin).* (2017) PMID: 27960592. PMC5406167.
- Okatan DÖ et al.: "Continuous 900-megahertz electromagnetic field applied in middle and late-adolescence causes qualitative and quantitative changes in the ovarian morphology, tissue and blood biochemistry of the rat" *Int J Radiat Biol.* (2018) PMID: 29268055.
- Roshangar L et al.: "Effect of low-frequency electromagnetic field exposure on oocyte differentiation and follicular development" *Adv Biomed Res.* (2014) PMID: 24627884; article.
- Shahin S et al.: "Mobile phone (1800MHz) radiation impairs female reproduction in mice, Mus musculus, through stress induced inhibition of ovarian and uterine activity" *Reprod Toxicol.* (2017) PMID: 28780396.
- Türedi S et al.: "Disruption of the ovarian follicle reservoir of prepubertal rats following prenatal exposure to a continuous 900-MHz electromagnetic field" *Int J Radiat Biol.* (2016) PMID: 27007703.
- Yüksel M et al.: "Long-term exposure to electromagnetic radiation from mobile phones and Wi-Fi devices decreases plasma prolactin, progesterone, and estrogen levels but increases uterine oxidative stress in pregnant rats and their offspring" *Endocrine.* (2016) PMID: 26578367.

(ii) Male and female birth ratio

- Baste V et al.: "Radiofrequency electromagnetic fields; male infertility and sex ratio of offspring" *Eur J Epidemiol.* (2008) PMID: 18415687.
- Dupont MJ et al.: "Reduced litter sizes following 48-h of prenatal exposure to 5 nT to 10 nT,0.5 Hz magnetic fields: implications for sudden infant deaths" *Int J Neurosci.* (2005) PMID: 15823935.
- Knave B et al.: "Long-term exposure to electric fields. A cross-sectional epidemiologic investigation of occupationally exposed workers in high-voltage substations" *Scand J Work Environ Health.* (1979) PMID: 472682. Article.

(iii) Male fertility

- Adams JA et al: "Effect of mobile telephones on sperm quality: a systematic review and meta-analysis" *Environ Int.* (2014) PMID: 24927498.
- Agarwal A et al.: (2015) "Are men talking their reproductive health away?" *Asian J Androl.* (2015) PMID: 25432495.
- Agarwal A et al.: "Effect of cell phone usage on semen analysis in men attending infertility clinic: an observational study" *Fertil Steril.* (2008) PMID: 17482179.
- Agarwal A et al.: "Effects of radiofrequency electromagnetic waves (RF-EMW) from cellular phones on human ejaculated semen: an in vitro pilot study" *Fertil Steril.* (2009) PMID: 18804757.
- Akdag MZ et al.: "Does prolonged radiofrequency radiation emitted from Wi-Fi devices induce DNA damage in various tissues of rats?" *J Chem Neuroanat.* (2016) PMID: 26775760.
- Al-Ali BM et al.: "Cell phone usage and erectile function" *Cent European J Urol.* (2013) PMID: 24578997.
- Al-Damegh MA: "Rat testicular impairment induced by electromagnetic radiation from a conventional cellular telephone and the protective effects of the antioxidants vitamins C and E" *Clinics (Sao Paulo).* (2012) PMID: 22892924. PMC3400170.
- Al-Quzwini O et al.: "Male fertility and its association with occupational and mobile phone towers hazards: An analytic study" *Middle East Fertility Soc J.* (2016) Article.
- Atasoy HI et al.: "Immunohistopathologic demonstration of deleterious effects on growing rat testes of radiofrequency waves emitted from conventional Wi-Fi devices" *J Pediatr Urol.* (2013) PMID: 22465825.
- Avendaño C et al.: "Use of laptop computers connected to internet through Wi-Fi decreases human sperm motility and increases sperm DNA fragmentation" *Fertil Steril.* (2012) PMID: 22112647.
- Dama MS et al.: "Mobile phones affect multiple sperm quality traits: a meta-analysis" *F1000Res.* (2013) PMID: 24327874.
- Dasdag S et al.: "Effect of long-term exposure of 2.4 GHz radiofrequency radiation emitted from Wi-Fi equipment on testes functions" *Electromagn Biol Med.* (2015) PMID: 24460421.
- De Iuliis GN et al.: "Mobile phone radiation induces reactive oxygen species production and DNA damage in human spermatozoa in vitro" *PLoS One.* (2009) PMID: 19649291. PMC2714176.
- Erogul O et al.: "Effects of electromagnetic radiation from a cellular phone on human sperm motility: an in vitrostudy" *Arch Med Res.* (2006) PMID: 16971222.
- Gao XH et al.: "[Cellphone electromagnetic radiation damages the testicular ultrastructure of male rats]" *Zhonghua Nan Ke Xue.* (2016) PMID: 28963835.
- Ghanbari M et al.: "The Effects of Cell Phone Waves (900 MHz-GSM Band) on Sperm Parameters and Total Antioxidant Capacity in Rats" *Int J Fertil Steril.* (2013) PMID: 24520459. PMC3850324.
- Houston B et al.: "The effects of radiofrequency electromagnetic radiation on sperm function" *Reproduction.* (2016) PMID: 27601711.
- Hu P et al.: "miR-638 Inhibits immature Sertoli cell growth by indirectly inactivating PI3K/AKT pathway via SPAG1 gene" *Cell Cycle.* (2017) PMID: 29119857.
- Kamali K et al.: "Effects of electromagnetic waves emitted from 3G+wi-fi modems on human semen analysis" *Urologia.* (2017) PMID: 28967061.

- Karaman MI et al.: "The effects of electromagnetic waves emitted by the cell phones on the testicular tissue" *Arch Ital Urol Androl.* (2014) PMID: 25641450; article.
- La Vignera S et al.: "Effects of the exposure to mobile phones on male reproduction: a review of the literature" *J Androl.* (2012) PMID: 21799142.
- Li DK et al.: "Exposure to magnetic fields and the risk of poor sperm quality" *Reprod Toxicol.* (2010) PMID: 19910156.
- Lin YY et al.: "1950MHz Radio Frequency Electromagnetic Radiation Inhibits Testosterone Secretion of Mouse Leydig Cells" *Int J Environ Res Public Health.* (2017) PMID: 29295490. PMC5800117.
- Liu K et al.: "Association between mobile phone use and semen quality: a systemic review and meta-analysis" *Andrology.* (2014) PMID: 24700791; article.
- Liu Q et al.: "Electromagnetic radiation at 900 MHz induces sperm apoptosis through bcl-2, bax and caspase-3 signaling pathways in rats" *Reprod Health.* (2015) PMID: 26239320. PMC4523914.
- Mailankot M et al.: "Radio frequency electromagnetic radiation (RF-EMR) from GSM (0.9/1.8GHz) mobile phones induces oxidative stress and reduces sperm motility in rats" *Clinics (Sao Paulo).* (2009) PMID: 19578660. PMC2705159.
- Mortazavi SA et al.: "The Fundamental Reasons Why Laptop Computers should not be Used on Your Lap" *J Biomed Phys Eng.* (2016) PMID: 28144597. PMC5219578.
- Odacı E et al.: "Exposure to a 900 MHz electromagnetic field for 1 hour a day over 30 days does change the histopathology and biochemistry of the rat testis" *Int J Radiat Biol.* (2015) PMID: 25786704.
- Sepehrimanesh M et al.: "Analysis of rat testicular proteome following 30-day exposure to 900 MHz electromagnetic field radiation" *Electrophoresis.* (2014) PMID: 25146694.
- Sepehrimanesh M et al.: "Proteomic analysis of continuous 900-MHz radiofrequency electromagnetic field exposure in testicular tissue: a rat model of human cell phone exposure" *Environ Sci Pollut Res Int.* (2017) PMID: 28397118.
- Solek P et al.: "Pulsed or continuous electromagnetic field induce p53/p21-mediated apoptotic signalling pathway in mouse spermatogenic cells in vitro and thus may affect male fertility" *Toxicology.* (2017) PMID: 28323003.
- Yan JG et al.: "Effects of cellular phone emissions on sperm motility in rats" *Fertil Steril.* (2007) PMID: 17628553.
- Zalata A et al.: "In vitro effect of cell phone radiation on motility, DNA fragmentation and clusterin gene expression in human sperm" *Int J Fertil Steril.* (2015) PMID: 25918601. PMC4410031.
- Zhang G et al.: "Effects of cell phone use on semen parameters: Results from the MARHCS cohort study in Chongqing, China" *Environ Int.* (2016) PMID: 26949865.
- Zhang WX et al.: "[Radiation-induced oxidative stress and claudin-11 mRNA expression in the testis]" *Zhonghua Nan Ke Xue.* (2013) PMID: 23678707.

(iv) Sterility and adverse outcomes

- Magras IN et al.: "RF radiation-induced changes in the prenatal development of mice" *Bioelectromagnetics.* (1997) PMID: 9261543; pdf.
- Qi G et al.: "Effects of extremely low-frequency electromagnetic fields (ELF-EMF) exposure on B6C3F1 mice" *Environ Health Prev Med.* (2015) PMID: 25939981. PMC4491062.

(68) Fetal effects, in utero exposure, prenatal exposure, embryo survival

- Aldad TS et al.: "Fetal radiofrequency radiation exposure from 800-1900 mhz-rated cellular telephones affects neurodevelopment and behaviour in mice" *Sci Rep.* (2012) PMID: 22428084. PMC3306017.
- Bahreyni Toossi MH et al.: "Exposure to mobile phone (900-1800 MHz) during pregnancy: tissue oxidative stress after childbirth" *J Matern Fetal Neonatal Med.* (2017) PMID: 28434276.
- Bellieni CV et al.: "Electromagnetic fields produced by incubators influence heart rate variability in newborns" *Arch Dis Child Fetal Neonatal Ed.* (2008) PMID: 18450804.

- Borhani N et al.: "Analysis of DNA fragmentation in mouse embryos exposed to an extremely low-frequency electromagnetic field" *Electromagn Biol Med.* (2011) PMID: 22047462.
- Divan HA et al.: "Cell phone use and behavioural problems in young children" *J Epidemiol Community Health.* (2012) PMID: 21138897.
- Divan HA et al: "Prenatal and postnatal exposure to cell phone use and behavioral problems in children" *Epidemiology* (2008) PMID: 18467962.
- Genuis SJ et al.: "Preconception Care: A New Standard of Care within Maternal Health Services" *Biomed Res Int.* (2016) PMID: 27314031.
- Hancı H et al.: "The effect of prenatal exposure to 900-MHz electromagnetic field on the 21-old-day rat testicle" *Reprod Toxicol.* (2013) PMID: 24095929.
- Nawrot PS et al.: "Effects of 2.45 GHz CW microwave radiation on embryofetal development in mice" *Teratology.* (1981) PMID: 7330780.
- Odacı E et al.: "Effects of prenatal exposure to a 900 MHz electromagnetic field on 60-day-old rat testis and epididymal sperm quality" *Biotech Histochem.* (2016) PMID: 26472053.
- Odacı E et al.: "Maternal exposure to a continuous 900-MHz electromagnetic field provokes neuronal loss and pathological changes in cerebellum of 32-day-old female rat offspring" *J Chem Neuroanat.* (2016) PMID: 26391347.
- Othman H et al.: "Postnatal development and behavior effects of in-utero exposure of rats to radiofrequency waves emitted from conventional WiFi devices" *Environ Toxicol Pharmacol.* (2017) PMID: 28458069.
- Özorak A et al.: "Wi-Fi (2.45 GHz)- and mobile phone (900 and 1800 MHz)-induced risks on oxidative stress and elements in kidney and testis of rats during pregnancy and the development of offspring" *Biol Trace Elem Res.* (2013) PMID: 24101576.
- Razavinasab M et al.: "Maternal mobile phone exposure alters intrinsic electrophysiological properties of CA1 pyramidal neurons in rat offspring" *Toxicol Ind Health.* (2016) PMID: 24604340.
- Rezk AY et al.: "Fetal and neonatal responses following maternal exposure to mobile phones" *Saudi Med J.* (2008)PMID: 18246230.
- Safian F et al.: "Survival Assessment of Mouse Preimplantation Embryos After Exposure to Cell Phone Radiation" *J Reprod Infertil.* (2016) PMID: 27478766.
- Stasinopoulou M et al.: "Effects of pre- and postnatal exposure to 1880-1900 MHz DECT base radiation on development in the rat" *Reprod Toxicol.* (2016) PMID: 27544572.
- Sudan M et al: "Prenatal and postnatal Cell Phone Exposure and Headaches in Children" *Open Pediatr. Med. Journal* (2012) PMID: 23750182.
- Türedi S et al.: "The effects of prenatal exposure to a 900-MHz electromagnetic field on the 21-day-old male rat heart" *Electromagn Biol Med.* (2015) PMID: 25166431.
- Türedi S et al.: "Disruption of the ovarian follicle reservoir of prepubertal rats following prenatal exposure to a continuous 900-MHz electromagnetic field" *Int J Radiat Biol.* (2016) PMID: 27007703.
- Wang Z et al.: "Moderate strength (0.23-0.28 T) static magnetic fields (SMF) modulate signaling and differentiation in human embryonic cells" *BMC Genomics.* (2009) PMID: 19653909; pdf.
- Zarei S et al.: "A Challenging Issue in the Etiology of Speech Problems: The Effect of Maternal Exposure to Electromagnetic Fields on Speech Problems in the Offspring" *J Biomed Phys Eng.* (2015) PMID: 26396971.

(69) Fractal mechanisms, scalar; *see also: Cardiovascular effects, Non-linear, Subtle Energy*

- Goldberger AL: "Fractal mechanisms in the electrophysiology of the heart" *IEEE Eng Med Biol Mag.* (1992) PMID: 11539106.
- Peng CK et al.: "Fractal mechanisms and heart rate dynamics. Long-range correlations and their breakdown with disease" *J Electrocardiol.* (1995) PMID: 8656130.

- Rubik B: "Effects of a Passive Online Software Application on Heart Rate Variability and Autonomic Nervous System Balance" *J Altern Complement Med.* (2017) PMID: 28051874. PMC5248536.
- Stanley HE et al.: "Statistical physics and physiology: monofractal and multifractal approaches" *Physica A.* (1999) PMID: 11543220.

(70) GABAA receptor

- Yang G et al.: "Exposure to 50 Hz magnetic field modulates GABAA currents in cerebellar granule neurons through an EP receptor-mediated PKC pathway" *J Cell Mol Med.* (2015) PMID: 26176998. PMC4594682.

(71) Gender differences

- Alhusseiny A et al.: "Electromagnetic energy radiated from mobile phone alters electrocardiographic records of patients with ischemic heart disease" *Ann Med Health Sci Res.* (2012) PMID: 23440607.
- Papageorgiou CC et al.: "Effects of wi-fi signals the p300 component of event-related potentials during an auditory hayling task" *J Integr Neurosci.* (2011) PMID: 21714138.
- Zhang Y et al.: "Effects of fetal microwave radiation exposure on offspring behavior in mice" *J Radiat Res.* (2015) PMID: 25359903.

(72) Gene expression

- Belyaev IY et al.: "Exposure of rat brain to 915 MHz GSM microwaves induces changes in gene expression but not double stranded DNA breaks or effects on chromatin conformation" *Bioelectromagnetics.* (2006) PMID: 16511873.
- Belyaev IY et al.: "Nonthermal effects of extremely high-frequency microwaves on chromatin conformation in cells in vitro—Dependence on physical, physiological, and genetic factors" *IEEE Trans Micr Theory Techniques.* (2000) Article.
- Goodwin TJ: "Physiological and Molecular Electromagnetic Fields of Time-varying Electronic Fields on Human Neuronal Cells" *NASA.* (2003) Article.
- Lee S et al.: "2.45 GHz radiofrequency fields alter gene expression in cultured human cells" *FEBS Lett.* (2005) PMID: 16107253. Article.
- Manta AK et al.: "Mobile-phone radiation-induced perturbation of gene-expression profiling, redox equilibrium and sporadic-apoptosis control in the ovary of Drosophila melanogaster" *Fly (Austin).* (2017) PMID: 27960592. PMC5406167.
- Muehsam D et al.: "Life rhythm as a symphony of oscillatory patterns: electromagnetic energy and sound vibration modulates gene expression for biological signaling and healing" *Glob Adv Health Med.* (2014) PMID: 24808981. PMC4010966.
- Parham F et al.: "The Use of Signal-Transduction and Metabolic Pathways to Predict Human Disease Targets from Electric and Magnetic Fields Using in vitro Data in Human Cell Lines" *Front Public Health.* (2016) PMID: 27656641; pdf.
- Zhao YL et al.: "The Screening of Genes Sensitive to Long-Term, Low-Level Microwave Exposure and Bioinformatic Analysis of Potential Correlations to Learning and Memory" *Biomed Environ Sci.* (2015) PMID: 26383594.
- Zhao TY et al.: "Exposure to cell phone radiation up-regulates apoptosis genes in primary cultures of neurons and astrocytes" *Neurosci Lett.* (2007) PMID: 17187929. PMC2713174.

(73) Genetic variants, DNA sequence variations, polymorphisms

- De Luca C et al: "Metabolic and genetic screening of electromagnetic hypersensitivity subjects as a feasible tool for diagnostics and intervention" *Mediators Inflamm.* (2014) PMID: 24812443; pdf.
- Eriksson N et al.: (2010) "Web-based, participant-driven studies yield novel genetic associations for common traits" *PLoS Genet.* (2010) PMID: 20585627 [EM photic sensitivity].

- Mortazavi SAR et al.: "Women with hereditary breast cancer predispositions should avoid using their smartphones, tablets, and laptops at night" *Iran J Basic Med Sci.* (2018) PMID: 29456806. PMC5811748.

(74) Genomic instability, DNA damage, genotoxic, micronuclei; see also chromosomal alterations

- Balamuralikrishnan B et al.: "Evaluation of chromosomal alteration in electrical workers occupationally exposed to low frequency of electro magnetic field (EMFs) in Coimbatore population, India" *Asian Pac J Cancer Prev.* (2012) PMID: 22938490. Article.
- Celikler S et al.: "A biomonitoring study of genotoxic risk to workers of transformers and distribution line stations" *Int J Environ Health Res.* (2009) PMID: 20183199.
- Gandhi G et al.: "A cross-sectional case control study on genetic damage in individuals residing in the vicinity of a mobile phone base station" *Electromagn Biol Med.* (2015) PMID: 25006864.
- Kesari KK et al: "Induction of micronuclei and superoxide production in neuroblastoma and glioma cell lines exposed to weak 50 Hz magnetic fields" *J R Soc Interface.* (2016) PMID: 26791000.
- Luukkonen J et al: "Induction of genomic instability, oxidative processes, and mitochondrial activity by 50Hz magnetic fields in human SH-SY5Y neuroblastoma cells" *Mutat Res.* (2014) PMID: 24374227.

(75) Genotoxicity

- Duan W et al.: "Comparison of the genotoxic effects induced by 50 Hz extremely low-frequency electromagnetic fields and 1800 MHz radiofrequency electromagnetic fields in GC-2 cells" *Radiat Res.* (2015) PMID: 25688995.
- Kocaman A et al.: "Genotoxic and carcinogenic effects of non-ionizing electromagnetic fields" *Environ Res.* (2018) PMID: 29427953.
- Ruediger HW: "Genotoxic effects of radiofrequency electromagnetic fields" *Pathophysiology.* (2009) PMID: 19285841.
- Schwarz C et al.: "Radiofrequency electromagnetic fields (UMTS, 1,950 MHz) induce genotoxic effects in vitro in human fibroblasts but not in lymphocytes" *Int Arch Occup Environ Health.* (2008) PMID: 18278508.
- Tice RR et al.: "Genotoxicity of radiofrequency signals. I. Investigation of DNA damage and micronuclei induction in cultured human blood cells" *Bioelectromagnetics.* (2002) PMID: 11835258.
- Verschaeve L: "Genetic damage in subjects exposed to radiofrequency radiation" *Mutat Res.* (2009) PMID: 19073278.

(76) Glioma, glioma cells

- Hao Y et al.: "STAT3 signalling pathway is involved in the activation of microglia induced by 2.45 GHz electromagnetic fields" *Int J Radiat Biol.* (2010) PMID: 20070213.
- Kanitz MH et al.: "Investigation of protein expression in magnetic field-treated human glioma cells" *Bioelectromagnetics.* (2007) PMID: 17570505.
- Momoli F et al.: "Probabilistic multiple-bias modelling applied to the Canadian data from the INTERPHONE study of mobile phone use and risk of glioma, meningioma, acoustic neuroma, and parotid gland tumors" *Am J Epidemiol.* (2017) PMID: 28535174.
- Savage RE Jr et al.: "Changes in gene and protein expression in magnetic field-treated human glioma cells" *Toxicol Mech Methods.* (2005) PMID: 20021071.
- Turner MC et al.: "Occupational exposure to extremely low-frequency magnetic fields and brain tumor risks in the INTEROCC study" *Cancer Epidemiol Biomarkers Prev.* (2014) PMID: 24935666. PMC4154968.
- Wang Y et al.: "Meta-analysis of association between mobile phone use and glioma risk" *J Cancer Res Ther.* (2016) PMID: 28230042. Article.

- Yang M et al.: "Mobile phone use and glioma risk: A systematic review and meta-analysis" *PLoS One.* (2017) PMID: 28472042. PMC5417432.

(77) Glucose metabolism, glucocorticoid receptors, diabetes

- Havas M: "Dirty electricity elevates blood sugar among electrically sensitive diabetics and may explain brittle diabetes" *Electromagn Biol Med.* (2008) PMID: 18568931.
- Havas M: "Electromagnetic Hypersensitivity: Biological Effects of Dirty Electricity with Emphasis on Diabetes and Multiple Sclerosis" *Electromagn Biol Med.* (2006) PMID: 17178585.
- Kleiber CE (2017) "Radiation from wireless technology elevates blood glucose and body temperature in 40-year-oldtype 1 diabetic male" *Electromagn Biol Med.* PMID: 28524704.
- Lu Y et al.: "Glucose administration attenuates spatial memory deficits induced by chronic low-power-density microwave exposure" *Physiol Behav.* (2012) PMID: 22564535.
- Meo SA et al.: "Association of Exposure to Radio-Frequency Electromagnetic Field Radiation (RF-EMFR) Generated by Mobile Phone Base Stations with Glycated Hemoglobin (HbA1c) and Risk of Type 2 Diabetes Mellitus" *Int J Environ Res Public Health.* (2015) PMID: 26580639. PMC4661664.
- Meo SA et al.: "Effects of exposure to electromagnetic field radiation (EMFR) generated by activated mobile phones on fasting blood glucose" *Int J Occup Med Environ Health.* (2013) PMID: 23771861. Article.
- Milham S: "Evidence that dirty electricity is causing the worldwide epidemics of obesity and diabetes" *Electromagn Biol Med.* (2014) PMID: 23781992.
- Misa-Agustiño MJ et al.: "EMF radiation at 2450 MHz triggers changes in the morphology and expression of heat shock proteins and glucocorticoid receptors in rat thymus" *Life Sci.* (2015) PMID: 25731700.
- Volkow ND et al.: (2011) "Effects of cell phone radiofrequency signal exposure on brain metabolism" *JAMA.* (2011) PMID: 21343580.

(78) Glutamate receptors, neuronal signalling, NMDA receptor

- Gökçek-Saraç Ç et al.: "Effects of acute and chronic exposure to both 900 MHz and 2100 MHz electromagnetic radiation on glutamate receptor signaling pathway" *Int J Radiat Biol.* (2017) PMID: 28565929.
- Rosiak J et al.: "Near-ultraviolet light perceived by the retina generates the signal suppressing melatonin synthesis in the chick pineal gland-an involvement of NMDA glutamate receptors" *Neurosci Lett.* (2005) PMID: 15843066.
- Salunke BP et al.: "Involvement of NMDA receptor in low-frequency magnetic field-induced anxiety in mice" *Electromagn Biol Med.* (2014) PMID: 24131395.
- Schwenkreis P et al.: "The NMDA antagonist memantine affects training induced motor cortex plasticity--a study using transcranial magnetic stimulation" *BMC Neurosci.* (2005) PMID: 15890074. PMC1134663.
- Soundara Rajan T et al.: "Mechanism of Action for rTMS: A Working Hypothesis Based on Animal Studies" *Front Physiol.* (2017) PMID: 28713286. PMC5491851.

(79) Glutathione (antioxidant) reduced, oxidative stress

- Bernat R: "Glutathione concentration and peptidase activity in the lens after exposure to microwaves" *Acta Physiol Pol.* (1985) PMID: 3837605.
- Garaj-Vrhovac V et al.: "Assessment of cytogenetic damage and oxidative stress in personnel occupationally exposed to the pulsed microwave radiation of marine radar equipment" *Int J Hyg Environ Health.* (2011) PMID: 20833106.
- Kesari KK et al.: "900-MHz microwave radiation promotes oxidation in rat brain" *Electromagn Biol Med.* (2011) PMID: 22047460.
- Meral I et al.: "Effects of 900-MHz electromagnetic field emitted from cellular phone on brain oxidative stress and some vitamin levels of guinea pigs" *Brain Res.* (2007) PMID: 17674954.

(80) Gravielectric effects, gravitation

- Herranz R et al.: "Microgravity simulation by diamagnetic levitation: effects of a strong gradient magnetic field on the transcriptional profile of Drosophila melanogaster" *BMC Genomics.* (2012) PMID: 22296880. PMC3305489.
- Slęzak A et al.: "Gravitational effects in a passive transmembrane transport: the flux graviosmotic and gravidiffusive effects in non-electrolytes" *J Biol Phys.* (2000) PMID: 23345718. PMC3456438.
- Tairbekov MG et al.: [The role of gravitational force in the evolution of living systems (the biomechanical and energy aspects)] *Izv Akad Nauk Ser Biol.* (1997) PMID: 9410270.

(81) Gut-microbiota-brain axis

- Galland L: "The gut microbiome and the brain" *J Med Food.* (2014) PMID: 25402818.
- Hall PA et al.: "Non-invasive brain stimulation for food cravings, consumption, and disorders of eating: A review of methods, findings and controversies" *Appetite.* (2017) PMID: 28288802.
- Montagnier L et al: "Transduction of DNA information through water and electromagnetic waves" *Electromagn Biol Med.* (2015) PMID: 26098521.
- Petra AI et al.: "Gut-Microbiota-Brain Axis and Its Effect on Neuropsychiatric Disorders With Suspected Immune Dysregulation" *Clin Ther.* (2015) PMID: 26046241.
- Rogers GB et al.: "From gut dysbiosis to altered brain function and mental illness: mechanisms and pathways" *Mol Psychiatry.* (2016) PMID: 27090305.

(82) Heat shock proteins

- Asano M et al.: "Normothermic Microwave Irradiation Induces Death of HL-60 Cells through Heat-Independent Apoptosis" *Sci Rep.* (2017) PMID: 28900243. PMC5595850.
- Blank M et al.: "Electromagnetic fields stress living cells" *Pathophysiology.* (2009) PMID: 19268550.
- Calabrò E et al.: "Modulation of heat shock protein response in SH-SY5Y by mobile phone microwaves" *World J Biol Chem.* (2012) PMID: 22371824. PMC3286792.
- Di Carlo A et al.: "Chronic electromagnetic field exposure decreases HSP70 levels and lowers cytoprotection" *J Cell Biochem.* (2002) PMID: 11813250.
- French PW et al.: "Mobile phones, heat shock proteins and cancer" *Differentiation.* (2001) PMID: 11683499.
- Goodman R et al.: "Extremely low frequency electromagnetic fields activate the ERK cascade, increase hsp70 protein levels and promote regeneration in Planaria" *Int J Radiat Biol.* (2009) PMID: 19639507. PMC2999986.
- López-Furelos A et al.: "Evidence of cellular stress and caspase-3 resulting from a combined two-frequency signal in the cerebrum and cerebellum of sprague-dawley rats" *Oncotarget.* (2016) PMID: 27589837. PMC5323107.
- Misa-Agustiño MJ et al.: "EMF radiation at 2450 MHz triggers changes in the morphology and expression of heat shock proteins and glucocorticoid receptors in rat thymus" *Life Sci.* (2015) PMID: 25731700.
- Shallom JM et al.: "Microwave exposure induces Hsp70 and confers protection against hypoxia in chick embryos" *J Cell Biochem.* (2002) PMID: 12210755.
- Zeni O et al.: "Cellular Response to ELF-MF and Heat: Evidence for a Common Involvement of Heat Shock Proteins?" *Front Public Health.* (2017) PMID: 29094036. PMC5651525.

(83) Heavy metals, aluminium, mercury in dental amalgam

- Byun YH et al.: "Mobile phone use, blood lead levels, and attention deficit hyperactivity symptoms in children: a longitudinal study" *PLoS One.*(2013) PMID: 23555766.
- Landler L et al.: "High levels of maternally transferred mercury disrupt magnetic responses of snapping turtle hatchlings (Chelydra serpentina)" *Environ Pollut.* (2017) PMID: 28501632.
- Omura Y et al.: "Chronic or intractable medical problems associated with prolonged exposure to unsuspected harmful environmental electric, magnetic or electro-magnetic fields radiating in the

bedroom or workplace and their exacerbation by intake of harmful light and heavy metals from common sources" *Acupunct Electrother Res.* (1991) PMID: 1685623.
- Paknahad M et al.: "Effect of radiofrequency radiation from Wi-Fi devices on mercury release from amalgam restorations" *J Environ Health Sci Eng.* (2016) PMID: 27418965.

(84) Hippo singaling pathway
- Colciago A et al.: "Tumor suppressor Nf2/merlin drives Schwann cell changes following electromagnetic field exposure through Hippo-dependent mechanisms" *Cell Death Discov.* (2015) PMID: 27551454. PMC4979489.
- Lo Sardo F et al.: "Melatonin and Hippo Pathway: Is There Existing Cross-Talk?" *Int J Mol Sci.* (2017) PMID: 28878191. PMC5618562.

(85) Hormesis and biphase effects
- Sun C et al.: "Mobile phone signal exposure triggers a hormesis-like effect in Atm+/+ and Atm-/- mouse embryonic fibroblasts" *Sci Rep.* (2016) PMID: 27857169.

(86) Hydrogen bonds, water, DNA
- Blank M et al.: "A mechanism for stimulation of biosynthesis by electromagnetic fields: charge transfer in DNA and base pair separation" *J Cell Physiol.* (2008) PMID: 17620313.
- Nikiforov VN et al.: "[On a Possible Mechanism of the Effect of Microwave Radiation on Biological Macromolecules]" *Biofizika.* (2016) PMID: 27192826.
- Tekutskaya EE et al.: "The effect of a low-frequency electromagnetic field on DNA molecules in aqueous solutions" *Biofizika.* (2015) abstract.
- Turton DA et al.: "Terahertz underdamped vibrational motion governs protein-ligand binding in solution" *Nat Commun.* (2014) PMID: 24893252.

(87) Hyperbaric oxygen treatment
- Harch PG et al.: "Case control study: hyperbaric oxygen treatment of mild traumatic brain injury persistent post-concussion syndrome and post-traumatic stress disorder" *Med Gas Res.* (2017) PMID: 29152209. PMC5674654.
- Shandley S et al.: "Increased circulating stem cells and better cognitive performance in traumatic brain injury subjects following hyperbaric oxygen therapy" *Undersea Hyperb Med.* (2017) PMID: 28779582.

(88) Immune response, lymphocytes
- Boscolo P et al.: "Effects of electromagnetic fields produced by radiotelevision broadcasting stations on the immune system of women" *Sci Total Environ.* (2001) PMID: 11419593.
- Boscolo P et al.: "Effects of low frequency electromagnetic fields on expression of lymphocyte subsets and production of cytokines of men and women employed in a museum" *Sci Total Environ.* (2001) PMID: 11327385.
- Conti P et al.: "Effect of electromagnetic fields on several CD markers and transcription and expression of CD4" *Immunobiology.* (1999) PMID: 10532279.
- Di Giampaolo L et al.: "Follow up study on the immune response to low frequency electromagnetic fields in men and women working in a museum" *Int J Immunopathol Pharmacol.* (2006) PMID: 17291405.
- Simkó M et al.: "Extremely low frequency electromagnetic fields as effectors of cellular responses in vitro: possible immune cell activation" *J Cell Biochem.* (2004) PMID: 15352165.

(89) Individual and inter-individual variability, individual sensitivity
- Ammann C et al.: "Response variability of different anodal transcranial direct current stimulation intensities across multiple sessions" *Brain Stimul.* (2017) PMID: 28420581. PMC5511514.

- Chew T et al.: "Inter- and Intra-individual Variability in Response to Transcranial Direct Current Stimulation (tDCS) at Varying Current Intensities" *Brain Stimul.* (2015) PMID: 26294061.
- Danker-Hopfe H et al.: "Effects of mobile phone exposure (GSM 900 and WCDMA/UMTS) on polysomnography based sleep quality: An intra- and inter-individual perspective" *Environ Res.* (2016) PMID: 26618505.
- Dyke K et al.: "Intra-Subject Consistency and Reliability of Response Following 2 mA Transcranial Direct Current Stimulation" *Brain Stimul.* (2016) PMID: 27387569.
- Foray N et al.: "100 Years of Individual Radiosensitivity: How We Have Forgotten the Evidence" *Radiology.* (2012) PMID: 22919036. Article.
- Fried PJ et al.: "Reproducibility of Single-Pulse, Paired-Pulse, and Intermittent Theta-Burst TMS Measures in Healthy Aging, Type-2 Diabetes, and Alzheimer's Disease" *Front Aging Neurosci.* (2017) PMID: 28871222. PMC5566559.
- Goldsworthy MR et al.: "Inter-subject variability of LTD-like plasticity in human motor cortex: a matter of preceding motor activation" *Brain Stimul.* (2014) PMID: 25216649.
- Havranek S et al.: "Electromuscular incapacitating devices discharge and risk of severe bradycardia" *Am J Forensic Med Pathol.* (2015) PMID: 25710795. PMC4927311.
- Heidegger T et al.: "A Data-Driven Approach to Responder Subgroup Identification after Paired Continuous Theta Burst Stimulation" *Front Hum Neurosci.* (2017) PMID: 28824394. PMC5543102.
- Horvath JC et al.: "Effects of a common transcranial direct current stimulation (tDCS) protocol on motor evoked potentials found to be highly variable within individuals over 9 testing sessions" *Exp Brain Res.* (2016) PMID: 27150317.
- Jamil A et al.: "Systematic evaluation of the impact of stimulation intensity on neuroplastic after-effects induced by transcranial direct current stimulation" *J Physiol.* (2017) PMID: 27723104. PMC5309387.
- Jannati A et al.: "Interindividual variability in response to continuous theta-burst stimulation in healthy adults" *Clin Neurophysiol.* (2017) PMID: 29028501.
- Labruna L et al.: "Efficacy of Anodal Transcranial Direct Current Stimulation is Related to Sensitivity to Transcranial Magnetic Stimulation" *Brain Stimul.* (2016) PMID: 26493498. PMC4724228.
- Nordin S et al.: "Odor and noise intolerance in persons with self-reported electromagnetic hypersensitivity" *Int J Environ Res Public Health.* (2014) PMID: 25166918.
- Pellegrini M et al.: "Biological and anatomical factors influencing interindividual variability to noninvasive brain stimulation of the primary motor cortex: a systematic review and meta-analysis" *Rev Neurosci.* (2017) PMID: 29055940.
- Samaha J et al.: "Correlated individual differences suggest a common mechanism underlying metacognition in visual perception and visual short-term memory" *Proc Biol Sci.* (2017) PMID: 29167365.
- Schienle A et al.: "Atmospheric electromagnetism: individual differences in brain electrical response to simulated sferics" *Int J Psychophysiol.* (1996) PMID: 8792205.
- Schmid MR et al.: "Sleep EEG alterations: effects of different pulse-modulated radio frequency electromagnetic fields" *J Sleep Res.* (2012) PMID: 21489004.
- Strube W et al.: "Efficacy and interindividual variability in motor-cortex plasticity following anodal tDCS and paired-associative stimulation" *Neural Plast.* (2015) PMID: 25866683. PMC4381571.
- Vallence AM et al.: "Inter- and intra-subject variability of motor cortex plasticity following continuous theta-burst stimulation" *Neuroscience.* (2015) PMID: 26208843.

(90) Inflammation

- Lameth J et al.: "Acute Neuroinflammation Promotes Cell Responses to 1800 MHz GSM Electromagnetic Fields in the Rat Cerebral Cortex" *Neurotox Res.* (2017) PMID: 28578480.

(91) Insulin levels

- Mortazavi SM et al.: "GSM 900 MHz Microwave Radiation-Induced Alterations of Insulin Level and Histopathological Changes of Liver and Pancreas in Rat" *J Biomed Phys Eng.* (2016) PMID: 28144593. PMC5219574.

(92) Integrins, transmembrane receptors, extracellular matrix

- Cervellati F et al.: "17-β-Estradiol counteracts the effects of high frequency electromagnetic fields on trophoblastic connexins and integrins" *Oxid Med Cell Longev.* (2013) PMID: 23819010; pdf.
- Kasten A et al.: "Mechanical integrin stress and magnetic forces induce biological responses in mesenchymal stem cells which depend on environmental factors" *J Cell Biochem.* (2010) PMID: 21053275.
- Xia P et al.: "TGF-β1-induced chondrogenesis of bone marrow mesenchymal stem cells is promoted by low-intensity pulsed ultrasound through the integrin-mTOR signaling pathway" *Stem Cell Res Ther.* (2017) PMID: 29237506. PMC5729425.

(93) Ionising radiation

- Rusin A et al.: "Chronic Fatigue and Immune Deficiency Syndrome (CFIDS), cellular metabolism, and ionizing radiation: A review of contemporary scientific literature and suggested directions for future research" *Int J Radiat Biol.* (2018) PMID: 29297728.

(94) Iron, iron binding, ferretin

- Çetkin M et al.: "Evaluation of the mobile phone electromagnetic radiation on serum iron parameters in rats" *Afr Health Sci.* (2017) PMID: 29026392. PMC5636244.
- Fattahi-Asl J et al.: "Effects of radiofrequency radiation on human ferritin: an in vitro enzymun assay" *J Med Signals Sens.* (2012) PMID: 23724375. PMC3662108.
- Hachulla E et al.: "Pseudo-iron deficiency in a French population living near high-voltage transmission lines: a dilemma for clinicians" *Eur J Intern Med.* (2000) PMID: 16373091. Article.
- Ren J et al.: "LF-MF inhibits iron metabolism and suppresses lung cancer through activation of P53-miR-34a-E2F1/E2F3 pathway" *Sci Rep.* (2017) PMID: 28389657. PMC5429732.

(95) Kidney effects

- Koca O et al.: "Effects of intensive cell phone (Philips Genic 900) use on the rat kidney tissue" *Urol J.* (2013) PMID: 23801472; article.

(96) Leukaemia

- Bastuji-Garin S et al.: "Acute leukaemia in workers exposed to electromagnetic fields" *Eur J Cancer.* (1990) PMID: 2149992.
- Coghill RW et al.: "Extra low frequency electric and magnetic fields in the bedplace of children diagnosed with leukaemia: a case-control study" *Eur J Cancer Prev.* (1996) PMID: 8818603.
- Coleman MP et al.: "Leukaemia and residence near electricity transmission equipment: a case-control study" *Br J Cancer.* (1989) PMID: 2486298. PMC2247309.
- Dolk H et al.: "Cancer incidence near radio and television transmitters in Great Britain. I. Sutton Coldfield transmitter" *Am J Epidemiol.* (1997) PMID: 8982016.
- Draper G et al.: "Childhood cancer in relation to distance from high voltage power lines in England and Wales: a case-control study" *BMJ.* (2005) PMID: 15933351. PMC558197.
- Fajardo-Gutiérrez A et al.: [Residence close to high-tension electric power lines and its association with leukemia in children] *Bol Med Hosp Infant Mex.* (1993) PMID: 8427647.
- Fear NT et al.: "Cancer in electrical workers: an analysis of cancer registrations in England, 1981-87" *Br J Cancer.* (1996) PMID: 8611410. PMC2074257.

- Feizi AA et al.: "Acute childhood leukemias and exposure to magnetic fields generated by high voltage overhead power lines - a risk factor in Iran" *Asian Pac J Cancer Prev.* (2007) PMID: 17477775. Article.
- Feychting M et al.: "Occupational and residential magnetic field exposure and leukemia and central nervous system tumors" *Epidemiology.* (1997) PMID: 9209851.
- Floderus B et al.: "Occupational exposure to electromagnetic fields in relation to leukemia and brain tumors: a case-control study in Sweden" *Cancer Causes Control.* (1993) PMID: 8218879.
- Greenland S et al.: "A pooled analysis of magnetic fields, wire codes, and childhood leukemia. Childhood Leukemia-EMF Study Group" *Epidemiology.* (2000) PMID: 11055621.
- Grellier J et al.: "Potential health impacts of residential exposures to extremely low frequency magnetic fields in Europe" *Environ Int.* (2014) PMID: 24161447.
- Guénel P et al.: "Incidence of cancer in persons with occupational exposure to electromagnetic fields in Denmark" *Br J Ind Med.* (1993) PMID: 8398864. PMC1012181.
- Hardell L et al.: "Exposure to extremely low frequency electromagnetic fields and the risk of malignant diseases - an evaluation of epidemiological and experimental findings" *Eur J Cancer Prev.* (1995) PMID: 7496333.
- Henshaw DL et al.: "Can disturbances in the atmospheric electric field created by powerline corona ions disrupt melatonin production in the pineal gland?" *J Pineal Res.* (2008) PMID: 18384531.
- Henshaw DL et al.: "Do magnetic fields cause increased risk of childhood leukemia via melatonin disruption?" *Bioelectromagnetics.* (2005) PMID: 16059923.
- Hocking B et al.: "Cancer incidence and mortality and proximity to TV towers" *Med J Aust.* (1996) PMID: 8985435. Article.
- Kabuto M et al.: "Childhood leukemia and magnetic fields in Japan: a case-control study of childhood leukemia and residential power-frequency magnetic fields in Japan" *Int J Cancer.* (2006) PMID: 16496405. 10.1002/ijc.21374.
- Kroll ME et al.: "Childhood cancer and magnetic fields from high-voltage power lines in England and Wales: a case-control study" *Br J Cancer.* (2010) PMID: 20877338. PMC2965853.
- London SJ et al.: "Exposure to residential electric and magnetic fields and risk of childhood leukemia" *Am J Epidemiol.* (1991) PMID: 1843457.
- Loomis DP et al.: "Mortality from brain cancer and leukaemia among electrical workers" *Br J Ind Med.* (1990) PMID: 2207035. PMC1035250.
- Mahdavi M et al.: "Association between ELF and RF electromagnetic field and Leukemia" *J Paramed Sci (JPS)* (2015) Abstract. Article.
- Milham S Jr "Mortality from leukemia in workers exposed to electrical and magnetic fields" *N Engl J Med.* (1982) PMID: 7088076; abstract.
- Milham S Jr: "Mortality in workers exposed to electromagnetic fields" *Environ Health Perspect.* (1985) PMID: 4085433. PMC1568699.
- Pearce MS et al.: "Paternal occupational exposure to electro-magnetic fields as a risk factor for cancer in children and young adults: a case-control study from the North of England" *Pediatr Blood Cancer.* (2007) PMID: 16941646.
- Qi G et al.: "Effects of extremely low-frequency electromagnetic fields (ELF-EMF) exposure on B6C3F1 mice" *Environ Health Prev Med.* (2015) PMID: 25939981. PMC4491062.
- Savitz DA et al.: "Leukemia and occupational exposure to electromagnetic fields: review of epidemiologic surveys" *J Occup Med.* (1987) PMID: 3546635.
- Savitz DA et al.: "Case-control study of childhood cancer and exposure to 60-Hz magnetic fields" *Am J Epidemiol.* (1988) PMID: 3164167.
- Savitz DA et al.: "Childhood cancer in relation to a modified residential wire code" *Environ Health Perspect.* (1993) PMID: 8513768. PMC1519679.
- Sohrabi MR et al.: "Living near overhead high voltage transmission power lines as a risk factor for childhood acute lymphoblastic leukemia: a case-control study" *Asian Pac J Cancer Prev.* (2010) PMID: 20843128. Article.

- Tabrizi MM et al.: "Role of Electromagnetic Field Exposure in Childhood Acute Lymphoblastic Leukemia and No Impact of Urinary Alpha- Amylase--a Case Control Study in Tehran, Iran" *Asian Pac J Cancer Prev.* (2015) PMID: 26625771.
- Thériault G et al.: "Cancer risks associated with occupational exposure to magnetic fields among electric utility workers in Ontario and Quebec, Canada, and France: 1970-1989" *Am J Epidemiol.* (1994) PMID: 8172168.
- Thériault G et al.: "Risks of leukaemia among residents close to high voltage transmission electric lines" *Occup Environ Med.* (1997) PMID: 9423573. PMC1128834.
- Törnqvist S et al.: "Incidence of leukaemia and brain tumours in some "electrical occupations"" *Br J Ind Med.* (1991) PMID: 1911402.
- Tynes T et al.: "Incidence of cancer in Norwegian workers potentially exposed to electromagnetic fields" *Am J Epidemiol.* (1992) PMID: 1415133.
- Wartenberg D: "Residential magnetic fields and childhood leukemia: a meta-analysis" *Am J Public Health.* (1998) PMID: 9842375. PMC1509032.
- Wertheimer N et al: "Electrical wiring configurations and childhood cancer" *Am J Epidemiol.* (1979) PMID: 453167.
- Wright WE et al.: "Leukaemia in workers exposed to electrical and magnetic fields" *Lancet.* (1982) PMID: 6128476.

(97) Light, Light Emitting Diodes (LEDs), blue light, light dependent effects

- Chellappa SL et al.: "In a Heartbeat: Light and Cardiovascular Physiology" *Front Neurol.* (2017) PMID: 29104560. PMC5654948.
- Dai Q et al.: "Effect of quantity and intensity of pulsed light on human non-visual physiological responses" *J Physiol Anthropol.* (2017) PMID: 28446222. PMC5405487.
- Giachello CN et al.: "Magnetic Fields Modulate Blue-Light-Dependent Regulation of Neuronal Firing by Cryptochrome" *J Neurosci.* (2016) PMID: 27798129. PMC5083005.
- Kim S et al.: "In vitro bactericidal effects of 625, 525, and 425 nm wavelength (red, green, and blue) light-emitting diode irradiation" *Photomed Laser Surg.* (2013) PMID: 24138193. PMC3818000.
- Lee S et al.: "Subadditive responses to extremely short blue and green pulsed light on visual evoked potentials, pupillary constriction and electroretinograms" *J Physiol Anthropol.* (2017) PMID: 29149913. PMC5693602.
- Lunn RM et al.: "Health consequences of electric lighting practices in the modern world: A report on the National Toxicology Program's workshop on shift work at night, artificial light at night, and circadian disruption" *Sci Total Environ.* (2017) PMID: 28724246.
- Monich VA et al.: "Modification in oxidative processes in muscle tissues exposed to laser- and light-emitting diode radiation" *Lasers Med Sci.* (2017) PMID: 29134402.
- Mortazavi SAR et al.: "Women with hereditary breast cancer predispositions should avoid using their smartphones, tablets, and laptops at night" *Iran J Basic Med Sci.* (2018) PMID: 29456806. PMC5811748.
- Murugan NJ et al.: "Synergistic interactions between temporal coupling of complex light and magnetic pulses upon melanoma cell proliferation and planarian regeneration" *Electromagn Biol Med.* (2017) PMID: 27463225.
- Otsuka K et al.: "Alternating light-darkness-influenced human electrocardiographic magnetoreception in association with geomagnetic pulsations" *Biomed Pharmacother.* (2001) PMID: 11774870.
- Rahman SA et al.: "The effects of spectral tuning of evening ambient light on melatonin suppression, alertness and sleep" *Physiol Behav.* (2017) PMID: 28472667.
- Soleymani T et al.: "Disparity in Cutaneous Pigmentary Response to LED vs Halogen Incandescent Visible Light: Results from a Single Center, Investigational Clinical Trial Determining a Minimal Pigmentary Visible Light Dose" *J Drugs Dermatol.* (2017) PMID: 29141058.

- Touitou Y et al.: "Association between light at night, melatonin secretion, sleep deprivation, and the internal clock: Health impacts and mechanisms of circadian disruption" *Life Sci.* (2017) PMID: 28214594.
- Umeda M et al.: "Bactericidal effects of a high-power, red light-emitting diode on two periodontopathic bacteria in antimicrobial photodynamic therapy in vitro" *J Investig Clin Dent.* (2011) PMID: 25426898.
- Vanderstraeten J et al.: "Low-Light Dependence of the Magnetic Field Effect on Cryptochromes: Possible Relevance to Plant Ecology" *Front Plant Sci.* (2018) PMID: 29491873.
- van de Werken M et al.: "Short-wavelength attenuated polychromatic white light during work at night: limited melatonin suppression without substantial decline of alertness" *Chronobiol Int.* (2013) PMID: 23705821.
- Yang Y et al.: "White light emitting diode suppresses proliferation and induces apoptosis in hippocampal neuron cells through mitochondrial cytochrome c oxydase-mediated IGF-1 and TNF-α pathways" *Free Radic Biol Med.* (2017) PMID: 29106990.
- Yuda E et al.: "Enhancement of autonomic and psychomotor arousal by exposures to blue wavelength light: importance of both absolute and relative contents of melanopic component" *J Physiol Anthropol.* (2017) PMID: 28143576. PMC5282632.
- Yuda E et al.: "Suppression of vagal cardiac modulation by blue light in healthy subjects" *J Physiol Anthropol.* (2016) PMID: 27716445. PMC5051049.

(98) Lipid metabolism

- Wang Z et al.: "Effects of electromagnetic fields on serum lipids in workers of a power plant" *Environ Sci Pollut Res Int.* (2016) PMID: 26423285.

(99) Lipid peroxidation, visual and somatosensory potentials

- Akpinar D et al.: "The effect of different strengths of extremely low-frequency electric fields on antioxidant status, lipid peroxidation, and visual evoked potentials" *Electromagn Biol Med.* (2012) PMID: 23045992.
- Gok DK et al.: "The developmental effects of extremely low frequency electric fields on visual and somatosensory evoked potentials in adult rats" *Electromagn Biol Med.* (2016) PMID: 25496054.
- Seifirad S et al.: "Effects of extremely low frequency electromagnetic fields on paraoxonase serum activity and lipid peroxidation metabolites in rat" *J Diabetes Metab Disord.* (2014) PMID: 25152870. PMC4141961.

(100) Liver lipids

- Torres-Duran PV et al.: "Effects of whole body exposure to extremely low frequency electromagnetic fields (ELF-EMF) on serum and liver lipid levels, in the rat" *Lipids Health Dis.* (2007) PMID: 18021407. PMC2203969.

(101) Lung cancer

- Armstrong B et al.: "Association between exposure to pulsed electromagnetic fields and cancer in electric utility workers in Quebec, Canada, and France" *Am J Epidemiol.* (1994) PMID: 7977291.

(102) Lymphocytes, lymphoma cancers

- Belyaev IY et al.: "Microwaves from UMTS/GSM mobile phones induce long-lasting inhibition of 53BP1/gamma-H2AX DNA repair foci in human lymphocytes" *Bioelectromagnetics.* (2009) PMID: 18839414.
- Markovà E et al.: "Microwaves from GSM mobile telephones affect 53BP1 and gamma-H2AX foci in human lymphocytes from hypersensitive and healthy persons" *Environ Health Perspect.* (2005) PMID: 16140623. PMC1280397.

- Milham S Jr: "Mortality in workers exposed to electromagnetic fields" *Environ Health Perspect.* (1985) PMID: 4085433. PMC1568699.
- Repacholi MH et al.: "Lymphomas in E mu-Pim1 transgenic mice exposed to pulsed 900 MHZ electromagnetic fields" *Radiat Res.* (1997) PMID: 9146709.

(103) Magnesium, deficiency; see also: Magneto-reception, Phosphorylation and calcium dependence

- Buchachenko AL et al.: "Magnetic isotope effect of magnesium in phosphoglycerate kinase phosphorylation" *Proc Natl Acad Sci U S A.* (2005) PMID: 16043694; pdf.
- Buchachenko AL et al.: "[Magnesium magnetic isotope effect: a key towards mechanochemistry of phosphorylating enzymes as molecular machines]" *Mol Biol (Mosk).* (2006) PMID: 16523686.
- Erdem O et al.: "Effects of Intermittent and Continuous Magnetic Fields on Trace Element Levels in Guinea Pigs" *Biol Trace Elem Res.* (2017) PMID: 28534099.
- Ge J et al.: "Metal cation controls phosphate release in the myosin ATPase" *Protein Sci.* (2017) PMID: 28795448.
- Mauskop A et al.: "Why all migraine patients should be treated with magnesium" *J Neural Transm (Vienna).* (2012) PMID: 22426836.
- Tarleton EK et al.: "Magnesium intake and depression in adults" *J Am Board Fam Med.* (2015) PMID: 25748766; pdf; response.
- Ulku R et al.: "Extremely low-frequency magnetic field decreased calcium, zinc and magnesium levels in costa of rat" *Biol Trace Elem Res.* (2011) PMID: 20872091.
- Zhang SL et al.: "A Circadian Clock in the Blood-Brain Barrier Regulates Xenobiotic Efflux" *Cell.* (2018) Abstract.

(104) Magnetite

- Gorobets O et al.: "Physiological origin of biogenic magnetic nanoparticles in health and disease: from bacteria to humans" *Int J Nanomedicine.* (2017) PMID: 28652739; pdf.
- Hautot D et al.: "Preliminary evaluation of nanoscale biogenic magnetite in Alzheimer's disease brain tissue" *Proc Biol Sci.* (2003) PMID: 12952638; pdf.
- Kirschvink JL et al.: "Magnetite biomineralization in the human brain" *Proc Natl Acad Sci U S A.* (1992) PMID: 1502184; pdf.
- Kirschvink JL et al.: "Magnetite in human tissues: a mechanism for the biological effects of weak ELF magnetic fields" *Bioelectromagnetics.* (1992) PMID: 1285705.
- Maher BA et al.: "Magnetite pollution nanoparticles in the human brain" *Proc Natl Acad Sci U S A.* (2016) PMID: 27601646; pdf.
- Moos T et al.: "The metabolism of neuronal iron and its pathogenic role in neurological disease: review" *Ann N Y Acad Sci.* (2004) PMID: 15105252.
- Wen J et al.: "Apoptosis selectively induced in BEL-7402 cells by folic acid-modified magnetic nanoparticles combined with 100 Hz magnetic field" *Int J Nanomedicine.* (2014) PMID: 24790442; pdf.

(105) Magneto-reception; *see also: Cryptochromes, Tryptophan, Neurological effects*

- Belova NA et al.: "The Effect of Extremely Low Frequency Alternating Magnetic Field on the Behavior of Animals in the Presence of the Geomagnetic Field" *J Biophys.* (2015) PMID: 26823664.
- Binhi VN et al.: "A physical mechanism of magnetoreception: Extension and analysis" *Bioelectromagnetics.* (2017) PMID: 27859403.
- Binhi VN et al.: "Biological effects of the hypomagnetic field: An analytical review of experiments and theories" *PLoS One.* (2017) PMID: 28654641. PMCID: PMC5487043.
- Buchachenko AL et al.: "[New mechanisms of biological effects of electromagnetic fields]" *Biofizika.* (2006) PMID: 16808357.
- Buchachenko AL et al.: "Magnetic field affects enzymatic ATP synthesis" *J Am Chem Soc.* (2008) PMID: 18774801.

- Chae KS et al.: "Potential Impact of Geomagnetic Field in Transcranial Magnetic Stimulation for the Treatment of Neurodegenerative Diseases" *Front Hum Neurosci.* (2017) PMID: 29021752. PMC5623677.
- Consales C et al.: "Fifty-Hertz Magnetic Field Affects the Epigenetic Modulation of the miR-34b/c in Neuronal Cells" *Mol Neurobiol.* (2017) PMID: 29039021.
- Deutschlander ME et al.: "The case for light-dependent magnetic orientation in animals" *J Exp Biol.* (1999) PMID: 10085262. Article.
- Eckert EE: "Magnetic influences on fetus and infant as reason for sudden infant death syndrome: a new testable hypothesis" *Med Hypotheses.* (1992) PMID: 1614359.
- Evans EW et al.: "Sub-millitesla magnetic field effects on the recombination reaction of flavin and ascorbic acid radicals" *J Chem Phys.* (2016) PMID: 27586950.
- Foley LE et al: "Human cryptochrome exhibits light-dependent magnetosensitivity" *Nat Commun.* (2011) PMID: 21694704. PMC3128388.
- Giachello CN et al.: "Magnetic Fields Modulate Blue-Light-Dependent Regulation of Neuronal Firing by Cryptochrome" *J Neurosci.* (2016) PMID: 27798129. PMC5083005.
- Günther A et al.: "Double-Cone Localization and Seasonal Expression Pattern Suggest a Role in Magnetoreception for European Robin Cryptochrome 4" *Curr Biol.* (2017) PMID: 29307554.
- Henshaw DL et al.: "Can disturbances in the atmospheric electric field created by powerline corona ions disrupt melatonin production in the pineal gland?" *J Pineal Res.* (2008) PMID: 18384531.
- Henshaw DL et al.: "Do magnetic fields cause increased risk of childhood leukemia via melatonin disruption?" *Bioelectromagnetics.* (2005) PMID: 16059923.
- Hore PJ et al.: "The Radical-Pair Mechanism of Magnetoreception" *Annu Rev Biophys.* (2016) PMID: 27216936.
- Jenrow KA et al.: "Weak extremely-low-frequency magnetic field-induced regeneration anomalies in the planarian Dugesia tigrine" *Bioelectromagnetics.* (1996) PMID: 8986364.
- Li Y et al.: "Extra-low-frequency magnetic fields alter cancer cells through metabolic restriction" *Electromagn Biol Med.* (2014) PMID: 23915261.
- Letuta UG et al.: "Enzymatic mechanisms of biological magnetic sensitivity" *Bioelectromagnetics.* (2017) PMID: 28715606.
- Martínez MA et al.: "Power Frequency Magnetic Fields Affect the p38 MAPK-Mediated Regulation of NB69 Cell Proliferation Implication of Free Radicals" *Int J Mol Sci.* (2016) PMID: 27058530.
- Murugan NJ et al.: "Temporally-patterned magnetic fields induce complete fragmentation in planaria" *PLoS One.* (2013) PMID: 23620783. PMC3631155.
- Myklatun A et al.: "Zebrafish and medaka offer insights into the neurobehavioral correlates of vertebrate magnetoreception" *Nat Commun.* (2018) PMID: 29476093. PMC5824813.
- Otsuka K et al.: "Alternating light-darkness-influenced human electrocardiographic magnetoreception in association with geomagnetic pulsations" *Biomed Pharmacother.* (2001) PMID: 11774870.
- Qin S et al.: "A magnetic protein biocompass" *Nat Mater.* (2015) PMID: 26569474.
- Ritz T et al.: "A model for photoreceptor-based magnetoreception in birds" *Biophys J.* (2000) PMID: 10653784. PMC1300674.
- Semm P et al.: "Effects of an earth-strength magnetic field on electrical activity of pineal cells" *Nature.* (1980) PMID: 7442806.
- Taylor BK et al.: "Detection of magnetic field properties using distributed sensing: a computational neuroscience approach" *Bioinspir Biomim.* (2017) PMID: 28524068.
- Thoss F et al.: "The human visual threshold depends on direction and strength of a weak magnetic field" *J Comp Physiol A Neuroethol Sens Neural Behav Physiol.* (2003) PMID: 12942272.
- Thoss F et al.: "The magnetic field sensitivity of the human visual system shows resonance and compass characteristic" *J Comp Physiol A.* (2000) PMID: 11138791.

- Wajnberg E et al.: "Titanium and iron titanium oxide nanoparticles in antennae of the migratory ant Pachycondyla marginata: an alternative magnetic sensor for magnetoreception?" *Biometals.* (2017) PMID: 28608290.
- Zablotskii V et al.: "How a High-Gradient Magnetic Field Could Affect Cell Life" *Sci Rep.* (2016) PMID: 27857227. PMC5114642.
- Zhadin MN: "Review of russian literature on biological action of DC and low-frequency AC magnetic fields" *Bioelectromagnetics.* (2001) PMID: 11122491.

(106) MAPK/ERK signalling pathway, phosphorylation, cancer

- Friedman J at al.: (2007) "Mechanism of short-term ERK activation by electromagnetic fields at mobile phone frequencies" *Biochem J.* (2007) PMID: 17456048; pdf.
- Geng DY et al.: "Mechanism underlying the bio-effects of an electromagnetic field based on the Huang-Ferrell model" *Genet Mol Res.* (2016) PMID: 27420980.
- Hough CM et al.: "Biological effects of intense THz pulses on human skin tissue models" *IEEE 42nd Int Conf (IRMMW-THz)* (2017) abstract.
- Kapri-Pardes E et al.: "Activation of Signaling Cascades by Weak Extremely Low Frequency Electromagnetic Fields" *Cell Physiol Biochem.* (2017) PMID: 29035881; pdf.
- Shahin S et al.: "2.45 GHz Microwave radiation impairs hippocampal learning and spatial memory: Involvement of local stress mechanism induced suppression of iGluR/ERK/CREB signalling" *Toxicol Sci.* (2017) PMID: 29069439.
- Sheikh AQ et al.: "Regulation of endothelial MAPK/ERK signalling and capillary morphogenesis by low-amplitude electric field" *J R Soc Interface.* (2013) PMID: 22993248.
- Tang J et al.: "Exposure to 900 MHz electromagnetic fields activates the mkp-1/ERK pathway and causes blood-brain barrier damage and cognitive impairment in rats" *Brain Res.* (2015) PMID: 25598203.
- Zuo HY et al.: "[Effects of electromagnetic radiation on RAF/MEK/ERK signaling pathway in rats hippocampus]" *Zhongguo Ying Yong Sheng Li Xue Za Zhi.* (2009) Chinese. PMID: 21189547.

(107) Mast cells and histaminemia

- Belpomme D et al: "Reliable disease biomarkers characterizing and identifying electrohypersensitivity and multiple chemical sensitivity as two etiopathogenic aspects of a unique pathological disorder" *Rev Environ Health* (2015) PMID: 26613326; pdf.
- Johansson O et al.: "Cutaneous mast cells are altered in normal healthy volunteers sitting in front of ordinary TVs/PCs - results from open-field provocation experiments" *J Cutan Pathol.* (2001) PMID: 11737520.

(108) Melanogenesis

- Cho SE et al.: "Pigmentation effect of electromagnetic fields at various intensities to melanocytes" *Tissue Engin Regen Medic.* (2016) abstract.
- Kim YM et al.: "Effects of Extremely Low Frequency Electromagnetic Fields on Melanogenesis through p-ERK and p-SAPK/JNK Pathways in Human Melanocytes" *Int J Mol Sci.* (2017) PMID: 29019940. PMC5666802.
- Kim YM et al.: "The activation of melanogenesis by p-CREB and MITF signaling with extremely low-frequency electromagnetic fields on B16F10 melanoma" *Life Sci.* (2016) PMID: 27543340. 10.1016/j.lfs.2016.08.015.

(109) Melanoma

- Olin R et al.: "Mortality experience of electrical engineers" *Br J Ind Med.* (1985) PMID: 3970890. PMC1007454.
- Tynes T et la.: "Residential and occupational exposure to 50 Hz magnetic fields and malignant melanoma: a population based study" *Occup Environ Med.* (2003) PMID: 12709519. PMC1740536.

(110) Melanopsin (OPN4), EM photo-sensitivity, blood-glucose, calcium flux

- Do MT et al.: "Photon capture and signalling by melanopsin retinal ganglion cells" *Nature.* (2009) PMID: 19118382.
- Hattar S et al.: "Melanopsin-containing retinal ganglion cells: architecture, projections, and intrinsic photosensitivity" *Science.* (2002) PMID: 11834834.
- Hydén D et al.: "On light-induced sneezing" *Eye (Lond).* (2009) PMID: 19575036.
- Koizumi A et al.: "The manipulation of neural and cellular activities by ectopic expression of melanopsin" *Neurosci Res.* (2013) PMID: 22982474.
- Lupi D et al.: "The acute light-induction of sleep is mediated by OPN4-based photoreception" *Nat Neurosci.* (2008) PMID: 19160505.
- Matynia A et al.: "Peripheral Sensory Neurons Expressing Melanopsin Respond to Light" *Front Neural Circuits.* (2016) PMID: 27559310.
- van der Meijden WP et al.: "Individual Differences in Sleep Timing Relate to Melanopsin-Based Phototransduction in Healthy Adolescents and Young Adults" *Sleep.* (2016) PMID: 27091519.
- Zaidi FH et al.: "Short-wavelength light sensitivity of circadian, pupillary, and visual awareness in humans lacking an outer retina" *Curr Biol.* (2007) PMID: 18082405.

(111) Melatonin reduction, circadian effects

- Belpomme D et al: "Reliable disease biomarkers characterizing and identifying electrohypersensitivity and multiple chemical sensitivity as two etiopathogenic aspects of a unique pathological disorder" *Rev Environ Health* (2015) PMID: 26613326; pdf.
- Henshaw DL et al.: "Can disturbances in the atmospheric electric field created by powerline corona ions disrupt melatonin production in the pineal gland?" *J Pineal Res.* (2008) PMID: 18384531.
- Henshaw DL et al.: "Do magnetic fields cause increased risk of childhood leukemia via melatonin disruption?" *Bioelectromagnetics.* (2005) PMID: 16059923.
- Kim HS et al.: "Eight hours of nocturnal 915 MHz radiofrequency identification (RFID) exposure reduces urinary levels of melatonin and its metabolite via pineal arylalkylamine N-acetyltransferase activity in male rats" *Int J Radiat Biol.* (2015) PMID: 26189731.
- Lo Sardo F et al.: "Melatonin and Hippo Pathway: Is There Existing Cross-Talk?" *Int J Mol Sci.* (2017) PMID: 28878191. PMC5618562.
- Morgan IG et al.: "Parallel suppression of retinal and pineal melatonin synthesis by retinally mediated light" *Neuroreport.* (1995) PMID: 7579141.
- O'Connor RP et al.: "Geophysical variables and behavior: LXXXII. A strong association between sudden infant death syndrome and increments of global geomagnetic activity--possible support for the melatonin hypothesis" *Percept Mot Skills.* (1997) PMID: 9106826.
- Reiter RJ: "Melatonin suppression by static and extremely low frequency electromagnetic fields: relationship to the reported increased incidence of cancer" *Rev Environ Health.* (1994) PMID: 7724876.
- Reiter RJ: "Static and extremely low frequency electromagnetic field exposure: reported effects on the circadian production of melatonin" *J Cell Biochem.* (1993) PMID: 8098713.
- Rosiak J et al.: "Near-ultraviolet light perceived by the retina generates the signal suppressing melatonin synthesis in the chick pineal gland-an involvement of NMDA glutamate receptors" *Neurosci Lett.* (2005) PMID: 15843066.
- Singh S et al.: "Effect of occupational EMF exposure from radar at two different frequency bands on plasma melatonin and serotonin levels" *Int J Radiat Biol.* (2015) PMID: 25565559.
- Sokolovic D et al.: "The Effects of Melatonin on Oxidative Stress Parameters and DNA Fragmentation in Testicular Tissue of Rats Exposed to Microwave Radiation" *Adv Clin Exp Med.* (2015) PMID: 26467130.
- Wilson BW et al.: "Chronic exposure to 60-Hz electric fields: effects on pineal function in the rat" *Bioelectromagnetics.* (1981) PMID: 7326058.

- Zawilska JB et al.: "Suppression of melatonin biosynthesis in the chicken pineal gland by retinally perceived light - involvement of D1-dopamine receptors" *J Pineal Res.* (2004) PMID: 14962058.

(112) Meridians, acupuncture points, endogenous fields

- Ahn AC et al.: "Electrical properties of acupuncture points and meridians: a systematic review" *Bioelectromagnetics.* (2008) PMID: 18240287.
- DeSmul A: "Very new waves in very old meridians: quantum medical physics of the living" *Acupunct Electrother Res.* (1996) PMID: 8791905.
- Hu Y et al.: "Altered Impedance of Ear Acupuncture Point MT2 in Breast Cancer Patients: A Preliminary Observation" *Evid Based Complement Alternat Med.* (2015) PMID: 26504483. PMC4609471.
- Korkushko AO et al.: "[Effects of low-intensity EHF-radiation on peripheral sections of the nervous system]" *Lik Sprava.* (2000) PMID: 16786651.
- Lysenyuk VP et al.: "Experimental study on the low-intensity millimeter-wave electro-magnetic stimulation of acupuncture points" *Electrother Res.* (2000) PMID: 10968646.
- Mothersill C et al.: "Alternative medicine techniques have non-linear effects on radiation response and can alter the expression of radiation induced bystander effects" *Dose Response.* (2013) PMID: 23550268.
- She YF et al.: [History and progress of study on electrical properties of acupoints at home and abroad] *Zhongguo Zhen Jiu.* (2010) PMID: 21290849.
- Usichenko TI et al.: "Treatment of rheumatoid arthritis with electromagnetic millimeter waves applied to acupuncture points - a randomized double blind clinical study" *Acupunct Electrother Res.* (2003) PMID: 12934956.
- Vorobyov VV et al.: "Hypothalamic effects of millimeter wave irradiation depend on location of exposed acupuncture zones in unanesthetized rabbits" *Am J Chin Med.* (2002) PMID: 12067094.

(113) Mesenchymal stem cells

- Jadidi M et al.: "Mesenchymal stem cells that located in the electromagnetic fields improves rat model of Parkinson's disease" *Iran J Basic Med Sci.* (2016) PMID: 27635198. PMC5010846.
- Kasten A et al.: "Mechanical integrin stress and magnetic forces induce biological responses in mesenchymal stem cells which depend on environmental factors" *J Cell Biochem.* (2010) PMID: 21053275.
- Marędziak M et al.: "Static magnetic field enhances the viability and proliferation rate of adipose tissue-derived mesenchymal stem cells potentially through activation of the phosphoinositide 3-kinase/Akt (PI3K/Akt) pathway" *Electromagn Biol Med.* (2017) PMID: 27367918.

(114) Metabolic theory and effects; *see also ATP*

- De Luca C et al: "Metabolic and genetic screening of electromagnetic hypersensitivity subjects as a feasible tool for diagnostics and intervention" *Mediators Inflamm.* (2014) PMID: 24812443; pdf.
- Gerardi G et al.: "Effects of electromagnetic fields of low frequency and low intensity on rat metabolism" *Biomagn Res Technol.* (2008) PMID: 18380892. PMC2362112.
- Iakimenko IL et al.: [Metabolic changes in cells under electromagnetic radiation of mobile communication systems] *Ukr Biokhim Zh (1999).* (2011) PMID: 21851043.
- Parham F et al.: "The Use of Signal-Transduction and Metabolic Pathways to Predict Human Disease Targets from Electric and Magnetic Fields Using in vitro Data in Human Cell Lines" *Front Public Health.* (2016) PMID: 27656641; pdf.
- Seyfried TN et al.: "Press-pulse: a novel therapeutic strategy for the metabolic management of cancer" *Nutr Metab (Lond).* (2017) PMID: 28250801; pdf.
- Shi Z et al.: "The Energy Metabolism in Caenorhabditis elegans under The Extremely Low-Frequency Electromagnetic Field Exposure" *Sci Rep.* (2015) PMID: 25683579. PMC4329544.

- Tan S et al.: "Study on dose-dependent, frequency-dependent, and accumulative effects of 1.5 GHz and 2.856 GHz microwave on cognitive functions in Wistar rats" *Sci Rep.* (2017) PMID: 28883530; pdf.

(115) Metallic and electric implants

- Hocking B et al.: "Guidance note: risk management of workers with medical electronic devices and metallic implants in electromagnetic fields" *Int J Occup Saf Ergon.* (2008) PMID: 18534156.

(116) Microglial cells, neuroglia, CNS immune system

- Hao Y et al.: "STAT3 signalling pathway is involved in the activation of microglia induced by 2.45 GHz electromagnetic fields" *Int J Radiat Biol.* (2010) PMID: 20070213.

(117) MicroRNA

- Capelli E et al.: "Low-Frequency Pulsed Electromagnetic Field Is Able to Modulate miRNAs in an Experimental Cell Model of Alzheimer's Disease" *J Healthc Eng.* (2017) PMID: 29065581. PMC5434238.
- Li H et al.: "Exosomal Small RNA Sequencing Uncovers the microRNA Dose Markers for Power Frequency Electromagnetic Field Exposure" *Biomarkers.* (2018) PMID: 29297241.
- Liu Y et al.: "Overexpression of miR-26b-5p regulates the cell cycle by targeting CCND2 in GC-2 cells under exposure to extremely low frequency electromagnetic fields" *Cell Cycle.* (2016) PMID: 26637059. PMC4943694.

(118) Migraine, headache

- Mohammadianinejad SE et al.: "The Effects of Exposure to Low Frequency Electromagnetic Fields in the Treatment of Migraine Headache: A Cohort Study" *Electron Physician.* (2016) PMID: 28163863. PMC5279981.

(119) Millimetre waves, mmW, (5G), 30-300 GHz, terahertz (Active Denial: 95 GHz)

- Alexandrov BS et al.: "DNA Breathing Dynamics in the Presence of a Terahertz Field" *Phys Lett A.* (2010) PMID: 20174451.
- Alexandrov BS et al.: "Non-thermal effects of terahertz radiation on gene expression in mouse stem cells" *Biomed Opt Express.* (2011) PMID: 21991556.
- Belyaev IY et al.: "Nonthermal effects of extremely high-frequency microwaves on chromatin conformation in cells in vitro—Dependence on physical, physiological, and genetic factors" *IEEE Trans Micr Theory Techniques.* (2000) Article.
- Bock J et al.: "Mammalian stem cells reprogramming in response to terahertz radiation" *PLoS One.* (2010) PMID: 21209821.
- De Smul A: "Very new waves in very old meridians: quantum medical physics of the living" *Acupunct Electrother Res.* (1996) PMID: 8791905.
- Di Donato L et al.: "Permeability changes of cationic liposomes loaded with carbonic anhydrase induced by millimetre waves radiation" *Radiat Res.* (2012) PMID: 22998228.
- Frei MR et al.: "Field orientation effects during 5.6-GHz radiofrequency irradiation of rats" *Aviat Space Environ Med.* (1990) PMID: 2285402.
- Gandhi OP et al.: "Absorption of Millimeter Waves by Human Beings and Its Biological Implications" *IEEE Trans Microwave Theory Techniques.* (1986) pdf.
- Habauzit D et al.: "Transcriptome analysis reveals the contribution of thermal and the specific effects in cellular response to millimeter wave exposure" *PLoS One.* (2014) PMID: 25302706.
- Jauchem JR et al.: "Cardiovascular and thermal responses in rats during 94 GHz irradiation" *Bioelectromagnetics.* (1999) PMID: 10230940.
- Korenstein-Ilan A et al.: "Terahertz radiation increases genomic instability in human lymphocytes" *Radiat Res.* (2008) PMID: 18666810.
- Le Dréan Y et al.: "State of knowledge on biological effects at 40–60 GHz" *Comptes Rendus Physique.* (2013) Abstract.

- Lysenyuk VP et al.: "Experimental study on the low-intensity millimeter-wave electro-magnetic stimulation of acupuncture points" *Electrother Res.* (2000) PMID: 10968646.
- Millenbaugh NJ et al.: "Gene expression changes in the skin of rats induced by prolonged 35 GHz millimeter-wave exposure" *Radiat Res.* (2008) PMID: 18302488.
- Pakhomov AG et al.: "Current state and implications of research on biological effects of millimeter waves: a review of the literature" *Bioelectromagnetics.* (1998) PMID: 9771583. Article.
- Ramundo-Orlando A: "Effects of millimeter waves radiation on cell membrane - A brief review" *J Infrared, Millimeter, and Terahertz Waves.* (2010) Abstract.
- Romanenko S et al.: "Effects of millimeter wave irradiation and equivalent thermal heating on the activity of individual neurons in the leech ganglion" *J Neurophysiol.* (2014) PMID: 25122711.
- Romanenko S et al.: "The interaction between electromagnetic fields at megahertz, gigahertz and terahertz frequencies with cells, tissues and organisms: risks and potential" *J R Soc Interface.* (2017) PMID: 29212756. PMC5746568.
- Ryan KL et al.: "Radio frequency radiation of millimeter wave length: potential occupational safety issues relating to surface heating" *Health Phys.* (2000) PMID: 10647983.
- Soghomonyan D et al.: "Millimeter waves or extremely high frequency electromagnetic fields in the environment: what are their effects on bacteria?" *Appl Microbiol Biotechnol.* (2016) PMID: 27087527.
- Soubere Mahamoud Y et al.: "Additive Effects of Millimeter Waves and 2-Deoxyglucose Co-Exposure on the Human Keratinocyte Transcriptome" *PLoS One.* (2016) PMID: 27529420. PMC4986955.
- Titushkin IA et al.: "Altered calcium dynamics mediates P19-derived neuron-like cell responses to millimeter-wave radiation" *Radiat Res.* (2009) PMID: 19929419.
- Torgomian É et al.: [Changes in ion transport through membranes, ATPase activity and antibiotics effects in Enterococcus hirae after low intensity electromagnetic irradiation of 51,8 and 53,0 GHz frequencies] *Biofizika.* (2013) PMID: 24455887.
- Torgomyan H et al.: "Bactericidal effects of low-intensity extremely high frequency electromagnetic field: an overview with phenomenon, mechanisms, targets and consequences" *Crit Rev Microbiol.* (2013) PMID: 22667685.
- Torgomyan H et al.: "Electromagnetic irradiation of Enterococcus hirae at low-intensity 51.8- and 53.0-GHz frequencies: changes in bacterial cell membrane properties and enhanced antibiotics effects" *FEMS Microbiol Lett.* (2012) PMID: 22288948. Article.
- Usichenko TI et al.: "Treatment of rheumatoid arthritis with electromagnetic millimeter waves applied to acupuncture points - a randomized double blind clinical study" *Acupunct Electrother Res.* (2003) PMID: 12934956.
- Vorobyov VV et al.: "Hypothalamic effects of millimeter wave irradiation depend on location of exposed acupuncture zones in unanesthetized rabbits" *Am J Chin Med.* (2002) PMID: 12067094.
- Zhao Z et al.: "[Effects of millimeter wave irradiation with different frequency and power density on their offsprings in mice]" *Zhonghua Yu Fang Yi Xue Za Zhi.* (1998) PMID: 10322774.
- Zhao ZG et al.: "[Relationship between millimeter wave irradiation in pregnant mice and c-Fos protein expression in hippocampus and learning and memory functions in their offsprings]" *Zhonghua Lao Dong Wei Sheng Zhi Ye Bing Za Zhi.* (2005) PMID: 16405774.

(120) Miscarriage

- Juutilainen J et al.: "Early pregnancy loss and exposure to 50-Hz magnetic fields" *Bioelectromagnetics.* (1993) PMID: 8323573.
- Lee GM et al.: "A nested case-control study of residential and personal magnetic field measures and miscarriages" *Epidemiology.* (2002) PMID: 11805582.
- Li DK et al.: "A population-based prospective cohort study of personal exposure to magnetic fields during pregnancy and the risk of miscarriage" *Epidemiology.* (2002) PMID: 11805581.

- Li DK et al.: "Exposure to Magnetic Field Non-Ionizing Radiation and the Risk of Miscarriage: A Prospective Cohort Study" *Sci Rep.* (2017) PMID: 29235463.
- Lindbohm ML et al.: "Magnetic fields of video display terminals and spontaneous abortion" *Am J Epidemiol.* (1992) PMID: 1462964.
- Mahmoudabadi FS et al.: "Use of mobile phone during pregnancy and the risk of spontaneous abortion" *J Environ Health Sci Eng.* (2015) PMID: 25937931. PMC4416385.
- Shamsi Mahmoudabadi F et al.: "Exposure to extremely low frequency electromagnetic fields during pregnancy and the risk ofspontaneous abortion: a case-control study" *J Res Health Sci.* (2013) PMID: 24077469. Article.
- Wang Q et al.: "Residential exposure to 50 Hz magnetic fields and the association with miscarriage risk: a 2-year prospective cohort study" *PLoS One.* (2013) PMID: 24312633. PMC3849403.
- Zhou LY et al.: "Epidemiological investigation of risk factors of the pregnant women with early spontaneous abortion in Beijing" *Chin J Integr Med.* (2017) PMID: 25877464.

(121) Mitochondrial dysfunction, ATPS, leading to ROS

- Calabrò E et al.: "50 Hz electromagnetic field produced changes in FTIR spectroscopy associated with mitochondrial transmembrane potential reduction in neuronal-like SH-SY5Y cells" *Oxid Med Cell Longev.* (2013) PMID: 23970948. PMC3730390.
- Esmekaya MA et al.: "Investigation of the effects of 2.1 GHz microwave radiation on mitochondrial membrane potential (ΔΨm), apoptotic activity and cell viability in human breast fibroblast cells" *Cell Biochem Biophys.* (2013) PMID: 23723005.
- Esmekaya MA et al.: "Mitochondrial hyperpolarization and cytochrome-c release in microwave-exposed MCF-7 cells" *Gen Physiol Biophys.* (2017) PMID: 27615380.
- Hao YH et al.: "Effects of microwave radiation on brain energy metabolism and related mechanisms" *Mil Med Res.* (2015) PMID: 26000171.
- Heaton GM et al.: "The calcium conductance of the inner membrane of rat liver mitochondria and the determination of the calcium electrochemical gradient" *Biochem J.* (1976) PMID: 949345. PMC1163798.
- Houston B et al.: "The effects of radiofrequency electromagnetic radiation on sperm function" *Reproduction.* (2016) PMID: 27601711.
- Kushnareva YE et al.: "Prooxidants open both the mitochondrial permeability transition pore and a low-conductance channel in the inner mitochondrial membrane" *Arch Biochem Biophys.* (2000) PMID: 10775426.
- Kushnareva YE et al.: "The role of low (< or = 1 mM) phosphate concentrations in regulation of mitochondrial permeability: modulation of matrix free Ca2+ concentration" *Arch Biochem Biophys.* (1999) PMID: 10049510.
- Li Y et al.: "Extra-low-frequency magnetic fields alter cancer cells through metabolic restriction" *Electromagn Biol Med.* (2014) PMID: 23915261.
- Poznanski RR et al.: "Induced mitochondrial membrane potential for modeling solitonic conduction of electrotonic signals" *PLoS One.* (2017) PMID: 28880876. PMC5589106.
- Schwarzländer M et al.: "Pulsing of membrane potential in individual mitochondria: a stress-induced mechanism to regulate respiratory bioenergetics in Arabidopsis" *Plant Cell.* (2012) PMID: 22395486. PMC3336130.
- Wagner S et al.: "Mitochondrial Energy Signaling and Its Role in the Low-Oxygen Stress Response of Plants" *Plant Physiol.* (2018) PMID: 29298823. PMC5813528.
- Zinov'eva MV et al.: [Nature of endogenous proton conductance of the inner mitochondrial membrane. Role of Ca2+ transport system in proton transfer] *Biokhimiia.* (1981) PMID: 6171308.

(122) Muscarinic receptor M1

- Hassanshahi A et al.: "The effect of Wi-Fi electromagnetic waves in unimodal and multimodal object recognition tasks in male rats" *Neurol Sci.* (2017) PMID: 28332042.

(123) Muscular activity, extra-cranial, chewing, finger movements

- Choi YH et al.: "The brain activation pattern of the medial temporal lobe during chewing gum: a functional MRI study" *Neural Regen Res.* (2017) PMID: 28616039. PMC5461620.
- Fiederer LD et al.: "Electrical Stimulation of the Human Cerebral Cortex by Extracranial Muscle Activity: Effect Quantification With Intracranial EEG and FEM Simulations" *IEEE Trans Biomed Eng.* (2016) PMID: 27448334. PMC5298223.
- Miyaguchi S et al.: "Corticomotor excitability induced by anodal transcranial direct current stimulation with and without non-exhaustive movement" *Brain Res.* (2013) PMID: 23891715.
- Momose T et al.: "Effect of mastication on regional cerebral blood flow in humans examined by positron-emission tomography with ^{15}O-labelled water and magnetic resonance imaging" *Arch Oral Biol.* (1997) PMID: 9134116.
- Onyper SV et al.: "Cognitive advantages of chewing gum. Now you see them, now you don't" *Appetite.* (2011) PMID: 21645566.
- Shirota Y et al.: "Influence of Concurrent Finger Movements on Transcranial Direct Current Stimulation (tDCS)-Induced Aftereffects" *Front Behav Neurosci.* (2017) PMID: 28955211. PMC5600944.

(124) Myelin, demyelination, Multiple Sclerosis (MS)

- Abbasi M et al.: "Multiple sclerosis and environmental risk factors: a case-control study in Iran" *Neurol Sci.* (2017) PMID: 28799006.
- Abdollahi F et al.: "Correlation of multiple sclerosis (MS) incidence trends with solar and geomagnetic indices: Time to revise the method of reporting MS epidemiological data" *Iran J Neurol.* (2014) PMID: 25295148. PMC4187332.
- Havas M: "Electromagnetic Hypersensitivity: Biological Effects of Dirty Electricity with Emphasis on Diabetes and Multiple Sclerosis" *Electromagn Biol Med.*(2006) PMID: 17178585.
- Johansson O et al: "Exacerbation of demyelinating syndrome after exposure to wireless modem with public hotspot" *Electromagn Biol Med.* (2016) PMID: 27355805.
- Karussis D et al.: "The spectrum of post-vaccination inflammatory CNS demyelinating syndromes" *Autoimmun Rev.* (2014) PMID: 24514081.
- Kim JH et al: "Long-term exposure to 835 MHz RF-EMF induces hyperactivity, autophagy and demyelination in the cortical neurons of mice" *Sci Rep.* (2017) PMID: 28106136.
- Kudo M: "Environmental Pathology: SY09-2 Multiple Sclerosis (MS) and neurodegeneration: cause and pathogenesis in relation to EMFs" *Pathology.* (2014) abstract.
- Maschi JP: "Sclérose en plaques et pollution électromagnétique : La théorie environnementale d'une maladie neurologique" [Multiple Sclerosis and Electromagnetic Pollution: The Environmental Theory of a Neurological Disease] (French) (2014) ISBN-13: 978-2874341571.
- Papathanasopoulos P et al.: "The possible effects of the solar and geomagnetic activity on multiple sclerosis" *Clin Neurol Neurosurg.* (2016) PMID: 27161905.
- Redmayne M et al: "Could myelin damage from radiofrequency electromagnetic field exposure help explain the functional impairment electrohypersensitivity? A review of the evidence" *J Toxicol Environ Health B Crit Rev.* (2014) PMID: 25205214.
- Rotenstein L et al.: "Embryonic development of glial cells and myelin in the shark, Chiloscyllium punctatum" *Gene Expr Patterns.* (2009) PMID: 1973369. PMC2783534.
- Sajedi SA et al.: "Which Environmental Factor Is Correlated with Long-Term Multiple Sclerosis Incidence Trends: Ultraviolet B Radiation or Geomagnetic Disturbances?" *Mult Scler Int.* (2017) PMID: 29204297. PMC5674510.

(125) Natural killer cells

- Gobba F et al.: "Extremely low frequency-magnetic fields (ELF-EMF) occupational exposure and natural killer activity in peripheral blood lymphocytes" *Sci Total Environ.* (2009) PMID: 18804846.

- Gobba F et al.: "Natural killer cell activity decreases in workers occupationally exposed to extremely low frequency magnetic fields exceeding 1 microT" *Int J Immunopathol Pharmacol.* (2009) PMID: 20074470.

(126) Nerve conduction, neuromodulation

- Bhadra N et al.: "Reversible conduction block in peripheral nerve using electrical waveforms" *Bioelectron Med (Lond).* (2018) PMID: 29480897. PMC5811084.
- Kilgore KL et al.: "Reversible nerve conduction block using kilohertz frequency alternating current" *Neuromodulation.* (2014) PMID: 23924075. PMC3834124.
- Pelot NA et al.: "Modeling the response of small myelinated axons in a compound nerve to kilohertz frequency signals" *J Neural Eng.* (2017) PMID: 28361793. PMC5677574.
- Springer S et al.: "Ulnar Nerve Conduction Block Using Surface Kilohertz Frequency Alternating Current: A Feasibility Study" *Artif Organs.* (2018) PMID: 29517147.
- Vucković A et al.: "Influence of variable nerve fibre geometry on the excitation and blocking threshold. A simulation study" *Med Biol Eng Comput.* (2005) PMID: 16035225.
- Zhang X et al.: "Mechanism of nerve conduction block induced by high-frequency biphasic electrical currents" *IEEE Trans Biomed Eng.* (2006) PMID: 17153201. PMC2821719.
- Zhao S et al.: "Conduction block in myelinated axons induced by high-frequency (kHz) non-symmetric biphasic stimulation" *Front Comput Neurosci.* (2015) PMID: 26217217. PMC4491630.

(127) Neurogenesis; *see also: Stem cells*

- Chen C et al.: "Exposure to 1800 MHz radiofrequency radiation impairs neurite outgrowth of embryonic neural stem cells" *Sci Rep.*(2014) PMID: 24869783.
- Eghlidospour M et al.: "Effects of radiofrequency exposure emitted from a GSM mobile phone on proliferation, differentiation, and apoptosis of neural stem cells" *Anat Cell Biol.* (2017) PMID: 28713615.

(128) Neurological effects, neuronal changes, EEG, cognitive function, learning, memory, sleep, pineal gland; *see also: Sleep, adrenaline, dopamine, serotonin, tryptophan etc.*

- Altunkaynak BZ et al.: "Different methods for evaluating the effects of microwave radiation exposure on the nervous system" *J Chem Neuroanat.* (2016) PMID: 26686295.
- Augner C et al.: "Effects of exposure to GSM mobile phone base station signals on salivary cortisol, alpha-amylase, and immunoglobulin A" *Biomed Environ Sci.* (2010) PMID: 20708499.
- Banerjee J et al.: "Immediate Effects of Repetitive Magnetic Stimulation on Single Cortical Pyramidal Neurons" *PLoS One.* (2017) PMID: 28114421. PMC5256952.
- Bise W: "Low power radio-frequency and microwave effects on human electroencephalogram and behaviour" *Physiol Chem Phys.* (1978) PMID: 751078.
- Buchner K et al.: "Changes of Clinically Important Neurotransmitters under the Influence of Modulated RF Fields - A Long-term Study under Real-life Conditions" *Umwelt-Medizin-Gesellschaft* (2011) (copy).
- Cameron MA et al.: "Differential effect of brief electrical stimulation on voltage-gated potassium channels" *J Neurophysiol.* (2017) PMID: 28202576. PMC5411463.
- Consales C et al.: "Fifty-Hertz Magnetic Field Affects the Epigenetic Modulation of the miR-34b/c in Neuronal Cells" *Mol Neurobiol.* (2017) PMID: 29039021.
- Deniz OG et al.: "Effects of short and long term electromagnetic fields exposure on the human hippocampus" *J Microsc Ultrastruct.* (2017) Article.
- Deshmukh PS et al.: (2015) "Cognitive Impairment and Neurogenotoxic Effects in Rats Exposed to Low-Intensity Microwave Radiation" *Int J Toxicol.* (2015) PMID: 25749756.
- Dileone M et al.: "Dopamine-dependent changes of cortical excitability induced by transcranial static magnetic field stimulation in Parkinson's disease" *Sci Rep.* (2017) PMID: 28659614. PMC5489478.

- Fiederer LD et al.: "Electrical Stimulation of the Human Cerebral Cortex by Extracranial Muscle Activity: Effect Quantification With Intracranial EEG and FEM Simulations" *IEEE Trans Biomed Eng.* (2016) PMID: 27448334. PMC5298223.
- Fiederer LDJ et al.: "The role of blood vessels in high-resolution volume conductor head modelling of EEG" *Neuroimage.* (2016) PMID: 26747748. PMC5225375.
- Forli A et al.: "Two-Photon Bidirectional Control and Imaging of Neuronal Excitability with High Spatial Resolution In Vivo" *Cell Rep.* (2018) PMID: 29539433.
- Francis JT et al.: "Sensitivity of neurons to weak electric fields" *J Neurosci.* (2003) PMID: 12917358. Article.
- Fraser A et al.: "Electromagnetic emission at micron wavelengths from active nerves" *Biophys J.* (1968) PMID: 5699805; pdf.
- Frey AH: "Behavioral biophysics" *Psychol Bull.* (1965) PMID: 14298209; abstract.
- Fröhlich F et al.: "Endogenous electric fields may guide neocortical network activity" *Neuron.* (2010) PMID: 20624597. PMC3139922.
- Giachello CN et al.: "Magnetic Fields Modulate Blue-Light-Dependent Regulation of Neuronal Firing by Cryptochrome" *J Neurosci.* (2016) PMID: 27798129. PMC5083005.
- Goodwin TJ: "Physiological and Molecular Electromagnetic Fields of Time-varying Electronic Fields on Human Neuronal Cells" *NASA.* (2003) Article.
- Guo L et al.: "The effect of an exogenous magnetic field on neural coding in deep spiking neural networks" *J Integr Neurosci.* (2018) PMID: 29526851.
- Hales CG: "The origins of the brain's endogenous electromagnetic field and its relationship to provision of consciousness" *J Integr Neurosci.* (2014) PMID: 25012714.
- Herrmann CS et al.: "Transcranial alternating current stimulation: a review of the underlying mechanisms and modulation of cognitive processes" *Front Hum Neurosci.* (2013) PMID: 23785325. PMC3682121.
- Hu Y et al.: "Alterations in White Matter Integrity in Young Adults with Smartphone Dependence" *Front Hum Neurosci.* (2017) PMID: 29163108. PMC5673664.
- Huang J et al.: "Association between exposure to electromagnetic fields from high voltage transmission lines and neurobehavioral function in children" *PLoS One.* (2013) PMID: 23843999. PMC3700989.
- Jamil A et al.: "Systematic evaluation of the impact of stimulation intensity on neuroplastic after-effects induced by transcranial direct current stimulation" *J Physiol.* (2017) PMID: 27723104. PMC5309387.
- Jedlicka P: "Revisiting the Quantum Brain Hypothesis: Toward Quantum (Neuro)biology?" *Front Mol Neurosci.* (2017) PMID: 29163041. PMC5681944.
- Jefferys JG: "Nonsynaptic modulation of neuronal activity in the brain: electric currents and extracellular ions" *Physiol Rev.* (1995) PMID: 7480159. 10.1152/physrev.1995.75.4.689.
- Jensen CS et al.: "Neuronal trafficking of voltage-gated potassium channels" *Mol Cell Neurosci.* (2011) PMID: 21627990.
- Kanter BR et al.: "A Novel Mechanism for the Grid-to-Place Cell Transformation Revealed by Transgenic Depolarization of Medial Entorhinal Cortex Layer II" *Neuron.* (2017) PMID: 28334610.
- Kaplan S et al.: "Electromagnetic field and brain development" *J Chem Neuroanat.* (2016) PMID: 26686296.
- Kerimoğlu G et al.: "Pernicious effects of long-term, continuous 900-MHz electromagnetic field throughoutadolescence on hippocampus morphology, biochemistry and pyramidal neuron numbers in 60-day-old Sprague Dawley male rats" *J Chem Neuroanat.* (2016) PMID: 27430379.
- Kim JH et al.: "Changes in numbers and size of synaptic vesicles of cortical neurons induced by exposure to 835 MHz radiofrequency-electromagnetic field" *PLoS One.* (2017) PMID: 29045446. PMC5646811.
- Kirimoto H et al.: "Non-invasive modulation of somatosensory evoked potentials by the application of static magnetic fields over the primary and supplementary motor cortices" *Sci Rep.* (2016) PMID: 27698365. PMC5048290.

- Kumari K et al.: "Behavioral testing of mice exposed to intermediate frequency magnetic fields indicates mild memory impairment" *PLoS One.* (2017) PMID: 29206232. PMC5714647.
- Lu Y et al.: "Differential pro-inflammatory responses of astrocytes and microglia involve STAT3 activation in response to 1800 MHz radiofrequency fields" *PLoS One.* (2014) PMID: 25275372. PMC4183530.
- Lustenberger C et al.: "Inter-individual and intra-individual variation of the effects of pulsed RF EMF exposure on the human sleep EEG" *Bioelectromagnetics*. (2015) PMID: 25690404.
- Lv B et al.: "Effects of acute electromagnetic fields exposure on the interhemispheric homotopic functional connectivity during resting state" *Conf Proc IEEE Eng Med Biol Soc.* (2015) PMID: 26736632.
- Lv B et al.: "The alteration of spontaneous low frequency oscillations caused by acute electromagnetic fields exposure" *Clin Neurophysiol.* (2014) PMID: 24012322.
- Marino AA et al.: "Trigeminal neurons detect cellphone radiation: Thermal or nonthermal is not the question" *Electromagn Biol Med.* (2017) PMID: 27419655.
- Matsugi A et al.: "Cerebellar transcranial static magnetic field stimulation transiently reduces cerebellar brain inhibition" *Funct Neurol.* (2017) PMID: 28676140. PMC5507156.
- Milham S et al.: "Dirty electricity, chronic stress, neurotransmitters and disease" *Electromagn Biol Med.* (2103) Erratum in (2014) PMID: 23323864.
- Mordillo-Mateos L et al.: "Effects of transcranial direct current stimulation on temperature and pain perception" *Sci Rep.* (2017) PMID: 28592857. PMC5462761.
- Mugunthan N et al.: "Effects of Long Term Exposure of 900-1800 MHz Radiation Emitted from 2G Mobile Phone on Mice Hippocampus- A Histomorphometric Study" *J Clin Diagn Res.* (2016) PMID: 27656427; pdf.
- Murphy SC et al.: "Transcranial magnetic stimulation (TMS) inhibits cortical dendrites" *Elife.* (2016) PMID: 26988796. PMC4811769.
- Narayanan SN et al.: "Radiofrequency electromagnetic radiation exposure effects on amygdala morphology, place preference behavior and brain caspase-3 activity in rats" *Environ Toxicol Pharmacol.* (2018) PMID: 29413766.
- Naro A et al.: "Effects of cerebellar transcranial alternating current stimulation on motor cortex excitability and motor function" *Brain Struct Funct.* (2017) PMID: 28064346.
- Nojima I et al.: " Combination of Static Magnetic Fields and Peripheral Nerve Stimulation Can Alter Focal Cortical Excitability" *Front Hum Neurosci.* (2016) PMID: 27932966. PMC5122585.
- Papageorgiou CC et al.: "Effects of wi-fi signals on the p300 component of event-related potentials during an auditory hayling task" *J Integr Neurosci.* (2011) PMID: 21714138.
- Pawela CP et al.: "Dorsal root ganglion stimulation attenuates the BOLD signal response to noxious sensory input in specific brain regions: Insights into a possible mechanism for analgesia" *Neuroimage.* (2017) PMID: 27876655.
- Poznanski RR et al.: "Solitonic conduction of electrotonic signals in neuronal branchlets with polarized microstructure" *Sci Rep.* (2017) PMID: 28566682. PMC5451471.
- Prucha J et al.: "Acute exposure to high-induction electromagnetic field affects activity of model peripheral sensory neurons" *J Cell Mol Med.* (2017) PMID: 29210178. DOI: 10.1111/jcmm.13423.
- Qiao S et al.: "Reduction of phosphorylated synapsin I (ser-553) leads to spatial memory impairment by attenuating GABA release after microwave exposure in Wistar rats" *PLoS One.* (2014) PMID: 24743689.
- Rawji V et al.: "tDCS changes in motor excitability are specific to orientation of current flow" *Brain Stimul.* (2018) PMID: 29146468. PMC5805821.
- Razavinasab M et al.: "Maternal mobile phone exposure alters intrinsic electrophysiological properties of CA1 pyramidal neurons in rat offspring" *Toxicol Ind Health.* (2016) PMID: 24604340.
- Roggeveen S et al.: "EEG Changes Due to Experimentally Induced 3G Mobile Phone Radiation" *PLoS One.* (2015) PMID: 26053854.

- Saikhedkar N et al.: "Effects of mobile phone radiation (900 MHz radiofrequency) on structure and functions of rat brain" *Neurol Res.* (2014) PMID: 24861496.
- Sasaki T et al.: "Spatial and memory circuits in the medial entorhinal cortex" *Curr Opin Neurobiol.* (2015) PMID: 25463560. PMC4416067.
- Schneider J et al.: "Nonthermal Effects of Lifelong High-Frequency Electromagnetic Field Exposure on Social Memory Performance in Rats" *Behav Neurosci.* (2014) PMID: 24999587.
- Schoeni A et al.: "Memory performance, wireless communication and exposure to radiofrequency electromagnetic fields: A prospective cohort study in adolescents" *Environ Int.* (2015) PMID: 26474271.
- Semm P et al.: "Effects of an earth-strength magnetic field on electrical activity of pineal cells" *Nature.* (1980) PMID: 7442806.
- Seo H et al.: "Multi-Scale Computational Models for Electrical Brain Stimulation" *Front Hum Neurosci.* (2017) PMID: 29123476. PMC5662877.
- Shirota Y et al.: "Influence of Concurrent Finger Movements on Transcranial Direct Current Stimulation (tDCS)-Induced Aftereffects" *Front Behav Neurosci.* (2017) PMID: 28955211. PMC5600944.
- Suvorov NB et al.: "[Systematic analysis of the state of man exposed to radio wave irradiation for a long time]" *Gig Sanit.* (1990) PMID: 2373376.
- Tarlacı S et al.: "Quantum neurophysics: From non-living matter to quantum neurobiology and psychopathology" *Int J Psychophysiol.* (2016) PMID: 25668717.
- Teimori F et al.: "The effects of 30 mT electromagnetic fields on hippocampus cells of rats" *Surg Neurol Int.* (2016) PMID: 27453795. PMC4946261.
- Varghese R et al.: "Rats exposed to 2.45GHz of non-ionizing radiation exhibit behavioral changes with increased brain expression of apoptotic caspase 3" *Pathophysiology.* (2018) PMID: 29153770.
- Vöröslakos M et al.: "Direct effects of transcranial electric stimulation on brain circuits in rats and humans" *Nat Commun.* (2018) PMID: 29396478. PMC5797140.
- Wang H et al.: "The relationship between NMDA receptors and microwave induced learning and memory impairment: a long term observation on Wistar rats" *Int J Radiat Biol.* (2014) PMID: 25426698.
- Wang LF et al.: "Microwave-Induced Structural and Functional Injury of Hippocampal and PC12 Cells Is Accompanied by Abnormal Changes in the NMDAR-PSD95-CaMKII Pathway" *Pathobiology.* (2015) PMID: 26337368.
- Wilmer HH et al.: "Smartphones and Cognition: A Review of Research Exploring the Links between MobileTechnology Habits and Cognitive Functioning" *Front Psychol.* (2017) PMID: 28487665. PMC5403814.
- Xiong L et al.: "Microwave exposure impairs synaptic plasticity in the rat hippocampus and PC12 cells through over-activation of the NMDA receptor signaling pathway" *Biomed Environ Sci.* (2015) PMID: 25566859.
- Xu Y et al.: "Collective responses in electrical activities of neurons under field coupling" *Sci Rep.* (2018) PMID: 29358677. PMC5778049.
- Yang X et al.: "The role of the JAK2-STAT3 pathway in pro-inflammatory responses of EMF-stimulated N9 microglial cells" *J Neuroinflammation.* (2010) PMID: 20828402. PMC2945324.
- Ye H et al.: "Neuron matters: electric activation of neuronal tissue is dependent on the interaction between the neuron and the electric field" *J Neuroeng Rehabil.* (2015) PMID: 26265444. PMC4534030.
- Zaghi S et al.: "Noninvasive brain stimulation with low-intensity electrical currents: putative mechanisms of action for direct and alternating current stimulation" *Neuroscientist.* (2010) PMID: 20040569.
- Zawilska JB et al.: "Suppression of melatonin biosynthesis in the chicken pineal gland by retinally perceived light - involvement of D1-dopamine receptors" *J Pineal Res.* (2004) PMID: 14962058.

- Zhang J et al.: "Acute effects of radiofrequency electromagnetic field emitted by mobile phone on brain function" *Bioelectromagnetics.* (2017) PMID: 28426166.
- Zhang M et al.: "Propagation of epileptiform activity can be independent of synaptic transmission, gap junctions, or diffusion and is consistent with electrical field transmission" *J Neurosci.* (2014) PMID: 24453330. PMC3898297.
- Zhao YL et al.: "The Screening of Genes Sensitive to Long-Term, Low-Level Microwave Exposure and Bioinformatic Analysis of Potential Correlations to Learning and Memory" *Biomed Environ Sci.* (2015) PMID: 26383594.
- Zheng Y et al.: "Effects of 15 Hz square wave magnetic fields on the voltage-gated sodium and potassium channels in prefrontal cortex pyramidal neurons" *Int J Radiat Biol.* (2017) PMID: 27924669.
- Zuo H et al.: "Neural Cell Apoptosis Induced by Microwave Exposure Through Mitochondria-dependent Caspase-3 Pathway" *Int J Med Sci.* (2014) PMID: 24688304.

(129) Neurological effects, muscular, peripheral nerves
- Mortazavi SM et al.: "Survey of the Effects of Exposure to 900 MHz Radiofrequency Radiation Emitted by a GSM Mobile Phone on the Pattern of Muscle Contractions in an Animal Model" *J Biomed Phys Eng.* (2015) PMID: 26396968.
- Say F et al.: "Controversies related to electromagnetic field exposure on peripheral nerves" *J Chem Neuroanat.* (2016) PMID: 26718608.

(130) Nitric oxide
- Patruno A et al.: "Extremely low frequency electromagnetic fields modulate expression of inducible nitric oxide synthase, endothelial nitric oxide synthase and cyclooxygenase-2 in the human keratinocyte cell line HaCat: potential therapeutic effects in wound healing" *Br J Dermatol.* (2010) PMID: 19799606.
- Pilla AA: "Electromagnetic fields instantaneously modulate nitric oxide signaling in challenged biological systems" *Biochem Biophys Res Commun.* (2012) PMID: 22940137.
- Salunke BP et al.: "Experimental evidence for involvement of nitric oxide in low frequency magnetic field induced obsessive compulsive disorder-like behaviour" *Pharmacol Biochem Behav.* (2014) PMID: 24780504.

(131) Non-Hodgkin lymphoma, follicular lymphoma
- Hardell L et al.: "Use of cellular or cordless telephones and the risk for non-Hodgkin's lymphoma" *Int Arch Occup Environ Health.* (2005) PMID: 16001209.
- Koeman T et al.: "Occupational extremely low-frequency magnetic field exposure and selected cancer outcomes in a prospective Dutch cohort" *Cancer Causes Control.* (2014) PMID: 24241907.

(132) Non-linear effects, 'windows', partial non-linear, frequency dependency
- Adey WR: "Frequency and power windowing in tissue interactions with weak electromagnetic fields" *Proc. IEEE.* (1980) abstract.
- Batsikadze G et al.: "Partially non-linear stimulation intensity-dependent effects of direct current stimulation on motor cortex excitability in humans" *J Physiol.* (2013) PMID: 23339180. PMC3624864.
- Bawin SM et al.: "Possible mechanisms of weak electromagnetic field coupling in brain tissue", pages 75-86; in Taylor LS et al.: *The Physical Basis of Electromagnetic Interactions with Biological Systems* (The Office of Naval Research) (1977) Article.
- Blackman CF et al.: "Multiple power-density windows and their possible origin" *Bioelectromagnetics.* (1989) PMID: 2540755.
- Carrubba S et al.: "Magnetosensory evoked potentials: consistent nonlinear phenomena" *Neurosci Res.* (2008) PMID: 18036693.

- Floros S et al.: "Frequency Dependent Non- Thermal Effects of Oscillating Electric Fields in the Microwave Region on the Properties of a Solvated Lysozyme System: A Molecular Dynamics Study" *PLoS One.* (2017) PMID: 28129348. PMC5271316.
- Jamil A et al.: "Systematic evaluation of the impact of stimulation intensity on neuroplastic after-effects induced by transcranial direct current stimulation" *J Physiol.* (2017) PMID: 27723104. PMC5309387.
- Li Y et al.: "Extra-low-frequency magnetic fields alter cells through metabolic restriction" *Electromagn Biol Med.* (2014) PMID: 23915261.
- Marino AA et al.: "Trigeminal neurons detect cellphone radiation: Thermal or nonthermal is not the question" *Electromagn Biol Med.* (2016) PMID: 27419655.
- Panagopoulos DJ et al.: "The identification of an intensity 'window' on the bioeffects of mobile telephony radiation" *Int J Radiat Biol.* (2010) PMID: 20397840.
- Postow E: "Non-linear biological responses to complex modulations" USAF School of Aeropsace Medicine. Aeromedical Review 3-81. (1981) Article.
- Taheri M et al.: "Klebsiella pneumonia, a Microorganism that Approves the Non-linear Responses to Antibiotics and Window Theory after Exposure to Wi-Fi 2.4 GHz Electromagnetic Radiofrequency Radiation" *J Biomed Phys Eng.* (2015) PMID: 26396967. PMC4576872.
- Zhu BY et al.: "Exposure Duration Is a Determinant of the Effect of Sinusoidal Electromagnetic Fields on Peak Bone Mass of Young Rats" *Calcif Tissue Int.* (2018) PMID: 29362823.

(133) Non-thermal effects

- Belyaev IY et al.: "Nonthermal effects of extremely high-frequency microwaves on chromatin conformation in cells in vitro—Dependence on physical, physiological, and genetic factors" *IEEE Trans Micr Theory Techniques.* (2000) Article.
- Creixell M et al.: "EGFR-targeted magnetic nanoparticle heaters kill cancer cells without a perceptible temperature rise" *ACS Nano.* (2011) PMID: 21838221.
- Giuliani L et al.: "Non-Thermal Effects and Mechanisms of Interaction Between Electromagnetic Fields and Living Matter" *Europ J Oncol.* (2010) part I, part II.
- Hyland GJ: "Physics and biology of mobile telephony" *Lancet.* (2000) PMID: 11117927.
- Iakimenko IL et al.: [Metabolic changes in cells under electromagnetic radiation of mobile communication systems] *Ukr Biokhim Zh (1999).* (2011) PMID: 21851043.
- Leszczynski D et al.: "Non-thermal thermal activation of the hsp27/p38MAPK stress pathway by mobile phone radiation in human endothelial cells: molecular mechanism for cancer- and blood-brain barrier-related effects" *Differentiation.* (2002) PMID: 12076339.
- Marino AA et al.: "Trigeminal neurons detect cellphone radiation: Thermal or nonthermal is not the question" *Electromagn Biol Med.* (2017) PMID: 27419655.
- Pilla AA: "Nonthermal electromagnetic fields: from first messenger to therapeutic applications" *Electromagn Biol Med.* (2013) PMID: 23675615.
- Rao VS et al.: "Nonthermal effects of radiofrequency-field exposure on calcium dynamics in stem cell-derived neuronal cells: elucidation of calcium pathways" *Radiat Res.* (2008) PMID: 18302487.
- Sanders AP et al.: "Effects of continuous-wave, pulsed, and sinusoidal-amplitude-modulated microwaves on brain energy metabolism" *Bioelectromagnetics.* (1985) PMID: 3977971.
- Sanders AP et al.: "Microwave effects on energy metabolism of rat brain" *Bioelectromagnetics.* (1980) PMID: 7284022.
- Yang KL et al.: "In vitro comparison of conventional hyperthermia and modulated electro-hyperthermia" *Oncotarget.* (2016) PMID: 2755650.
- Yang L et al.: "Long-Term Evolution Electromagnetic Fields Exposure Modulates the Resting State EEG on Alpha and Beta Bands" *Clin EEG Neurosci.* (2017) PMID: 27118764.
- Zhao Z et al.: "[Effects of millimeter wave irradiation with different frequency and power density on their offsprings in mice]" *Zhonghua Yu Fang Yi Xue Za Zhi.* (1998) PMID: 10322774.

Differences between heating with irradiation and without irradiation:

- Merritt JH et al.: "The effect of 1.6 GHz radiation on neurotransmitters in discrete areas of the rat brain" USAF School of Aerospace Medicine, Brooks. (1976) Abstract.

(134) Obesity

- Li DK et al.: "A prospective study of in-utero exposure to magnetic fields and the risk of childhood obesity" *Sci Rep.* (2012) PMID: 22844581. PMC3406339.

(135) Olfaction

- Gane S et al.: "Molecular vibration-sensing component in human olfaction" *PLoS One.* (2013) PMID: 23372854. PMC3555824.
- Mastrodonato A et al.: "Olfactory memory is enhanced in mice exposed to extremely low-frequency electromagnetic fields via Wnt/β-catenin dependent modulation of subventricular zone neurogenesis" *Sci Rep.* (2018) PMID: 29321633. 10.1038/s41598-017-18676-1.

(136) Optogenetics, photobiology

- Milias-Argeitis A et al.: "Automated optogenetic feedback control for precise and robust regulation of gene expression and cell growth" *Nat Commun.* (2016) PMID: 27562138.
- Ye H et al.: "A synthetic optogenetic transcription device enhances blood-glucose homeostasis in mice" *Science.* (2011) PMID: 21700876.

(137) Oxidative stress, redox state

- Abu Khadra KM et al.: "Evaluation of selected biochemical parameters in the saliva of young males using mobile phones" *Electromagn Biol Med.* (2015) PMID: 24499288.
- Akpınar D et al.: "Effects of pre- and postnatal exposure to extremely low-frequency electric fields on mismatch negativity component of the auditory event-related potentials: Relation to oxidative stress" *Electromagn Biol Med.* (2016) PMID: 27070942.
- Bahreyni Toossi MH et al.: "Exposure to mobile phone (900-1800 MHz) during pregnancy: tissue oxidative stress after childbirth" *J Matern Fetal Neonatal Med.* (2017) PMID: 28434276.
- Belpomme D et al: "Reliable disease biomarkers characterizing and identifying electrohypersensitivity and multiple chemical sensitivity as two etiopathogenic aspects of a unique pathological disorder" *Rev Environ Health* (2015) PMID: 26613326; pdf.
- Çelik Ö et al.: "Oxidative stress of brain and liver is increased by Wi-Fi (2.45GHz) exposure of rats during pregnancy and the development of newborns" *J Chem Neuroanat.* (2015) PMID: 26520617.
- Consales C et al.: "Electromagnetic fields, oxidative stress, and neurodegeneration" *Int J Cell Biol.* (2012) PMID: 22991514.
- Djordjevic NZ et al.: "Anxiety-like behavioural effects of extremely-low-frequency electromagnetic field in rats" *Environ Sci Pollut Res Int.* (2017) PMID: 28756602.
- Ertilav K et al.: "Long term exposure to cell phone frequencies (900 and 1800 MHz) induces apoptosis, mitochondrial oxidative stress and TRPV1 channel activation in the hippocampus and dorsal root ganglion of rats" *Metab Brain Dis.* (2018) PMID: 29332300.
- Esmekaya MA et al.: "900 MHz pulse-modulated radiofrequency radiation induces oxidative stress on heart, lung, testis and liver tissues" *Gen Physiol Biophys.* (2011) PMID: 21460416.
- Ghanbari AA et al.: "Protective Effects of Vitamin E Consumption against 3MT Electromagnetic Field Effects on Oxidative Parameters in Substantia Nigra in Rats" *Basic Clin Neurosci.* (2016) PMID: 27872692.
- Gulati S et al.: "Phenotypic and genotypic characterization of antioxidant enzyme system in human population exposed to radiation from mobile towers" *Mol Cell Biochem.* (2017) PMID: 28819931.
- Gumral N et al.: "The effects of electromagnetic radiation (2450 MHz wireless devices) on the heart and blood tissue: role of melatonin" *Bratisl Lek Listy.* (2016) PMID: 28125893.

- Henrykowska G et al.: "The effect of 50 hz magnetic field of different shape on oxygen metabolism in blood platelets: in vitro studies" *Int J Occup Med Environ Health.* (2009) PMID: 19887367.
- Jankowski W et al.: [Influence of electromagnetic field on chosen parameters of thrombocytes' oxygen metabolism--in vitro research] *Pol Merkur Lekarski.* (2008) PMID: 18702336.
- Kıvrak EG et al.: "Effects of electromagnetic fields exposure on the antioxidant defense system" *J Microsc Ultrastruct.* (2017) Article.
- Kunt H et al.: "Effects of electromagnetic radiation exposure on bone mineral density, thyroid, and oxidative stress index in electrical workers" *Onco Targets Ther.* (2016) PMID: 26929645. PMC4758783.
- Marjanovic Cermak AM et al.: "Oxidative stress response in SH-SY5Y cells exposed to short-term 1800 MHz radiofrequency radiation" *J Environ Sci Health A Tox Hazard Subst Environ Eng.* (2017) PMID: 29148897.
- Mattsson M et al: "Grouping of experimental conditions as an approach to evaluate effects of extremely low frequency magnetic fields on oxidative response in in vitro studies" *Front. Public Health.*(2014) pdf; PMID: 25229055.
- Megha K et al.: "Low intensity microwave radiation induced oxidative stress, inflammatory response and DNA damage in rat brain" *Neurotoxicology.* (2015) PMID: 26511840.
- Megha K et al.: "Microwave radiation induced oxidative stress, cognitive impairment and inflammation in brain of Fischer rats" *Indian J Exp Biol.* (2012)PMID: 23986973.
- Nazıroğlu M et al.: "Recent reports of Wi-Fi and mobile phone-induced radiation on oxidative stress and reproductive signaling pathways in females and males" *J Membr Biol.* (2013) PMID: 24105626.
- Odacı E et al.: "Pathological effects of prenatal exposure to a 900 MHz electromagnetic field on the 21-day-old male rat kidney" *Biotech Histochem.* (2014) PMID: 25158858.
- Othman H et al.: "Effects of prenatal exposure to WIFI signal (2.45GHz) on postnatal development and behavior in rat: Influence of maternal restraint" *Behav Brain Res.* (2017) PMID: 28288806.
- Özorak A et al.: "Wi-Fi (2.45 GHz)- and mobile phone (900 and 1800 MHz)-induced risks on oxidative stress and elements in kidney and testis of rats during pregnancy and the development of offspring" *Biol Trace Elem Res.* (2013) PMID: 24101576.
- Rakhmanin YA et al.: "[Relationship between the prevalence of chronic noninfectious diseases and electrophysical state of the environment]" Gig Sanit. (2015) Russian. PMID: 26856159.
- Sahin D et al.: "The 2100MHz radiofrequency radiation of a 3G-mobile phone and the DNA oxidative damage in brain" *J Chem Neuroanat.* (2016) PMID: 26775761.
- Shahin S et al.: "2.45 GHz Microwave radiation impairs hippocampal learning and spatial memory: Involvement of local stress mechanism induced suppression of iGluR/ERK/CREB signalling" *Toxicol Sci.* (2017) PMID: 29069439.
- Simkó M: "Cell type specific redox status is responsible for diverse electromagnetic field effects" *Curr Med Chem.*(2007) PMID: 17456027.
- Sun Y et al.: "Mitochondrial DNA damage and oxidative damage in HL-60 cells exposed to 900MHz radiofrequency fields" *Mutat Res.* (2017) PMID: 28340409.
- Terzi M et al.: "The role of electromagnetic fields in neurological disorders" *J Chem Neuroanat.* (2016) PMID: 27083321.
- Tök L: "Effects of melatonin on Wi-Fi-induced oxidative stress in lens of rats" *Indian J Ophthalmol.* (2014) PMID: 24492496.
- Tsybulin O et al.: "Oxidative effect of low-intensity microwave radiation in the model of developing quail embryos" *Oxid Antioxid Med Sci.* (2017) pdf.
- Türedi S et al.: "The effects of prenatal exposure to a 900-MHz electromagnetic field on the 21-day-old male rat heart" *Electromagn Biol Med.* (2014) PMID: 25166431.
- Xing F et al.: "1800MHz Microwave Induces p53 and p53-Mediated Caspase-3 Activation Leading to Cell Apoptosis In Vitro" *PLoS One.* (2016) PMID: 27689798. PMC5045209.

- Yakymenko I et al: "Oxidative mechanisms of biological activity of low-intensity radiofrequency radiation" *Electromagn Biol Med.* (2015) PMID: 26151230.
- Yüksel M et al.: "Long-term exposure to electromagnetic radiation from mobile phones and Wi-Fi devices decreases plasma prolactin, progesterone, and estrogen levels but increases uterine oxidative stress in pregnant rats and their offspring" *Endocrine.* (2016) PMID: 26578367.
- Zhang D et al.: "Resveratrol may reverse the effects of long-term occupational exposure to electromagnetic fields on workers of a power plant" *Oncotarget.* (2017) PMID: 28537898; pdf.

(138) p53, tumour suppressor protein
- Xing F et al.: "1800MHz Microwave Induces p53 and p53-Mediated Caspase-3 Activation Leading to Cell Apoptosis In Vitro" PLoS One. (2016) PMID: 27689798. PMC5045209.

(139) Pancreatic lesions
- Topsakal S et al.: "The ameliorative effect of gallic acid on pancreas lesions induced by 2.45 GHz electromagnetic radiation (Wi-Fi) in young rats" *J Rad Res Appl Sci.* (2017) doi.org/10.1016/j.jrras.2017.04.009; pdf.

(140) Parametric oscillation, resonance frequencies
- Hinrikus H et al.: "Mechanism of low-level microwave radiation effect on nervous system" *Electromagn Biol Med.* (2016) PMID: 27874295.

(141) Parkinson's Disease
- Benassi B et al.: "Extremely Low Frequency Magnetic Field (ELF-MF) Exposure Sensitizes SH-SY5Y Cells to the Pro-Parkinson's Disease Toxin MPP(.)" *Mol Neurobiol.* (2016) PMID: 26223801.
- Jadidi M et al.: "Mesenchymal stem cells that located in the electromagnetic fields improves rat model of Parkinson's disease" *Iran J Basic Med Sci.* (2016) PMID: 27635198. PMC5010846.
- Sandyk R: "Effect of weak electromagnetic fields on the amplitude of the pattern reversal VEP response in Parkinson's disease" *Int J Neurosci.* (1996) PMID: 8707479.

(142) Perception, sensed present, hypnotisability
- Booth JN et al.: "Increased feelings of the sensed presence and increased geomagnetic activity at the time of the experience during exposures to transcerebral weak complex magnetic fields" *Int J Neurosci.* (2005) PMID: 16051550.
- Healey F et al.: "Enhanced hypnotic suggestibility following application of burst-firing magnetic fields over the right temporoparietal lobes: a replication" *Int J Neurosci.* (1996) PMID: 9003980.
- Hill DR et al.: "Application of transcerebral, weak (1 microT) complex magnetic fields and mystical experiences: are they generated by field-induced dimethyltryptamine release from the pineal organ?" *Percept Mot Skills.* (2003) PMID: 15002845.
- Meli SC et al.: "Red light facilitates the sensed presence elicited by application of weak, burst-firing magnetic fields over the temporal lobes" *Int J Neurosci.* (2009) PMID: 19116832.
- Sculthorpe L et al.: "Does phase-modulation of applied 40-Hz transcerebral magnetic fields affect subjective experiences and hypnotic induction?" *Percept Mot Skills.* (2003) PMID: 15002842.
- Tiller SG et al.: "Enhanced hypnotizability by cerebrally applied magnetic fields depends upon the order of hemispheric presentation: an anistropic effect" *Int J Neurosci.* (1994) PMID: 7744557.
- Tiller SG et al.: "Geophysical variables and behavior: XCVII. Increased proportions of the left-sided sense of presence induced experimentally by right hemispheric application of specific (frequency-modulated) complex magnetic fields" *Percept Mot Skills.* (2002) PMID: 11883572.

(143) Phosphates, Posner molecules, quantum entanglement

- Weingarten CP et al.: "A New Spin on Neural Processing: Quantum Cognition" *Front Hum Neurosci.* (2016) PMID: 27833543.

(144) Phospholipid bilayers

- Kong Z et al.: "Investigation of the morphological transition of a phospholipid bilayer membrane in an external electric field via molecular dynamics simulation" *J Mol Model.* (2017) PMID: 28289956.
- Muratori C et al.: "Activation of the phospholipid scramblase TMEM16F by nanosecond pulsed electric field (nsPEF) facilitates its diverse cytophysiological effects" *J Biol Chem.* (2017) PMID: 28982976; pdf.
- Ziegler MJ et al.: "Interface water dynamics and porating electric fields for phospholipid bilayers" *J Phys Chem B.* (2008) PMID: 18837540.

(145) Phosphorylation, ATP, magnesium + calcium dependence; see also: Magnesium

- Buchachenko AL et al.: "Spin biochemistry: magnetic 24Mg-25Mg-26Mg isotope effect in mitochondrial ADP phosphorylation" *Cell Biochem Biophys.* (2005) PMID: 16049349.
- Buchachenko AL et al.: "Magnetic isotope effect of magnesium in phosphoglycerate kinase phosphorylation" *Proc Natl Acad Sci U S A.* (2005) PMID: 16043694; pdf.
- Buchachenko AL et al.: "[Magnesium magnetic isotope effect: a key towards mechanochemistry of phosphorylating enzymes as molecular machines]" *Mol Biol (Mosk).* (2006) PMID: 16523686.
- Buchachenko AL et al.: "Magnetic field affects enzymatic ATP synthesis" *J Am Chem Soc.* (2008) PMID: 18774801.
- Kapri-Pardes E et al.: "Activation of Signaling Cascades by Weak Extremely Low Frequency Electromagnetic Fields" *Cell Physiol Biochem.* (2017) PMID: 29035881; pdf.
- Kitaoka K et al.: "Exposure to an Extremely-Low-Frequency Magnetic Field Stimulates Adrenal Steroidogenesis via Inhibition of Phosphodiesterase Activity in a Mouse Adrenal Cell Line" *PLoS One.* (2016) PMID: 27100201. PMC4839720.
- Markov MS et al.: "Extremely weak AC and DC magnetic fields significantly affect myosin phosphorylation" in: Allen MJ, Cleary SF, Sowers AE, Shillady DD (eds) "Charge and Field Effects in Biosystems – 3" Birkhaeuser, Boston (1992) abstract.
- Markov MS et al.: "Effects of weak low frequency sinusoidal and DC magnetic fields on myosin phosphorylation in cell-free preparation" *Bioelectrochemistry & Bioenergetics.* (1993) abstract.
- Markov MS et al.: "Static magnetic field modulation of myosin phosphorylation: Calcium dependence in two enzyme preparations" *Bioelectrochemistry & Bioenergetics.* (1994) abstract.
- Markov MS et al.: "Weak static magnetic field modulation of myosin phosphorylation in a cell-free preparation: Calcium dependence" *Bioelectrochemistry & Bioenergetics.* (1997) abstract.
- Stull JT et al.: "Myosin light chain kinase and the role of myosin light chain phosphorylation in skeletal muscle" *Arch Biochem Biophys.* (2011) PMID: 21284933.; pdf.

(146) Photobiomodulation (PBM), Low Level Laser (Light) Therapy (LLLT)

- Borzabadi-Farahani A: "Effect of low-level laser irradiation on proliferation of human dental mesenchymal stem cells; a systemic review" *J Photochem Photobiol B.* (2016) PMID: 27475781.
- Chung H et al.: "The nuts and bolts of low-level laser (light) therapy" *Ann Biomed Eng.* (2012) PMID: 22045511. PMC3288797.
- de Freitas LF et al.: "Proposed Mechanisms of Photobiomodulation or Low-Level Light Therapy" *IEEE J Sel Top Quantum Electron.* (2016) PMID: 28070154. PMC5215870.
- Hamblin MR: "Mechanisms and applications of the anti-inflammatory effects of photobiomodulation" *AIMS Biophys.* (2017) PMID: 28748217. PMC5523874.
- Hennessy M et al.: "Photobiomodulation and the brain: a new paradigm" *J Opt.* (2017) PMID: 28580093. PMC5448311.
- Huang YY et al.: "Biphasic does response in low level therapy - an update" *Dose Response.* (2011) PMID: 22461763. PMC3315174.

(147) Photo-induced electron transfer, cryptochrome, DNA, magnetoreception, visual stimulation

- Byrdin M et al.: "Dissection of the triple tryptophan electron transfer chain in Escherichia coli DNA photolyase: Trp382 is the primary donor in photoactivation" Proc Natl Acad Sci U S A. 2003;100(15):8676-8681; PMID: 12835419. PMC166371.
- Henbest KB et al.: "Magnetic-field effect on the photoactivation reaction of Escherichia coli DNA photolyase" *Proc Natl Acad Sci U S A.* (2008) PMID: 18799743. PMC2567148.
- Romei V et al.: "Spontaneous fluctuations in posterior alpha-band EEG activity reflect variability in excitability of human visual areas" *Cereb Cortex.* (2008) PMID: 18093905. PMC2517102.
- Sheppard DM et al.: "Millitesla magnetic field effects on the photocycle of an animal cryptochrome" *Sci Rep.* (2017) PMID: 28176875. PMC5296725.

(148) Photons, Biophotons, Photosensitivity, phosphenes, ultra weak photon emission; *see also: Biophotons, and Photosensitivity section 2*

- Bókkon I et al.: "Endogenous spontaneous ultraweak photon emission in the formation of eye-specific retinogeniculate projections before birth" *Rev Neurosci.* (2016) PMID: 26656799. Article.
- Burgos RC et al.: "Crossing the Boundaries of Our Current Healthcare System by Integrating Ultra-Weak Photon Emissions with Metabolomics" *Front Physiol.* (2016) PMID: 28018239. PMC5156693.
- Burgos RCR et al.: "Ultra-weak photon emission as a dynamic tool for monitoring oxidative stress metabolism" *Sci Rep.* (2017) PMID: 28450732. PMC5430737.
- Császár N et al.: "Phosphene perception is due to the ultra-weak photon emission produced in various parts of the visual system: glutamate in the focus" *Rev Neurosci.* (2016) PMID: 26544101. Article.
- He M et al.: "Spontaneous ultra-weak photon emission in correlation to inflammatory metabolism and oxidative stress in a mouse model of collagen-induced arthritis" *J Photochem Photobiol B.* (2017) PMID: 28199905.
- Hellingwerf KJ et al.: "Photobiology of microorganisms: how photosensors catch a photon to initialize signalling" *Mol Microbiol.* (1996) PMID: 8878032.
- Kumar S et al.: "Possible existence of optical communication channels in the brain" *Sci Rep.* (2016) PMID: 27819310. PMC5098150.
- Meissl H et al.: "Pineal photosensitivity. A comparison with retinal photoreception" *Acta Neurobiol Exp (Wars).* (1994) PMID: 7801789.
- Morgan IG et al.: "Parallel suppression of retinal and pineal melatonin synthesis by retinally mediated light" *Neuroreport.* (1995) PMID: 7579141.
- Northrup TE et al.: "Quantum information transfer using photons" *Nature Photonics.* (2014) Abstract. Article.
- Packer AM et al.: "Simultaneous all-optical manipulation and recording of neural circuit activity with cellular resolution in vivo" *Nat Methods.* (2015) PMID: 25532138. PMC4933203.
- Phan TX et al.: "Intrinsic Photosensitivity Enhances Motility of T Lymphocytes" *Sci Rep.* (2016) PMID: 27995987.
- Phillips JB et al: "The role of extraocular photoreceptors in newt magnetic compass orientation: parallels between light-dependent magnetoreception and polarized light detection in vertebrates" *J Exp Biol.* (2001) PMID: 11511670. Article.
- Popp FA: "Properties of biophotons and their theoretical implications" *Indian J Exp Biol.* (2003) PMID: 15244259.
- Rahnama M et al.: "Emission of mitochondrial biophotons and their effect on electrical activity of membrane via microtubules" *J Integr Neurosci.* (2011) PMID: 21425483.
- Rector DM et al.: "In Vivo Observations of Rapid Scattered Light Changes Associated with Neurophysiological Activity" In: Frostig RD (ed.) *In Vivo Optical Imaging of Brain Function.* 2nd ed. (2009). PMID: 26844322.

- Salari V et al.: "The Physical Mechanism for Retinal Discrete Dark Noise: Thermal Activation or Cellular Ultraweak Photon Emission?" *PLoS One.* (2016) PMID: 26950936. PMC4780715.
- Salari V et al.: "Ultraweak photon emission in the brain" *J Integr Neurosci.* (2015) PMID: 26336891.
- Samaha J et al.: "Distinct Oscillatory Frequencies Underlie Excitability of Human Occipital and Parietal Cortex" *J Neurosci.* (2017) PMID: 28179556. PMC5354329.
- Schwabl H et al.: "Spontaneous ultraweak photon emission from biological systems and the endogenous light field" *Forsch Komplementarmed Klass Naturheilkd.* (2005) PMID: 15947466.
- Shanei A et al.: "Detection of Ultraweak Photon Emission (UPE) from Cells as a Tool for Pathological Studies" *J Biomed Phys Eng.* (2017) PMID: 29445715. PMC5809932.
- Sun M et al.: "Measuring ultra-weak photon emission as a non-invasive diagnostic tool for detecting early-stage type 2 diabetes: A step toward personalized medicine" *J Photochem Photobiol B.* (2017) PMID: 27888740.
- van Wijk R et al.: "Light-induced photon emission by mammalian cells" *J Photochem Photobiol B.* (1993) PMID: 8487126.
- Volkov V: "Discovering electrophysiology in photobiology: A brief overview of several photobiological processes with an emphasis on electrophysiology" *Commun Integr Biol.* (2014) PMID: 25328636. PMC4183612.
- Wijk EP et al.: "Multi-site recording and spectral analysis of spontaneous photon emission from human body" *Forsch Komplementarmed Klass Naturheilkd.* (2005) PMID: 15947468.
- Yang M et al.: "Ultra-weak photon emission in healthy subjects and patients with type 2 diabetes: evidence for a non-invasive diagnostic tool" *Photochem Photobiol Sci.* (2017) PMID: 28294270.
- Zangari A et al.: "Node of Ranvier as an Array of Bio-Nanoantennas for Infrared Communication in Nerve Tissue" *Sci Rep.* (2018) PMID: 29323217. PMC5764955.

(149) Photosynthesis

- Herdean A et al.: "A voltage-dependent chloride channel fine-tunes photosynthesis in plants" *Nat Commun.* (2016) PMID: 27216227; pdf.
- Holick MF: "Photosynthesis of vitamin D in the skin: effect of environmental and life-style variables" *Fed Proc.* (1987) PMID: 3030826.
- Suchkov S et al.: "The role of human photosynthesis in predictive, preventive and personalized medicine" *EPMA J.* (2014) PMC4125832; pdf.
- Tang C et al.: "Electromagnetic Radiation Disturbed the Photosynthesis of Microcystis aeruginosa at the Proteomics Level" *Sci Rep.* (2018) PMID: 29323219. PMC5764990.

(150) Polarisation

- Muheim R et al.: "Polarized light modulates light-dependent magnetic compass orientation in birds" *Proc Natl Acad Sci U S A.* (2016) PMID: 26811473; pdf.
- Panagopoulos DJ et al.: "Polarization: A Key Difference between Man-made and Natural Electromagnetic Fields, in regard to Biological Activity" *Sci Rep.* (2015) PMID: 26456585.
- Panagopoulos DJ et al.: "On the biophysical mechanism of sensing atmospheric discharges by living organisms" *Sci Total Environ.* (2017) PMID: 28558424.

(151) Polyamines

- Paik MJ et al.: "Metabolomic study of urinary polyamines in rat exposed to 915 MHz radiofrequency identification signal" *Amino Acids.* (2016) PMID: 26319644.

(152) Potassium, voltage-gated potassium channels

- Cameron MA et al.: "Differential effect of brief electrical stimulation on voltage-gated potassium channels" *J Neurophysiol.* (2017) PMID: 28202576. PMC5411463.

- Jensen CS et al.: "Neuronal trafficking of voltage-gated potassium channels" *Mol Cell Neurosci.* (2011) PMID: 21627990.
- Nishizawa M et al.: "Molecular dynamics simulation of Kv channel voltage sensor helix in a lipid membrane with applied electric field" *Biophys J.* (2008) PMID: 18487312. PMC2483744.
- Zheng Y et al.: "Effects of 15 Hz square wave magnetic fields on the voltage-gated sodium and potassium channels in prefrontal cortex pyramidal neurons" *Int J Radiat Biol.* (2017) PMID: 27924669.

(153) Prions, protein misfolding

- Lian HY et al.: "Generation and propagation of yeast prion [URE3] are elevated under electromagnetic field" *Cell Stress Chaperones.* (2017) PMID: 29214607.

(154) Protein expression, proteome, miRNA

- Dasdag S et al.: "Effects of 2.4 GHz radiofrequency radiation emitted from Wi-Fi equipment on microRNA expression in brain tissue" *Int J Radiat Biol.* (2015) PMID: 25775055.
- Erdal ME et al.: "miRNA expression profile is altered differentially in the rat brain compared to blood after experimental exposure to 50 Hz and 1 mT electromagnetic field" *Prog Biophys Mol Biol.* (2017) PMID: 28782562.
- Fragopoulou AF et al.: "Brain proteome response following whole body exposure of mice to mobile phone or wireless DECT base radiation" *Electromagn Biol Med.* (2012) PMID: 22263702.
- Huang CY et al.: "Extremely low-frequency electromagnetic fields cause G1 phase arrest through the activation of the ATM-Chk2-p21 pathway" *PLoS One.* (2014) PMID: 25111195; pdf.
- Liu Y et al.: "Extremely Low-Frequency Electromagnetic Fields Affect the miRNA-Mediated Regulation of Signaling Pathways in the GC-2 Cell Line" *PLoS One.* (2015) PMID: 26439850; pdf.
- Luo Q et al.: "Proteomic analysis on the alteration of protein expression in the early-stage placental villous tissue of electromagnetic fields associated with cell phone exposure" *Reprod Sci.* (2013) PMID: 23420827.
- Nylund R et al.: "Mobile phone radiation causes changes in gene and protein expression in human endothelial cell lines and the response seems to be genome- and proteome-dependent" *Proteomics.* (2006) PMID: 16878295.
- Nylund R et al.: "Proteomics analysis of human endothelial cell line EA.hy926 after exposure to GSM 900 radiation" *Proteomics.* (2004) PMID: 15188403.
- Patruno A et al.: "mTOR Activation by PI3K/Akt and ERK Signaling in Short ELF-EMF Exposed Human Keratinocytes" *PLoS One.* (2015) PMID: 26431550; pdf.
- Tang C et al.: "Electromagnetic Radiation Disturbed the Photosynthesis of Microcystis aeruginosa at the Proteomics Level" *Sci Rep.* (2018) PMID: 29323219. PMC5764990.

(155) Pulses, electrical, laser

- Colombelli J et al.: [Laser nanosurgery in cell biology] *Med Sci (Paris).* (2006) PMID: 16828043. Article.
- Iwanaga S et al.: "Slow Ca(2+) wave stimulation using low repetition rate femtosecond pulsed irradiation" *Opt Express.* (2006) PMID: 19503390.
- Nishinura N et al.: "In vivo manipulation of biological systems with femtosecond laser pulses" *Proc. SPIE 6261.* (2006) Abstract. Article.
- Schoenbach KH: "From the basic science of biological effects of ultrashort electrical pulses to medical therapies" *Bioelectromagnetics.* (2018) PMID: 29528124.
- Tirlapur UK et al.: "Femtosecond near-infrared laser pulses elicit generation of reactive oxygen species in mammalian cells leading to apoptosis-like death" *Exp Cell Res.* (2001) PMID: 11161708.
- Zhu Y et al.: "Molecular response of mitochondria to a short-duration femtosecond-laser stimulation" *Biomed Opt Express.* (2017) PMID: 29188094. PMC5695944.

(156) Purkinje cells, brain effects

- Naro A et al.: "Effects of cerebellar transcranial alternating current stimulation on motor cortex excitability and motor function" *Brain Struct Funct.* (2017) PMID: 28064346.
- Odacı E et al.: "Maternal exposure to a continuous 900-MHz electromagnetic field provokes neuronal loss and pathological changes in cerebellum of 32-day-old female rat offspring" *J Chem Neuroanat.* (2016) PMID: 26391347.
- Sonmez OF et al.: "Purkinje cell number decreases in the adult female rat cerebellum following exposure to 900 MHz electromagnetic field" *Brain Res.* (2010) PMID: 20691167.

(157) Radical pairs, free radicals, resonance

- Adair RK: "Effects of very weak magnetic fields on radical pair reformation" *Bioelectromagnetics.* (1999) PMID: 10230939.
- Barnes F et al.: "Role of radical pairs and feedback in weak radio frequency field effects on biological systems" *Environ Res.* (2018) PMID: 29438901.
- Barnes FS et al.: "The effects of weak magnetic fields on radical pairs" *Bioelectromagnetics.* (2015) PMID: 25399679.
- Usselman RJ et al.: "Spin biochemistry modulates reactive oxygen species (ROS) production by radio frequency magnetic fields" *PLoS One.* (2014) PMID: 24681944.

(158) Reactive oxygen species (ROS), Heat shock proteins (HSP); *see also: Oxidative Stress*

- Falone S et al.: "Power frequency magnetic field promotes a more malignant phenotype in neuroblastoma cells via redox-related mechanisms" *Sci Rep.* (2017) PMID: 28904402. PMC5597619.
- Friedman J at al.: (2007) "Mechanism of short-term ERK activation by electromagnetic fields at mobile phone frequencies" *Biochem J.* (2007) PMID: 17456048; pdf.
- Kesari KK et al.: "Cell phone radiation exposure on brain and associated biological systems" *Indian J Exp Biol.*(2013) PMID: 23678539.
- Lewicka M et al.: "The effect of electromagnetic radiation emitted by display screens on cell oxygen metabolism - in vitro studies" *Arch Med Sci.* (2015) PMID: 26788099. PMC4697066.
- Manta AK et al.: "Mobile-phone radiation-induced perturbation of gene-expression profiling, redox equilibrium and sporadic-apoptosis control in the ovary of Drosophila melanogaster" *Fly (Austin).* (2017) PMID: 27960592. PMC5406167.
- Martínez MA et al.: "Power Frequency Magnetic Fields Affect the p38 MAPK-Mediated Regulation of NB69 Cell Proliferation Implication of Free Radicals" *Int J Mol Sci.* (2016) PMID: 27058530.
- Ni S et al.: "Study of oxidative stress in human lens epithelial cells exposed to 1.8 GHz radiofrequency fields" *PLoS One.* (2013) PMID: 23991100.
- Tang R et al.: "Extremely low frequency magnetic fields regulate differentiation of regulatory T cells: Potential role for ROS-mediated inhibition on AKT" *Bioelectromagnetics.* (2016) PMID: 26807660.
- Usselman RJ et al.: "Spin Biochemistry Modulates Reactive Oxygen Species (ROS) Production by Radio Frequency Magnetic Fields" *PLoS One.* (2014) PMID: 24681944.
- Wang H et al.: "Magnetic Fields and Reactive Oxygen Species" *Int J Mol Sci.* (2017) PMID: 29057846. PMC5666856.

(159) Resonance signalling, ion cyclotron resonance

- Foletti A et al.: "Bioelectromagnetic medicine: The role of resonance signaling" *Electromagn Biol Med.* (2013) PMID: 23323834.
- Liboff AR: "Electric polarization and the viability of living systems: ion cyclotron resonance-like interactions" *Electromagn Biol Med.* (2009) PMID: 19811395.
- Liboff AR et al.: "Helical water wires" *Electromagn Biol Med.* (2017) PMID: 28524701.

(160) Rouleaux formation, pearl chain, in blood

- Teige K et al.: "Aggregation of Red Blood Cells in a Strong Electric Field" *Nature.* (1946) PMID: 20276880.

(161) Schwannoma, Schwann cells

- Colciago A et al.: "Tumor suppressor Nf2/merlin drives Schwann cell changes following electromagnetic field exposure through Hippo-dependent mechanisms" *Cell Death Discov.* (2015) PMID: 27551454. PMC4979489.

(162) Sciatic nerve

- Kerimoğlu G et al.: "A histopathological and biochemical evaluation of oxidative injury in the sciatic nerves of malerats exposed to a continuous 900-megahertz electromagnetic field throughout all periods of adolescence" *J Chem Neuroanat.* (2018) PMID: 29331319.

(163) Sensitisation, electrosensitisation, cellular

- Gianulis EC et al : "Selective susceptibility to nanosecond pulsed electric field (nsPEF) across different human cell types" *Cell Mol Life Sci.* (2017) PMID: 27986976.
- Jensen SD et al.: "Delayed hypersensitivity to nanosecond pulsed electric field in electroporated cells" *Sci Rep.* (2017) PMID: 28887559; pdf.
- Muratori C et al.: "Electrosensitization Increases Antitumor Effectiveness of Nanosecond Pulsed Electric Fields In Vivo" *Technol Cancer Res Treat.* 2017) PMID: 28585492.

(164) Serotonin

- Aboul Ezz HS et al.: "The effect of pulsed electromagnetic radiation from mobile phone on the levels of monoamine neurotransmitters in four different areas of rat brain" *Eur Rev Med Pharmacol Sci.* (2013) PMID: 23852905. Article.
- Megha K et al.: "Effect of Low-Intensity Microwave Radiation on Monoamine Neurotransmitters and Their Key Regulating Enzymes in Rat Brain" *Cell Biochem Biophys.* (2015) PMID: 25672490.
- Singh S et al.: "Effect of occupational EMF exposure from radar at two different frequency bands on plasma melatonin and serotonin levels" *Int J Radiat Biol.* (2015) PMID: 25565559.

(165) Sialic acid, neurotransmission

- Zheng Y et al.: "Effects of 15 Hz square wave magnetic fields on the voltage-gated sodium and potassium channels in prefrontal cortex pyramidal neurons" *Int J Radiat Biol.* (2016) PMID: 27924669.

(166) Skin cancer, skin effects, mast cells, hydroxyproline, collagen

- Aschermann C: "Electrosensitivity: A patient with Burn-like Skin Manifestations"*Umwelt-Medizin-Gesellschaft.* (2011) pdf (trans).
- Bayat M et al.: "Effect of long-term exposure of mice to 900 MHz GSM radiation on experimental cutaneous candidiasis" *Saudi J Biol Sci.* (2017) PMID: 28490964. PMC5415128.
- Çam ST et al.: "Effects of 900 MHz radiofrequency radiation on skin hydroxyproline contents" *Cell Biochem Biophys.* (2014) PMID: 24760629.
- Ceyhan AM et al.: "Protective effects of β-glucan against oxidative injury induced by 2.45-GHz electromagnetic radiation in the skin tissue of rats" *Arch Dermatol Res.* (2012) PMID: 22237725.
- Gangi S et al.: "Skin changes in "screen dermatitis" versus classical UV - and ionizing irradiation-related damage - similarities and differences" *Exp Dermatol.* (1997) PMID: 9412815.
- Johansson O et al.: "Cutaneous mast cells are altered in normal health volunteers sitting in front of ordinary TVs/PCs - results from open-field provocation experiments" *J Cutan Pathol.* (2001) PMID: 11737520.

- Johansson O et al.: "Skin changes in patients claiming to suffer from "screen dermatitis": a two-case open-field provocation study" *Exp Dermatol.* (1994) PMID: 7881769.
- Snow PJ et al.: "Effects of locus coeruleus stimulation on the responses of SI neurons of the rat to controlled natural and electrical stimulation of the skin" *Arch Ital Biol.* (1999) PMID: 9934431.
- Szmigielski S et al.: "Accelerated development of spontaneous and benzopyrene-induced skin cancer in mice exposedto 2450-MHz microwave radiation" *Bioelectromagnetics.* (1982) PMID: 7126270. Abstract.
- Szudziński A et al.: "Acceleration of the development of benzopyrene-induced skin cancer in mice by microwave radiation" *Arch Dermatol Res.* (1982) PMID: 6299207.

(167) Sleep effects

- Akerstedt T et al.: "A 50-Hz electromagnetic field impairs sleep" *J Sleep Res.* (1999) PMID: 10188140. Article.
- Carter B et al.: "Association Between Portable Screen-Based Media Device Access or Use and Sleep Outcomes: A Systematic Review and Meta-analysis" *JAMA Pediatr.* (2016) PMID: 27802500. PMC5380441.
- Chahal H et al.: "Availability and night-time use of electronic entertainment and communication devices are associated with short sleep duration and obesity among Canadian children" *Pediatr Obes.* (2013) PMID: 22962067.
- Chaput JP et al.: "Electronic screens in children's bedrooms and adiposity, physical activity and sleep: do the number and type of electronic devices matter?" *Can J Public Health.* (2014) PMID: 25166130.
- Cheung CH et al.: "Daily touchscreen use in infants and toddlers is associated with reduced sleep and delayed sleep onset" *Sci Rep.* (2017) PMID: 28406474. PMC5390665.
- Danker-Hopfe H et al.: "Effects of mobile phone exposure (GSM 900 and WCDMA/UMTS) on polysomnography based sleep quality: An intra- and inter-individual perspective" *Environ Res.* (2016) PMID: 26618505.
- D'Atri A et al.: "Bilateral 5 Hz transcranial alternating current stimulation on fronto-temporal areas modulates resting-state EEG" *Sci Rep.* (2017) PMID: 29142322. PMC5688177.
- Dube N et al.: "The use of entertainment and communication technologies before sleep could affect sleep and weight status: a population-based study among children" *Int J Behav Nutr Phys Act.* (2017) PMID: 28724380. PMC5517950.
- Exelmans L et al.: "Bedtime mobile phone use and sleep in adults" *Soc Sci Med.* (2016) PMID: 26688552.
- Huber R et al.: "Electromagnetic fields, such as those from mobile phones, alter regional cerebral blood flow and sleep and waking EEG" *J Sleep Res.* (2002) PMID: 12464096. Article.
- Hung CS et al.: "Mobile phone 'talk-mode' signal delays EEG-determined sleep onset" *Neurosci Lett.* (2007) PMID: 17548154.
- Huss A et al.: "Environmental Radiofrequency Electromagnetic Fields Exposure at Home, Mobile and Cordless Phone Use, and Sleep Problems in 7-Year-Old Children" *PLoS One.* (2015) PMID: 26509676.
- LeBourgeois MK et al.: "Digital Media and Sleep in Childhood and Adolescence" *Pediatrics.* (2017) PMID: 29093040. PMC5658795.
- Lee JE et al.: "Relationship between Mobile Phone Addiction and the Incidence of Poor and Short Sleep among Korean Adolescents: a Longitudinal Study of the Korean Children & Youth Panel Survey" *J Korean Med Sci.* (2017) PMID: 28581275. PMC5461322.
- Liu H et al.: "Occupational electromagnetic field exposures associated with sleep quality: a cross-sectional study" *PLoS One.* (2014) PMID: 25340654.
- Lowden A et al.: "Sleep after mobile phone exposure in subjects with mobile phone-related symptoms" *Bioelectromagnetics.* (2011) PMID: 20857453.
- Lustenberger C et al.: "Stimulation of the brain with radiofrequency electromagnetic field pulses affects sleep-dependent performance improvement" *Brain Stimul.* (2013) PMID: 23482083.

- Mohammadbeigi A et al.: "Sleep Quality in Medical Students; the Impact of Over-Use of Mobile Cell-Phone and Social Networks" *J Res Health Sci.* (2016) PMID: 27061997. Article.
- Munezawa T et al.: "The association between use of mobile phones after lights out and sleep disturbances among Japanese adolescents: a nationwide cross-sectional survey" *Sleep.* (2011) PMID: 21804663. PMC3138156.
- Regel SJ et al.: "Pulsed radio-frequency electromagnetic fields: dose-dependent effects on sleep, the sleep EEG and cognitive performance" *J Sleep Res.* (2007) PMID: 17716273. Article.
- Royant-Parola S et al.: [The use of social media modifies teenagers' sleep-related behavior] *Encephale.* (2017) PMID: 28602529.
- Sahin S et al.: "Evaluation of mobile phone addiction level and sleep quality in university students" *Pak J Med Sci.* (2013) PMID: 24353658. PMC3817775.
- Schmid MR et al.: "Sleep EEG alterations: effects of pulsed magnetic fields versus pulse-modulated radio frequencyelectromagnetic fields" *J Sleep Res.* (2012) PMID: 22724534. Article.
- Yogesh S et al.: "Mobile usage and sleep patterns among medical students" *Indian J Physiol Pharmacol.* (2014) PMID: 25508317.

(168) Sodium, voltage-gated sodium channels

- Banerjee J et al.: "Immediate Effects of Repetitive Magnetic Stimulation on Single Cortical Pyramidal Neurons" *PLoS One.* (2017) PMID: 28114421. PMC5256952.
- Zheng Y et al.: "Effects of 15 Hz square wave magnetic fields on the voltage-gated sodium and potassium channels in prefrontal cortex pyramidal neurons" *Int J Radiat Biol.* (2017) PMID: 27924669.

(169) Stem cells, osteoblasts; see also Neurogenesis

- Bhargav H et al.: "Effect of Mobile Phone-Induced Electromagnetic Field on Brain Hemodynamics and Human Stem Cell Functioning: Possible Mechanistic Link to Cancer Risk and Early Diagnostic Value of Electronphotonic Imaging" *J Stem Cells.* (2015) PMID: 27144830.
- Chen C et al.: "Exposure to 1800 MHz radiofrequency radiation impairs neurite outgrowth of embryonic neural stem cells" *Sci Rep.*(2014) PMID: 24869783.
- Markovà E et al.: "Microwaves from Mobile Phones Inhibit 53BP1 Focus Formation in Human Stem Cells More Strongly Than in Differentiated Cells: Possible Mechanistic Link to Cancer Risk" *Environ Health Perspect.* (2010) PMID: 20064781. PMC2854769.
- Shahbazi-Gahrouei D et al.: "Effects of RF-EMF Exposure from GSM Mobile Phones on Proliferation Rate of Human Adipose-derived Stem Cells: An In-vitro Study" *J Biomed Phys Eng.* (2016) PMID: 28144594. PMC5219575.
- Zhou J et al.: "Different electromagnetic field waveforms have different effects on proliferation, differentiation and mineralization of osteoblasts in vitro" *Bioelectromagnetics.* (2014) PMID: 23775573.

(170) Stochastic resonance, non-linear white noise effects, signal to noise ratio

- Benzi R et al.: "The mechanism of stochastic resonance" *J Phys A: Math Gen.* (1981) Crossref
- Bezrukov SM et al.: "Noise-induced enhancement of signal transduction across voltage-dependent ion channels" *Nature.* (1995) PMID: 7477370.
- Douglass JK et al.: "Noise enhancement of information transfer in crayfish mechanoreceptors by stochastic resonance" *Nature.* (1993) PMID: 8377824.
- Galvanovskis J et al.: "Amplification of electromagnetic signals by ion channels" *Biophys J.* (1997) PMID: 9414219. PMC1181210.
- Goychuk I et al.: "Stochastic resonance in ion channels characterized by information theory" *Phys Rev E Stat Phys Plasmas Fluids Relat Interdiscip Topics.* (2000) PMID: 11088223.
- Hänggi P: "Stochastic resonance in biology. How noise can enhance detection of weak signals and help improve biological information processing" *Chemphyschem.* (2002) PMID: 12503175.

- Krauss P et al.: "Adaptive stochastic resonance for unknown and variable input signals" *Sci Rep.* (2017) PMID: 28550314. PMC5446399.
- Tanaka K et al.: "Stochastic resonance in auditory steady-state responses in a magnetoencephalogram" *Clin Neurophysiol.* (2008) PMID: 18621581.
- Teng H-C: "The Molecular Biological Application of the Theory of Stochastic Resonance: The Cellular Response to the ELF AC Magnetic Field" *Nat Sci.* (2005) Article.
- Vázquez-Rodríguez B et al.: "Stochastic resonance at criticality in a network model of the human cortex" *Sci Rep.* (2017) PMID: 29026142. PMC5638949.
- Wei X et al.: "Endogenous field feedback promotes the detectability for exogenous electric signal in the hybrid coupled population" *Chaos.* (2015) PMID: 25637924.
- Wiesenfeld K et al.: "Stochastic resonance and the benefits of noise: from ice ages to crayfish and SQUIDs" *Nature.* (1995) PMID: 7800036.
- Xu W et al.: "Low-intensity electric fields induce two distinct response components in neocortical neuronal populations" *J Neurophysiol.* (2014) PMID: 25122710. PMC4315449.
- Zhao J et al.: "Weak electric fields detectability in a noisy neural network" *Cogn Neurodyn.* (2017) PMID: 28174614.

***(171)* Subtle Energy effects;** *see also: Biofield*

- Bhargav H et al.: "Acute effects of mobile phone radiations on subtle energy levels of teenagers using electrophotonic imaging technique: A randomized controlled study" *Int J Yoga.* (2017) PMID: 28149063.
- Rosch PJ: "Bioelectromagnetic and Subtle Energy Medicine: The Interface between Mind and Matter" *Ann. N.Y. Acad. Sci.* (2009) abstract; pdf.
- Rubik B: "Effects of a Passive Online Software Application on Heart Rate Variability and Autonomic Nervous System Balance" *J Altern Complement Med.* (2017) PMID: 28051874. PMC5248536.
- Srinivasan TM: "Biophotons as Subtle Energy Carriers" *Int J Yoga.* (2017) PMID: 28546674; article.

(172) Sudden Infant Death syndrome

- Bellieni CV et al.: "Electromagnetic fields produced by incubators influence heart rate variability in newborns" *Arch Dis Child Fetal Neonatal Ed.* (2008) PMID: 18450804.
- Dupont MJ et al.: "Geophysical variables and behavior: XCIX. Reductions in numbers of neurons within the parasolitary nucleus in rats exposed perinatally to a magnetic pattern designed to imitate geomagnetic continuous pulsations: implications for sudden infant death" *Percept Mot Skills.* (2004) PMID: 15209312.
- Dupont MJ et al.: "Reduced litter sizes following 48-h of prenatal exposure to 5 nT to 10 nT,0.5 Hz magnetic fields: implications for sudden infant deaths" *Int J Neurosci.* (2005) PMID: 15823935.
- Eckert EE: "Magnetic influences on fetus and infant as reason for sudden infant death syndrome: a new testable hypothesis" *Med Hypotheses.* (1992) PMID: 1614359.
- O'Connor RP et al.: "Geophysical variables and behavior: LXXXII. A strong association between sudden infant death syndrome and increments of global geomagnetic activity--possible support for the melatonin hypothesis" *Percept Mot Skills.* (1997) PMID: 9106826.
- O'Connor RP et al.: "Geophysical variables and behavior: LXXXV. Sudden infant death, bands of geomagnetic activity, and pc1 (0.2 to 5 HZ) geomagnetic micropulsations" *Percept Mot Skills.* (1999) PMID: 10483626.
- Persinger MA et al.: "Geophysical variables and behavior: CIII. Days with sudden infant deaths and cardiac arrhythmias in adults share a factor with PC1 geomagnetic pulsations: implications for pursuing mechanism" *Percept Mot Skills.* (2001) PMID: 11453188.

(173) Sympathetic nervous system effects

- Hänninen O et al.: "Cardiovascular Responses to Electromagnetic Radiation" *J. Afr. Ass. Physiol. Sci.* (2013) pdf.

(174) Synergistic effects

- Jankowska M et al.: "Exposure to 50 Hz electromagnetic field changes the efficiency of the scorpion alpha toxin" *J Venom Anim Toxins Incl Trop Dis.* (2015) PMID: 26430395. PMC4589959.
- Murugan NJ et al.: "Synergistic interactions between temporal coupling of complex light and magnetic pulses upon melanoma cell proliferation and planarian regeneration" *Electromagn Biol Med.* (2017) PMID: 27463225.
- Whissell PD et al.: "Emerging synergisms between drugs and physiologically-patterned weak magnetic fields: implications for neuropharmacology and the human population in the twenty-first century" *Curr Neuropharmacol.* (2007) PMID: 19305744. PMC2644491.

(175) Teeth

- Bondemark L: "Orthodontic magnets. A study of force and field pattern, biocompatibility and clinical effects" *Swed Dent J Suppl.* (1994) PMID: 7801229.
- Darendeliler MA et al.: "The effects of samarium-cobalt magnets and pulsed electromagnetic fields on tooth movement" *Am J Orthod Dentofacial Orthop.* (1995) PMID: 7771362.
- Dogan MS et al.: "Effect of electromagnetic fields and antioxidants on the trace element content of rat teeth" *Drug Des Devel Ther.* (2017) PMID: 28496309. PMC5422323.
- Dogru M et al.: "Examination of extremely low frequency electromagnetic fields on orthodontic tooth movement in rats" *Biotechnol Biotechnol Equip.* (2014) PMID: 26019497. PMC4433910.
- Stark TM et al.: "Effect of pulsed electromagnetic fields on orthodontic tooth movement" *Am J Orthod Dentofacial Orthop.* (1987) PMID: 3468800.

(176) Tensegrity

- Mognaschi ME et al.: "Field models and numerical dosimetry inside an extremely-low-frequency electromagnetic bioreactor: the theoretical link between the electromagnetically induced mechanical forces and the biological mechanisms of the cell tensegrity" *Springerplus.* (2014) PMID: 25202652. PMC4156577.

(177) Testicular cancer, seminoma cancer

- Houshyari M et al.: "Incidence of Seminoma Cancer in Staffs that Worked in Electromagnetic Waves Station; Three Cases Report" *Iran J Cancer Prev.* (2015) PMID: 25821575. PMC4360355.
- Stenlund C et al.: "Occupational exposure to magnetic fields in relation to male breast cancer and testicular cancer: a Swedish case-control study" *Cancer Causes Control.* (1997) PMID: 9134242.

(178) Testosterone reduced

- Wang Z et al.: "Effects of electromagnetic fields exposure on plasma hormonal and inflammatory pathway biomarkers in male workers of a power plant" *Int Arch Occup Environ Health.* (2016) PMID: 25808749.

(179) Therapeutic uses

- Hannemann PF et al: "The effects of low-intensity pulsed ultrasound and pulsed electromagnetic fields bone growth stimulation in acute fractures: a systematic review and meta-analysis of randomized controlled trials" *Arch Orthop Trauma Surg.* (2014) PMID: 24895156.
- Hyland GJ: "Physical basis of adverse and therapeutic effects of low intensity microwave radiation" *Indian J Exp Biol.* (2008) PMID: 18697627.
- Muratori C et al.: "Electrosensitization Increases Antitumor Effectiveness of Nanosecond Pulsed Electric Fields In Vivo" *Technol Cancer Res Treat.* (2017) PMID: 28585492.

- Ross CL et al.: "The effect of low-frequency electromagnetic field on human bone marrow stem/progenitor cell differentiation" *Stem Cell Res.* (2015) PMID: 26042793.
- Tang A et al: "Repetitive Transcranial Magnetic Stimulation of the Brain: Mechanisms from Animal and Experimental Models" *Neuroscientist* (2015) PMID: 26643579.

(180) Thermal stress; *see also Heat Shock Proteins*
- Zeni O et al.: "Cellular Response to ELF-MF and Heat: Evidence for a Common Involvement of Heat Shock Proteins?" *Front Public Health.* (2017) PMID: 29094036. PMC5651525.
- Zhang ZY et al.: "Coupling Mechanism of Electromagnetic Field and Thermal Stress on Drosophila melanogaster" *PLoS One.* (2016) PMID: 27611438. PMC5017647.

(181) Thymus gland, heat-shock proteins
- Misa-Agustiño MJ et al.: "EMF radiation at 2450 MHz triggers changes in the morphology and expression of heat shock proteins and glucocorticoid receptors in rat thymus" *Life Sci.* (2015) PMID: 25731700.

(182) Thyroid hormones and cancer
- Baby NM et al.: "The Effect of Electromagnetic Radiation due to Mobile Phone Use on Thyroid Function in Medical Students Studying in a Medical College in South India" *Indian J Endocrinol Metab.* (2017) PMID: 29285437. PMC5729662.
- Carlberg M et al: "Increasing incidence of thyroid cancer in the Nordic countries with main focus on Swedish data" *BMC Cancer* (2016) PMID: 27388603.
- Kunt H et al.: "Effects of electromagnetic radiation exposure on bone mineral density, thyroid, and oxidative stress index in electrical workers" *Onco Targets Ther.* (2016) PMID: 26929645. PMC4758783.
- Mortavazi S et al: "Alterations in TSH and Thyroid Hormones following Mobile Phone Use" *Oman Med J.* (2009) PMID: 22216380.

(183) Tinnitus; see also Auditory effects, Microwave Hearing
- Medeiros LN et al.: "Tinnitus and cell phones: the role of electromagnetic radiofrequency radiation" *Braz J Otorhinolaryngol.* (2016) PMID: 26602000; pdf.

(184) Transthyretin
- Söderqvist F et al.: "Mobile and cordless telephones, serum transthyretin and the blood-cerebrospinal fluid barrier: a cross-sectional study" *Environ Health.* (2009) PMID: 19383125. PMC2679014.
- Söderqvist F et al.: "Radiofrequency fields, transthyretin, and Alzheimer's disease" *J Alzheimers Dis.* (2010) PMID: 20164553.

(185) Tricarbolic Acid (TCA)
- Lin KW et al.: "Exposure of ELF-EMF and RF-EMF Increase the Rate of Glucose Transport and TCA Cycle in Budding Yeast" *Front Microbiol.* (2016) PMID: 27630630. PMC5005349.

(186) Trigeminal nerve
- Hocking B et al.: "Neurological changes induced by a mobile phone" *Occup Med (Lond).* (2002) PMID: 12422029.
- Marino AA et al.: "Trigeminal neurons detect cellphone radiation: Thermal or nonthermal is not the question" *Electromagn Biol Med.* (2016)PMID: 27419655.

(187) Tryptophan, flavin, tyrosine, cysteine; *see also: Cryptochrome*
- Aubert C et al.: "Intraprotein electron transfer between tyrosine and tryptophan in DNA photolyase from Anacystis nidulans" *Proc Natl Acad Sci U S A.* (1999) PMID: 10318899. PMC21875.

- Gillard JM et al.: "Effect of complexation of flavin radical with tryptophan on electron transfer rates: A model for flavin-protein interactions" *Biochem Biophys Res Commun.* (1974) PMID: 4831077. Abstract.
- Gindt YM et al.: "Origin of the transient electron paramagnetic resonance signals in DNA photolyase" *Biochemistry.* (1999) PMID: 10194296.
- Kopka B et al.: "Electron transfer pathways in a light, oxygen, voltage (LOV) protein devoid of the photoactive cysteine" *Sci Rep.* (2017) PMID: 29042655. PMC5645311.
- Lee AA et al.: "Alternative radical pairs for cryptochrome-based magnetoreception" *J R Soc Interface.* (2014) PMID: 24671932. PMC4006233.
- Lu CY et al.: "Electron transfer oxidation of tryptophan and tyrosine by triplet states and oxidized radicals of flavin sensitizers: a laser flash photolysis study" *Biochim Biophys Acta.* (2002) PMID: 12031292.
- Maeda K et al.: "Magnetically sensitive light-induced reactions in cryptochrome are consistent with its proposed role as a magnetoreceptor" *Proc Natl Acad Sci U S A.* (2012) PMID: 22421133. PMC3323948.
- Megha K et al.: "Effect of Low-Intensity Microwave Radiation on Monoamine Neurotransmitters and Their Key Regulating Enzymes in Rat Brain" *Cell Biochem Biophys.* (2015) PMID: 25672490.
- Paul S et al.: "Magnetic field effect in natural cryptochrome explored with model compound" *Sci Rep.* (2017) PMID: 28928466. PMC5605708.
- Paul S et al.: "The Flavin–Tryptophan Dyad F10T as a Cryptochrome Model Compound: Synthesis and Photochemistry" *ChemPhotoChem.* (2017) Abstract.
- Vanderstraeten J: [Magnetic fields and health: from epidemiology to cryptochrome chemistry] *Rev Med Brux.* (2017) PMID: 28525248.

(188) Tumour promotion, tumour-specific frequencies, co-carcingogenicity

- de Siqueira EC et al.: "Does cell phone use increase the chances of parotid gland tumor development? A systematic review and meta-analysis" *J Oral Pathol Med. Review.* (2016) PMID: 27935126.
- Lerchl A et al: "Tumor promotion by exposure to radiofrequency electromagnetic fields below exposure limits for humans" *Biochem Biophys Res Commun.* (2015) PMID: 25749340.
- Milham S et al.: "Tumor-specific frequencies and ocular melanoma" *Electromagn Biol Med.* (2016) PMID: 27552371.
- Sofftitti M et al: "Life-span exposure to sinusoidal-50 Hz magnetic field and acute low-dose γ radiation induce carcinogenic effects in Sprague-Dawley rats" *Int J Radiat Biol.* (2016) PMID: 26894944.
- Tillmann T et al.: "Indication of cocarcinogenic potential of chronic UMTS-modulated radiofrequency exposure in an ethylnitrosourea mouse model" *Int J Radiat Biol.* (2010) PMID: 20545575.

(189) Ultrasound

- Leighton TG: "Are some people suffering as a result of increasing mass exposure of the public to ultrasound in air?" *Proc Math Phys Eng Sci.* (2016) PMID: 26997897; pdf.

(190) Urinary tract

- Li DK et al.: "Electric blanket use during pregnancy in relation to the risk of congenital urinary tract anomalies among women with a history of subfertility" *Epidemiology.* (1995) PMID: 8562623.

(191) Vagus nerve

- Burgess AP et al: "Acute Exposure to Terrestrial Trunked Radio (TETRA) has effects on the electroencephalogram and electrocardiogram, consistent with vagal nerve stimulation" *Environ Res.* (2016) PMID: 27419367.

- Torres-Rosas R et al.: "Dopamine mediates vagal modulation of the immune system by electroacupuncture" *Nat Med.* (2014) PMID: 24562381; pdf.
- Yuda E et al.: "Suppression of vagal cardiac modulation by blue light in healthy subjects" *J Physiol Anthropol.* (2016) PMID: 27716445. PMC5051049.

(192) Vibration

- Gane S et al.: "Molecular vibration-sensing component in human olfaction" *PLoS One.* (2013) PMID: 23372854. PMC3555824.

(193) Water: adsorbed, biopolymers, hydration layer, hydrogen bond, osmotic permeability, aquaporin 4

- English NJ et al.: "Near-microsecond human aquaporin 4 gating dynamics in static and alternating external electric fields: Non-equilibrium molecular dynamics" J *Chem Phys.* (2016) PMID: 27586951.
- Ketabi N et al.: "Electromagnetic fields (UHF) increase voltage sensitivity of membrane ion channels; possible indication of cell phone effect on living cells" *Electromagn Biol Med.* (2015) PMID: 24236537.
- Kuznetsov DB et al.: "Epitaxy of the bound water phase on hydrophilic surfaces of biopolymers as key mechanism of microwave radiation effects on living objects" *Colloids Surf B Biointerfaces.* (2017) PMID: 28288341.
- Marracino P et al.: "Human Aquaporin 4 Gating Dynamics under Perpendicularly-Oriented Electric-Field Impulses: A Molecular Dynamics Study" *Int J Mol Sci.* (2016) PMID: 27428954. PMC4964506.
- Mohammadzadeh M et al.: "Electromagnetic field (EMF) effects on channel activity of nanopore OmpF protein" *Eur Biophys J.* (2009) PMID: 19603160.
- Nandi PK et al.: "Perturbation of hydration layer in solvated proteins by external electric and electromagnetic fields: Insights from non-equilibrium molecular dynamics" *J Chem Phys.* (2016) PMID: 27908109.
- Reale R et al.: "Human aquaporin 4 gating dynamics under and after nanosecond-scale static and alternating electric-field impulses: a molecular dynamics study of field effects and relaxation" *J Chem Phys.* (2013) PMID: 24289379.
- Solomentsev GY et al.: "Hydrogen bond perturbation in hen egg white lysozyme by external electromagnetic fields: a nonequilibrium molecular dynamics study" *J Chem Phys.* (2010) PMID: 21186890.

(194) Water: EM information transfer, conditioned water, bacterial DNA signals

- Alberto F et al.: "Electromagnetic information delivery as a new tool in translational medicine" *Int J Clin Exp Med.* (2014) PMID: 25356108.
- D'Emilia E et al.: "Weak-field H3O+ ion cyclotron resonance alters water refractive index" *Electromagn Biol Med.* (2017) PMID: 27368079.
- Dotta BT et al.: "Incremental Shifts in pH spring water can be stored as "space-memory": encoding and retrieval through the application of the same rotating magnetic field" *NeuroQuantology.* (2013) abstract; pdf.
- Foletti A et al.: "Electromagnetic information transfer through aqueous system" *Electromagn Biol Med.* (2017) PMID: 28704129.
- Foletti A et al.: "Experimental finding on the electromagnetic information transfer of specific molecular signals mediated through the aqueous system on two human cellular models" *J Altern Complement Med.* (2012) PMID: 22385079.
- Gang N et al.: "Water dynamics following treatment by one hour 0.16 tesla static magnetic fields depend on exposure" *Water J.* (2012) abstract; pdf.
- Montagnier L et al: "Electromagnetic detection of HIV DNA in the blood of AIDS patients treated by antiretroviral therapy" *Interdiscip Sci.* (2009) PMID: 20640802.

- Montagnier L et al: "Electromagnetic signals are produced by aqueous nanostructures derived from bacterial DNA sequences" *Interdiscip Sci.* (2009) PMID: 20640822.
- Montagnier L et al: "Transduction of DNA information through water and electromagnetic waves" *Electromagn Biol Med.* (2015) PMID: 26098521.
- Yamabhai M et al: "Diverse biological effects of electromagnetic-treated water" *Homeopathy* (2014) PMID: 24931750.

(195) Water: electrolysed reduced water, ionised water

(with anti-oxidant properties, as in fresh vegetables and fruit, micro-clusters, as in waterfall spray and water struck by lightning, and with an increased concentration of alkaline, as in some mineral waters)

- Franceschelli S et al: "New Approach in Translational Medicine: Effects of Electrolyzed Reduced Water (ERW) on NF-κB/iNOS Pathway in U937 Cell Line under Altered Redox State" *Int J Mol Sci.* (2016) PMID: 27598129.
- Shirahata S et al: "Electrolyzed-reduced water scavenges active oxygen species and protects DNA from oxidative damage" *Biochem Biophys Res Commun.* (1997) PMID: 9169001.

15. Sensitivity of plants and animals to electromagnetic exposure

The weight of evidence from many studies shows convincing and consistent evidence of sensitivity by plants and animals to non-thermal levels of electromagnetic exposure, both natural and man-made, as with human studies. Plants and animals cannot experience the Electrophobia or Nocebo effect suggested for some human symptoms, providing additional support for real human Electromagnetic Sensitivity and Hyper-Sensitivity.

- Adámková J et al.: "Directional preference in dogs: Laterality and "pull of the north" *PLoS One.* (2017) PMID: 28945773; pdf.
- Akbal A et al.: "Effects of Electromagnetic Waves Emitted by Mobile Phones on Germination, Root Growth, and Root Tip Cell Mitotic Division of Lens culinaris Medik" *Pol. J. Environ. Stud.* (2012) Abstract. Article.
- Amyan A et al.: "The biological effect of extremely low frequency electromagnetic fields and vibrations on barley seed hydration and germination" *ScientificWorldJournal.* (2004) PMID: 15517103. Article.
- Anderson JM et al.: "Insight into shark magnetic field perception from empirical observations" *Sci Rep.* (2017) PMID: 28887553. PMC5591188.
- Atli E et al.: "The effects of microwave frequency electromagnetic fields on the development of Drosophila melanogaster" *Int J Radiat Biol.* (2006) PMID: 16846978.
- Balmori A: "Anthropogenic radiofrequency electromagnetic fields as an emerging threat to wildlife orientation" *Sci Total Environ.* (2015) PMID: 25747364.
- Balmori A: "Electromagnetic pollution from phone masts. Effects on wildlife" *Pathophysiology.* (2009) PMID: 19264463.
- Balmori A et al.: "The urban decline of the house sparrow (Passer domesticus): a possible link with electromagnetic radiation" *Electromagn Biol Med.* (2007) PMID: 17613041.
- Batellier F et al.: "Effects of exposing chicken eggs to a cell phone in "call" position over the entire incubation period" *Theriogenology.* (2008) PMID: 18255134.
- Bellono NW et al.: "Molecular basis of ancestral vertebrate electroreception" *Nature.* (2017) PMID: 28264196. PMC5354974.
- Belova NA et al.: "The Effect of Extremely Low Frequency Alternating Magnetic Field on the Behavior of Animals in the Presence of the Geomagnetic Field" *J Biophys.* (2015) PMID: 26823664; pdf.
- Bureau YR et al.: "Effect of enhanced geomagnetic activity on hypothermia and mortality in rats" *Int J Biometeorol.* (1996) PMID: 9008433.
- Cammaerts MC et al.: "Effect of man-made electromagnetic fields on common Brassicaceae Lepidium sativum (cress d'Alinois) seed germination: a preliminary replication study" *Phyton, Int J Exper Botany.* (2015) Article.
- Cammaerts MC et al: "Food collection and response to pheromones in an ant species exposed to electromagnetic radiation" *Electromagn Biol Med.* (2013) PMID: 23320633.
- Cammaerts MC et al: "GSM 900 MHz radiation inhibits ants' association between food sites and encountered cues" *Electromagn Biol Med.* (2012) PMID: 22268919.
- Chittka L: "Bee cognition" *Curr Biol.* (2017) PMID: 29017035.
- Clarke D et al.: "The bee, the flower, and the electric field: electric ecology and aerial electroreception" *J Comp Physiol A Neuroethol Sens Neural Behav Physiol.* (2017) PMID: 28647753.
- Cresci A et al.: "Glass eels (Anguilla anguilla) have a magnetic compass linked to the tidal cycle" *Sci Adv.* (2017) PMID: 28630895. PMC5466372.
- Cucurachi S et al.: "A review of the ecological effects of radiofrequency electromagnetic fields (RF-EMF)" *Environ Int.* (2013) PMID: 23261519.
- Dalio JS: "Effect of Electromagnetic (cell phone) radiations on Apis" *J Res Agric Animal Sci.* (2015) article.

- Deutschlander ME et al.: "The case for light-dependent magnetic orientation in animals" *J Exp Biol.* (1999) PMID: 10085262. Article.
- de Vries L et al.: "Comparison of Navigation-Related Brain Regions in Migratory versus Non-Migratory Noctuid Moths" *Front Behav Neurosci.* (2017) PMID: 28928641; pdf.
- Diego-Rasilla FJ et al.: "Spontaneous magnetic alignment behaviour in free-living lizards" *Naturwissenschaften.* (2017) PMID: 28251303.
- Durif CM et al.: "Magnetic compass orientation in the European eel" *PLoS One.* (2013) PMID: 23554997. PMC3598651.
- Engels S et al.: "Anthropogenic electromagnetic noise disrupts magnetic compass orientation orientation in a migratory bird" *Nature.* (2014) PMID: 24805233.
- Ernst DA et al.: "Effect of magnetic pulses on Caribbean spiny lobsters: implications for magnetoreception" *J Exp Biol.* (2016) PMID: 27045095.
- Everaert J et al.: "A possible effect of electromagnetic from mobile phone base stations on the number of breeding house sparrows (Passer domesticus)" *Electromagn Biol Med.* (2007) PMID: 17454083.
- Favre D: "Disturbing Honeybees' Behavior with Electromagnetic Waves: a Methodology" *J Behav.* (2017); pdf.
- Ferrari TE et al: "Severe Honey Bee (Apis mellifera) Losses Correlate with Geomagnetic and Proton Disturbances in Earth's Atmosphere" *Astrobiol Outreach.*(2015) article.
- Fu JP et al.: "Elimination of the geomagnetic field stimulates the proliferation of mouse neural progenitor and stem cells" *Protein Cell.* (2016) PMID: 27484904; pdf.
- Giachello CN et al.: "Magnetic Fields Modulate Blue-Light-Dependent Regulation of Neuronal Firing by Cryptochrome" *J Neurosci.* (2016) PMID: 27798129. PMC5083005.
- Geronikolou S et al.: "Diverse radiofrequency sensitivity and radiofrequency effects of mobile or cordless phone near fields exposure in Drosophila melanogaster" *PLoS One.* (2014) PMID: 25402465. PMC4234246.
- Grémiaux A et al: "Low-amplitude, high-frequency electromagnetic field exposure causes delayed and reduced growth in Rosa hybrid" *J Plant Physiol.* (2016) PMID: 26643955.
- Haggerty K: "Adverse Influence of Radio Frequency Background on Trembling Aspen Seedlings: Preliminary Observations"*Int J Forestry Res.*(2010)http://dx.doi.org/10.1155/2010/836278.
- Haider T et al.: "Clastogenic effects of radiofrequency radiations on chromosomes of Tradescantia" *Mutat Res.* (1994) PMID: 7515472.
- Halgamuge MN: "Review: Weak radiofrequency radiation exposure from mobile phone radiation on plants" *Electromagn Biol Med.* (2017) Review. PMID: 27650031.
- Harst W et al.: "Can Electromagnetic Exposure Cause a Change in Behaviour? Studying Possible Non-Thermal Influences on Honey Bees – An Approach within the Framework of Educational Informatics" *Acta Systemica.* (2006) pdf.
- Hart V et al.: "Dogs are sensitive to small variations of the Earth's magnetic field" *Front Zool.* (2013) PMID: 24370002; pdf.
- Hässig M et al.: [Increased occurrence of nuclear cataract in the calf after erection of a mobile phone basestation] *Schweiz Arch Tierheilkd.* (2012) PMID: 22287140. DOI: 10.1024/0036-7281/a000300.
- Hässig M et al.: "Prevalence of nuclear cataract in Swiss veal calves and its possible association with mobiletelephone antenna base stations" *Schweiz Arch Tierheilkd.* (2009) PMID: 19780007. Article.
- Henbest KB et al.: "Magnetic-field effect on the photoactivation reaction of Escherichia coli DNA photolyase" *Proc Natl Acad Sci U S A.* (2008) PMID: 18799743. PMC2567148.
- Herdean A et al.: "A voltage-dependent chloride channel fine-tunes photosynthesis in plants" *Nat Commun.* (2016) PMID: 27216227; pdf.
- Hiscock HG et al.: "Disruption of Magnetic Compass Orientation in Migratory Birds by Radiofrequency Electromagnetic Fields" *Biophys J.* (2017) PMID: 28978441. PMC5627152.
- Hussein S et al.: "Biochemical and histological studies on adverse effects of mobile phone radiation on rat's brain" *J Chem Neuroanat.* (2016) PMID: 27474378.

- Kattnig DR et al.: "Chemical amplification of magnetic field effects relevant to avian magnetoreception" *Nat Chem.* (2016) PMID: 27001735.
- Kilfoyle AK et al.: "Effects of EMF emissions from undersea electric cables on coral reef fish" *Bioelectromagnetics*. (2018) PMID: 29119574.
- King BL et al.: "Calcium activated K^+ channels in the electroreceptor of the skate confirmed by cloning. Details of subunits and splicing" *Gene.* (2016) PMID: 26687710. PMC4724458.
- Kumar NR et al.: "Exposure to cell phone radiations produces biochemical changes in worker honey bees" *Toxicol Int.* (2011) PMID: 21430927. PMC3052591.
- Lambinet V et al.: "Honey bees possess a polarity-sensitive magnetoreceptor" *J Comp Physiol A Neuroethol Sens Neural Behav Physiol.* (2017) PMID: 28916947.
- Lambinet V et al.: "Linking magnetite in the abdomen of honey bees to a magnetoreceptive function" *Proc Biol Sci.* (2017) PMID: 28330921; pdf.
- Landler L et al.: "Spontaneous magnetic alignment by yearling snapping turtles: rapid association of radio frequency dependent pattern of magnetic input with novel surroundings" *PLoS One.* (2015) PMID: 25978736. PMC4433231.
- Lefeldt N et al.: "Migratory blackcaps tested in Emlen funnels can orient at 85 degrees but not at 88 degrees magnetic inclination" *J Exp Biol.* (2015) PMID: 25452505. Article.
- Liang CH et al: "Magnetic Sensing through the Abdomen of the Honey bee" *Sci Rep.* (2016) PMID: 27005398.
- Liptai P et al.: "Effect of wi-fi radiation on seed germination and plant growth – experiment" *Ann Fac Engin Hunedoara – Int J Engin.* (2017) Article.
- Macedo L et al.: "Atlantic forest mammals cannot find cellphone coverage" *Biolog Conservat.* (2018) Abstract.
- Malkemper EP et al.: "Magnetoreception in the wood mouse (Apodemus sylvaticus): influence of weak frequency-modulated radio frequency fields" *Sci Rep.* (2015) PMID: 25923312. PMC4413948.
- Manta AK et al.: "Mobile-phone radiation-induced perturbation of gene-expression profiling, redox equilibrium and sporadic-apoptosis control in the ovary of Drosophila melanogaster" *Fly (Austin).* (2017) PMID: 27960592. PMC5406167.
- Margaritis LH et al: "Drosophila oogenesis as a bio-marker responding to EMF sources" *Electromagn Biol Med.* (2014) PMID: 23915130.
- Meyer CG et al.: "Sharks can detect changes in the geomagnetic field" *J R Soc Interface.* (2005) PMID: 16849172; pdf.
- Mina D et al: "Immune responses of a wall lizard to whole-body exposure to radiofrequency electromagnetic radiation" *Int J Radiat Biol.* (2016) PMID: 26853383.
- Muheim R et al.: "Polarized light modulates light-dependent magnetic compass orientation in birds" *Proc Natl Acad Sci U S A.* (2016) PMID: 26811473; pdf.
- Murugan NJ et al.: "Group planarian sudden mortality: Is the threshold around global geomagnetic activity ≥K6?" *Commun Integr Biol.* (2015) PMID: 27066174. PMC4802799.
- Naisbett-Jones LC et al.: "A Magnetic Map Leads Juvenile European Eels to the Gulf Stream" *Curr Biol.* (2017) PMID: 28416118. Article.
- Natan E et al.: "The symbiotic magnetic-sensing hypothesis: do Magnetotactic Bacteria underlie the magneticsensing capability of animals?" *Mov Ecol.* (2017) PMID: 29085642. PMC5651570.
- Nicholls B et al.: "The aversive effect of electromagnetic radiation on foraging bats: a possible means of discouraging bats from approaching wind turbines" *PLoS One.* (2009) PMID: 19606214. PMC2705803.
- Nishimura T et al.: "Lizards respond to an extremely low-frequency electromagnetic field" *J Exp Biol.* (2010) PMID: 20511511.
- Olcese J et al.: "Geomagnetic field detection in rodents" *Life Sci.* (1988) PMID: 3276998.
- Panagopoulos DJ et al: "Mobile Telephony Radiation Effects on Living Organisms" in: Harper AC et al (edd.) (2008) "Mobile Telephones: Networks, Applications and Performance" (2008) *Nova Science Pub.*; article.

- Pakhomov A et al.: "Very weak oscillating magnetic field disrupts the magnetic compass of songbird migrants" *J R Soc Interface.* (2017) PMID: 28794163.
- Pall ML: "Electromagnetic Fields Act Similarly in Plants as in Animals: Probable Activation of Calcium Channels via Their Voltage Sensor" *Curr Chem Biol.* (2016) article.
- Panagopoulos DJ et al.: "Bioeffects of mobile telephony radiation in relation to its intensity or distance from the antenna" *Int J Radiat Biol.* (2010) PMID: 20397839.
- Panagopoulos DJ et al.: "Effect of GSM 900-MHz mobile phone radiation on the reproductive capacity of Drosophila melanogaster" *Electromagn Biol Med.* (2004) doi.org/10.1081/JBC-120039350.
- Panagopoulos DJ et al.: "The effect of exposure duration on the biological activity of mobile telephony radiation" *Mutat Res.* (2010) PMID: 20399887.
- Panagopoulos DJ et al.: "Cell death induced by GSM 900-MHz and DCS 1800-MHz mobile telephony radiation" *Mutat Res.* (2007) PMID: 17045516.
- Pawlak K et al.: "Plasma thyroid hormones and corticosterone levels in blood of chicken embryos and post hatch chickens exposed during incubation to 1800 MHz electromagnetic field" *Int J Occup Med Environ Health.* (2014) PMID: 24488772. DOI: 10.2478/s13382-014-0222-7.
- Poh AH et al.: "Effects of low-powered RF sweep between 0.01-20 GHz on female Aedes Aegypti mosquitoes: A collective behaviour analysis" *PLoS One.* (2017) PMID: 28582398. PMC5459433.
- Prato FS et al.: "Magnetoreception in laboratory mice: sensitivity to extremely low-frequency fields exceeds 33 nT at 30 Hz" *J R Soc Interface.* (2013) PMID: 23365198.
- Qureshi ST et al.: "Radiofrequency radiations induced genotoxic and carcinogenic effects on chickpea (Cicer arietinum L.) root tip cells" *Saudi J Biol Sci.* (2017) PMID: 28490961. PMC5415122.
- Radhakrishnan R: "Seed pretreatment with magnetic field alters the storage proteins and lipid profiles in harvested soybean seeds" *Physiol Mol Biol Plants.* (2018) PMID: 29515328.
- Rahmani A et al: "Report on Possible Impacts of Communication Towers on Wildlife Including Birds and Bees" *Ministry of Environment & Forest, Government of India*; (2011) 88 pages; pdf.
- Ritz T et al.: "A model for photoreceptor-based magnetoreception in birds" *Biophys J.* (2000) PMID: 10653784. PMC1300674.
- Roux D et al.: "Electromagnetic fields (900 MHz) evoke consistent molecular responses in tomato plants" *Physiol. Plantarum.* (2006) Abstract.
- Sagioglou NE et al: "Apoptotic cell death during Drosophila oogenesis is differentially increased by electromagnetic radiation depending on modulation, intensity and duration of exposure" *Electromagn Biol Med.* (2016) PMID: 25333897.
- Syalima PR et al.: "Mobile phone radiation induces sedation in Periplaneta americana" *Curr Sci.* (2017) Article.
- Schwarze S et al.: "Migratory blackcaps can use their magnetic compass at 5 degrees inclination, but are completely random at 0 degrees inclination" *Sci Rep.* (2016) PMID: 27667569. PMC5036058.
- Schwarze S et al.: "Weak Broadband Electromagnetic Fields are More Disruptive to Magnetic Compass Orientation in a Night-Migratory Songbird (Erithacus rubecula) than Strong Narrow-Band Fields" *Front Behav Neurosci.* (2016) PMID: 27047356; PMC4801848.
- Selga T et al.: "Response of Pinus Sylvestris L. needles to electromagnetic fields. Cytological and ultrastructural aspects" *Sci. Total Environ.* (1996) Abstract.
- Sharma VP et al: "Changes in honeybee behaviour and biology under the influence of cellphone radiations" *Curr Sci.* (2010) article.
- Sharma VP et al.: "Mobile phone radiation inhibits Vigna radiata (mung bean) root growth by inducing oxidative stress" *Sci Total Environ.* (2009) PMID: 19682728.
- Sheppard DM et al.: "Millitesla magnetic field effects on the photocycle of an animal cryptochrome" *Sci Rep.* (2017) PMID: 28176875. PMC5296725.
- Singh HP et al.: "Cell phone electromagnetic field radiations affect rhizogenesis through impairment of biochemical processes" *Environ Monit Assess.* (2012) PMID: 21562792.

- Sivani S et al.: "Impacts of radio-frequency electromagnetic field (RF-EMF) from cell phone towers and wireless devices on biosystem and ecosystem - a review" *Biol Med.* (2012) Article.
- Soran ML et al: "Influence of microwave frequency electromagnetic radiation on terpene emission and content in aromatic plants" *J Plant Physiol.* (2014) PMID: 25050479.
- Stefi AL et al.: "The aftermath of long-term exposure to non-ionizing radiation on laboratory cultivated pine plants (Pinus halepensis M.)" *Flora.* (2017) abstract.
- Stefi AL et al.: "The effect of the non-ionizing radiation on exposed, laboratory cultivated upland cotton (Gossypium hirsutum L.) plants" *Flora.* (2017) abstract.
- Tkalec M et al.: "Effects of radiofrequency electromagnetic fields on seed germination and root meristematic cells of Allium cepa L" *Mutat Res.* (2009) PMID: 19028599.
- Tkalec M et al.: "Exposure to radiofrequency radiation induces oxidative stress in duckweed Lemna minor L" *Sci Total Environ.* (2007) PMID: 17825879.
- Tkalec M et al.: "Influence of 400, 900, and 1900 MHz electromagnetic fields on Lemna minor growth and peroxidase activity" *Bioelectromagnetics.* (2005) PMID: 15768427.
- Tomanova K et al.: "The magnetic orientation of the Antarctic amphipod Gondogeneia antarctica is cancelled by very weak radiofrequency fields" *J Exp Biol.* (2016) PMID: 27026715. DOI: 10.1242/jeb.132878.
- Vácha M et al.: "Radio frequency magnetic fields disrupt magnetoreception in American cockroach" *J Exp Biol.* (2009) PMID: 19837889. DOI: 10.1242/jeb.028670.
- Vanderstraeten J et al.: "Low-Light Dependence of the Magnetic Field Effect on Cryptochromes: Possible Relevance to Plant Ecology" *Front Plant Sci.* (2018) PMID: 29491873.
- Vian A et al.: "Plant Responses to High Frequency Electromagnetic Fields" *Biomed* Res Int. (2016) PMID: 26981524. PMC4769733.
- Wajnberg E et al.: "Titanium and iron titanium oxide nanoparticles in antennae of the migratory ant Pachycondyla marginata: an alternative magnetic sensor for magnetoreception?" *Biometals.* (2017) PMID: 28608290.
- Waldmann-Selsam C et al: "Tree damage in the vicinity of mobile phone base stations" *Umwelt-medizin-gesellschaft.* (2013); (trans.) pdf.
- Waldmann-Selsam C et al: "Radiofrequency radiation injures trees around mobile phone base stations" *Sci Total Environ.* (2016) PMID: 27552133.
- Waldmann-Selsam C et al: "Trees in Bamberg and Hallstadt in the radiation field of 65 mobile phone base stations: Examples from a documentation about 700 trees (2006-2016)" *Sci Total Environ.* (2016) pdf.
- Wan GJ et al.: "Bio-effects of near-zero magnetic fields on the growth, development and reproduction of small brown planthopper, Laodelphax striatellus and brown planthopper, Nilaparvata lugens" *J Insect Physiol.* (2014) PMID: 24995837.
- Wiltschko R et al.: "Magnetoreception in birds: the effect of radio-frequency fields" *J R Soc Interface.* (2015) PMID: 25540238.
- Wyszkowska J et al.: "Exposure to extremely low frequency electromagnetic fields alters the behaviour, physiology and stress protein levels of desert locusts" *Sci Rep.* (2016) PMID: 27808167; pdf.
- Xu J et al.: "Behavioral evidence for a magnetic sense in the oriental armyworm, Mythimna separate" *Biol Open.* (2017) PMID: 28126710; pdf.
- Xu JJ et al.: "Molecular characterization, spatial-temporal expression and magnetic response patterns of iron-sulfur cluster assembly1 (IscA1) in the rice planthopper, Nilaparvata lugens" *Insect Sci.* (2017) PMID: 29063672.
- Zareen N et al.: "Derangement of chick embryo retinal differentiation caused by radiofrequency electromagnetic fields" *Congenit Anom (Kyoto).* (2009) PMID: 19243412.
- Zhang Y et al.: "Vertebrate-like CRYPTOCHROME 2 from monarch regulates circadian transcription via independent repression of CLOCK and BMAL1 activity" *Proc Natl Acad Sci U S A.* (2017) PMID: 28831003.

- Zhou Z et al.: "Social behavioral testing and brain magnetic resonance imaging in chicks exposed to mobile phone radiation during development" *BMC Neurosci.* (2016) PMID: 27287450. PMC4902983.

16. Electromagnetic warfare

Non-thermal electromagnetic warfare, utilising ES/EHS specific symptoms, began in 1953 with microwave irradiation of the USA Embassy in Moscow. It was used against peace protestors at the USAF airbase, Greenham Common, Newbury, UK, in 1983 and in many recent conflicts in the Middle East. It is now said to be used by several governments against some unaware civilian targets. Understandably, there are few peer-reviewed medical studies on this topic, although it inspired much of the EM research in the USSR and USA.
More recently the TASER electronic stun gun has also been widely deployed against civilian targets, with some reports of serious adverse consequences.

- Azadani PN et al.: "Funding source and author affiliation in TASER research are strongly associated with a conclusion of device safety" *Am Heart J.* (2011) PMID: 21884872.
- Bealy K: "Electromagnetic Pollution: A Little Known Health Hazard, A New Means of Control?" *Preliminary Report, Greenham Common Women's Peace Camp* (1984).
- Guthrie LB: "Legal Implications of the Soviet Microwave Bombardment of the U.S. Embassy" *Boston Coll Internat Compar Law Rev.* (1977) pdf.
- Guyatt D: "Some aspects of anti-personnel electromagnetic weapons" Synopsis for the Internat. Com. of the Red Cross Symposium: "The Medical Profession and the Effects of Weapons" (1996).
- Havranek S et al.: "Electromuscular incapacitating devices discharge and risk of severe bradycardia" *Am J Forensic Med Pathol.* (2015) PMID: 25710795. PMC4927311.
- Johnson Liakouris AG: "Radiofrequency (RF) Sickness in the Lilienfield Study: an effect of modulated microwaves?" *Arch Environ Health.* (1998) PMID:9814721; pdf.
- Mehl LE: "Electrical injury from Tasering and miscarriage" *Acta Obstet Gynecol Scand.* (1992) PMID: 1316038.
- Nanthakumar K et al.: "Cardiac stimulation with high voltage discharge from stun guns" *CMAJ.* (2008) PMID: 18450834. PMC2374856.

17. Further information

Bias in studies according to sources of funding:

- Azadani PN et al.: "Funding source and author affiliation in TASER research are strongly associated with a conclusion of device safety" *Am Heart J.* (2011) PMID: 21884872.
- Huss A et al: "Source of funding and results of studies of health effects of mobile phone use: systematic review of experimental studies" *Environ Health Perspect.* (2007) PMID: 17366811.
- Ledford BW: "Cell Phones, Electromagnetic Radiation, and Cancer: A Study of Author Affiliation, Funding, Bias, and Results" *Proc Pol Stud Org.* (2010) pdf.
- Levis AG et al: "Mobile phones and head tumours. The discrepancies in cause-effect relationships in the epidemiological studies - how do they arise?" *Environ Health.* (2011) PMID: 21679472.
- Morgan LL: "Estimating the risk of brain tumors from cellphone use: Published case-control studies" *Pathophysiology.* (2009) PMID: 19356911.

Pressure on scientists to deny effects has been reported:

- *"The U.S. Air Force School of Aerospace Medicine has consistently suggested to us that there are no effects of low-level microwave exposure despite evidence to the contrary presented in the peer-reviewed literature."*
- *"pressure was applied [by Brooks officials] ... that we not report significant biological effects of low-power microwave irradiation."*
  (Hjeresen D: Letter, *Health Physics.* February 1991; "Experimenting with Microwave Weapons" Microwave News, December 8 2006)

Books, information, reviews, websites etc. on Electromagnetic Sensitivity and Electromagnetic Hypersensitivity:

- Beck RC et al.: "Bibliography on the Psychoactivity of Electromagnetic Fields" ARCHAEUS (1986) Article. (24 pages; over 600 references).
- Bevington M: "Electromagnetic Sensitivity and Electromagnetic Hypersensitivity: A Summary" 2nd ed. (2013) ISBN: 9781872072210 (available from ES-UK) (112 pages; 1,800 refs).
- Bioinitiative Report (2012): link
- Dr Magda Havas: Archive of1960-70s US Navy medical researcher Dr ZR Glaser
- Electrosensitivity.co: Mechanisms and pathways (over 300 studies as at 08.2017)
- EMF Portal: Studies (25,100 publications and 6,000 summaries, as at 08.2017)
- EMF Safety: Bibliographies
- Emfwise.com: Effects
- EMR Aware: EHS studies (97 files, 2017)
- Environmental Health Trust: Bees, Butterflies And Wildlife: Research On Electromagnetic Fields And The Environment (2017; over 70 studies)
- Hecht K: "Health Implications of Long-term Exposure to Electrosmog" (Effects of Wireless Communication Technologies: A Brochure Series of the Competence Initiative for the Protection of Humanity, the Environment and Democracy e.V.) Brochure 6; (2012) trans. Katharina Gustavs (2016) ISBN: 9783981259841; 64 pages; pdf.
- Oceania Radiofrequency Scientific Advisory Association (ORSAA): database
- Oscillatorium: EMF and Birds (2016)
- Philips A & J: *The Powerwatch Handbook* (2009)
- Powerwatch: Electrical Hypersensitivity (8 articles)
- Prove-It: Studies (1,168 refs)
- Rosch PJ (ed.) *Bioelectromagnetic and Subtle Energy Medicine* CRC Press (2nd ed., 2014), 672 pages.
- SSITA: Goldsworthy A: "The Biological Effects of Weak Electromagnetic Fields" (2012)

- Swiss Agency for Environment, Forests and Landscape: "Electrosmog in the environment" (SAEFL, Bern; DIV-5801-E) (2005) 60 pages; pdf.
- Switch2safe: Studies
- US Naval Medical Research Inst.: "Bibliography of Reported Biological Phenomena and Clinical Manifestations attributed to Microwave and Radio-Frequency Radiation" (1971) (2,308 refs)
- WiFi in Schools.com: "136 Studies Showing Health Effects from WiFi Radio Frequency Radiation"
- WiFi in Schools.org.uk: Studies

Michael Bevington
Electrosensitivity UK
4th edition; March 26 2018
(1st edition 2016)