Compilation of Research Studies on Cell Tower Radiation and Health

Peer Reviewed Published Research on Cell Tower Radiation, Base Station Radiation and Health Effects

Watch a CBS investigation into California firefighters fighting to halt cell towers on their firestations below.

American Academy of Pediatrics Website

"Electromagnetic Fields: A Hazard to Your Health?" on Cell Tower Radiation

"In recent years, concern has increased about exposure to radio frequency electromagnetic radiation emitted from cell phones and phone station antennae. An Egyptian study confirmed concerns that living nearby mobile phone base stations increased the risk for developing:

Headaches

Memory problems

Dizziness

Depression

Sleep problems

Short-term exposure to these fields in experimental studies have not always shown negative effects, but this does not rule out cumulative damage from these fields, so larger studies over longer periods are needed to help understand who is at risk. In large studies, an association has been observed between symptoms and exposure to these fields in the everyday environment."

–American Academy of Pediatrics

European Parliament requested a research report "Health Impact of 5G" which was released in July 2021 and concluded that commonly used RFR frequencies (450 to 6000 MHz) are probably carcinogenic for humans and clearly affect male fertility with possible adverse effects on the development of embryos, fetuses and newborns.

A review entitled "Evidence for a health risk by RF on humans living around mobile phone base stations: From radiofrequency sickness to cancer reviewed the existing scientific literature and found radiofrequency sickness, cancer and changes in biochemical parameters (Balmori 2022).

Surveys of people living near cell tower antennas in France, Spain, Iraq, India, Germany, Egypt, Poland have found significantly higher reports of health issues including sleep issues, fatigue and headaches (See Santini et al. 2003, López 2021, Alazawi 2011, Pachuau and Pachuaua 2016, Eger et al. 2004, Abdel-Rassoul et al. 2007, Bortkiewicz et al., 2004).

Two published case reports document illness that developed after 5G antennas were installed. In "The Microwave Syndrome after Installation of 5G Emphasizes the Need for Protection from Radiofrequency Radiation" (Hardell and Nilsson 2023), a man and woman developed microwave syndrome symptoms (e.g., neurological symptoms, tinnitus, fatigue, insomnia, emotional distress, skin disorders, and blood pressure variability) after a 5G base station was installed on the roof above their apartment.

Similarly, in "Development of the Microwave Syndrome in Two Men Shortly after Installation of 5G on the Roof above their Office" two men developed symptoms after 5G antennas were activated on the roof of their workplace. The symptoms disappeared in both men within a couple of weeks (case 1) or immediately (case 2) after leaving the office.

Anthony B. Miller, L. Lloyd Morgan, Iris Udasin, Devra Lee Davis, Cancer epidemiology update, following the 2011 IARC evaluation of radiofrequency electromagnetic fields (Monograph 102), *Environmental Research*, Volume 167, 2018, Pages 673-683, ISSN 0013-9351

Radiofrequency radiation is emitted by cell towers. This review paper concludes that "Based on the evidence reviewed it is our opinion that IARC's current categorization of RFR as a possible human carcinogen (Group 2B) should be upgraded to Carcinogenic to Humans (Group 1)."

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." Electromagnetic Biology and Medicine 36.3 (2017): 295-305.

This study evaluated effects in the human blood of individuals living near mobile phone base stations (within 80 meters) compared with healthy controls (over 300 meters). The study found higher radiofrequency radiation exposures and statistically significant differences in the blood of people living closer to the cellular antennas. The group living closer to the antennas had for example, statistically significant higher frequency of micronuclei and a rise in lipid peroxidation in their blood. These changes are considered biomarkers predictive of cancer.

Rodrigues NCP, Dode AC, Andrade MKdN, O'Dwyer G, Monteiro DLM, Reis INC, Rodrigues RP, Frossard VC, Lino VTS. The Effect of Continuous Low-Intensity Exposure to Electromagnetic Fields from Radio Base Stations to Cancer Mortality in Brazil. *International Journal of Environmental Research and Public Health*. 2021; 18(3):1229. https://doi.org/10.3390/ijerph18031229

For all cancers and for the specific types investigated (breast, cervix, lung, and esophagus cancers),

the higher the exposure to RBS (radio base stations- cell antenna installations) radiofrequency, the higher the median of mortality rate. In capitals where radio base station radiofrequency exposure was higher than 000/antennas-year, the median of the breast cancer mortality rate was 27.33/100,000, while for all cancers, it was 111.68/100,000 (Table 1).

"Conclusions: The balance of our results indicates that the exposure to radiofrequency electromagnetic fields from an RBS increases the rate of mortality by all cancers and specifically by breast, cervix, lung, and esophageal cancers. These conclusions are based on the fact that the findings of this study indicate that, the higher the RBS radiofrequency exposure, the higher the cancer mortality rate, especially for cervix cancer (adjust RR = 2.18). The spatial analysis showed that the highest RBS radiofrequency exposure was observed in a city located in the southern region of Brazil, which also showed the highest mortality rate for all types of cancer and specifically for lung and breast cancers."

Meo, S. A., Almahmoud, M., Alsultan, Q., Alotaibi, N., Alnajashi, I., & Hajjar, W. M. (2018). Mobile Phone Base Station Tower Settings Adjacent to School Buildings: Impact on Students' Cognitive Health. *American Journal of Men's Health*.

High exposure to RF-EMF produced by mobile phone base station towers was associated with delayed fine and gross motor skills, spatial working memory, and attention in school adolescents compared to students who were exposed to low RF-EMF.

Long-term exposure to microwave radiation provokes cancer growth: evidences from radars and mobile communication systems. Yakymenko (2011) Exp Oncology, 33(2):62-70.

Even a year of operation of a powerful base transmitting station for mobile communication reportedly resulted in a dramatic increase of cancer incidence among population living nearby.

Association of Exposure to Radio-Frequency Electromagnetic Field Radiation (RF-EMFR) Generated by Mobile Phone Base Stations (MPBS)with Glycated Hemoglobin (HbA1c) and Risk of Type 2 Diabetes Mellitus , Sultan Ayoub Meo et al, International Journal of Environmental Research and Public Health, 2015

Elementary school students who were exposed to high RF-EMFR generated by MPBS had a significantly higher risk of type 2 diabetes mellitus relative to their counterparts who were exposed to lower RF-EMFR.

Isabel López, Nazario Félix, Marco Rivera, Adrián Alonso, Ceferino Maestú. What is the radiation before 5G? A correlation study between measurements in situ and in real time and epidemiological indicators in Vallecas, Madrid. Environmental Research. Volume 194, March 2021, 110734. https://doi.org/10.1016/j.envres.2021.110734.

Residents of a Madrid Spain neighborhood surrounded by nine telephone antennas took a survey. 105 measurements of electromagnetic radiation were taken both outside and inside the houses. People who were exposed to higher radiation values presented with more severe headaches, dizziness and nightmares and slept fewer hours.

Neurobehavioral effects among inhabitants around mobile phone base stations Abdel-Rassoul et al, Neurotoxicology, 2007

This study found that living nearby mobile phone base stations (cell antennas) increased the risk for neuropsychiatric problems such as headaches, memory problems, dizziness, tremors,depression, sleep problems and some changes in the performance of neurobehavioral functions.

Meo SA, Almahmoud M, Alsultan Q, Alotaibi N, Alnajashi I, Hajjar WM, Mobile Phone Base Station Tower Settings Adjacent to School Buildings: Impact on Students' Cognitive Health. Am J Mens Health. 2018 Dec 7:1557988318816914. doi: 10.1177/1557988318816914.

This study investigated the impact of exposure to radiofrequency electromagnetic field (RF-EMF) radiation generated by mobile phone base station towers (MPBSTs) on cognitive functions. Two hundred and seventeen volunteer male students aged between 13 and 16 registered from two different intermediate schools: 124 students were from School 1 and 93 students were from School 2. The MPBSTs were located within 200 m from the schoolbuildings. In School 1, RF-EMF was 2.010 μW/cm2 with a frequency of 925 MHz and in School 2, RF-EMF was 10.021 μW/cm2 with a frequency of 925 MHz. Students were exposed to EMFR for 6 hr a day, 5 days a week for a total period of 2 years. The Narda Safety Test Solution device SRM-3006 was used to measure RF-EMF in both schools, and cognitive functions tasks were measured by the Cambridge Neuropsychological Test Automated Battery (CANTAB). Significant impairment in Motor Screening Task (MOT; p = .03) and Spatial Working Memory (SWM) task (p = .04) was identified among the group of students who were exposed to high RF-EMF produced by MPBSTs. High exposure to RF-EMF produced by MPBSTs was associated with delayed fine and gross motor skills, spatial working memory, and attention in school adolescents compared to students who were exposed to low RF-EMF.

Biological Effects from Exposure to Electromagnetic Radiation Emitted by Cell Tower Base Stations and Other Antenna Arrays, Levitt & Lai, Environmental Reviews, 2010

This review of 100 studies found approximately 80% showed biological effects near towers. "Both anecdotal reports and some epidemiology studies have found headaches, skin rashes, sleep disturbances, depression, decreased libido, increased rates of suicide, concentration problems, dizziness, memory changes, increased risk of cancer, tremors, and other neurophysiological effects in populations near base stations."

Mortality by neoplasia and cellular telephone base stations. Dode et al. (Brazil), Science of the Total

Environment, Volume 409, Issue 19, 1 September 2011, Pages 3649–3665

This 10 year study on cell phone antennas by the Municipal Health Department in Belo Horizonte and several universities in Brazil found a clearly elevated relative risk of cancer mortality at residential distances of 500 meters or less from cell phone transmission towers. Shortly after this study was published, the city prosecutor sued several cell phone companies and requested that almost half of the cities antennas be removed. Many antennas were dismantled.

Pearce, M., Limiting liability with positioning to minimize negative health effects of cellular phone towers, Environmental Research, Volume 181, 2020,

"There is a large and growing body of evidence that human exposure to RFR from cellular phone base stations causes negative health effects including both i) neuropsychiatric complaints such as headache, concentration difficulties, memory changes, dizziness, tremors, depressive symptoms, fatigue and sleep disturbance, and ii) increased incidence of cancer and living in proximity to a cell-phone transmitter station." The author recommends long-term planning "to minimize the risk of liability from unintended human harm due to cellular phone base station siting" including voluntary restrictions on the placement of cellular phone base stations within 500 m of schools and hospitals."

Epidemiological Evidence for a Health Risk from Mobile Phone Base Stations Khurana, Hardell et al., International Journal of Occupational Environmental Health, Vol 16(3):263-267, 2010

A review of 10 epidemiological studies that assessed for negative health effects of mobile phone base stations (4 studies were from Germany, and 1 each from Austria, Egypt, France, Israel, Poland, Spain) found that seven showed altered neurobehavioral effects near cell tower and three showed increased cancer incidence.
The review also found that eight of the 10 studies reported increased prevalence of adverse neurobehavioral symptoms or cancer in populations living at distances < 500 meters from base stations. None of the studies reported exposure above accepted international guidelines, suggesting that current guidelines may be inadequate in protecting the health of human populations.

Health effects of living near mobile phone base transceiver station (BTS) antennae: a report from Isfahan, Iran. Shahbazi-Gahrouei et al, Electromagnetic Biology Medicine, 2013.

This cross-sectional study found the symptoms of nausea, headache, dizziness, irritability, discomfort, nervousness, depression, sleep disturbance, memory loss and lowering of libido were statistically increased in people living closer than 300 m from cell antennas as compared to those living farther away. The study concludes that "antennas should not be sited closer than 300 m to people to minimize exposure."

How does long term exposure to base stations and mobile phones affect human hormone profiles? Eskander EF et al, (2011), Clin Biochem

RFR exposures significantly impacted ACTH, cortisol, thyroid hormones, prolactin for females, and testosterone levels for males.

Investigation on the health of people living near mobile telephone relay stations: Incidence according to distance and sex Santini et al, 2002 , Pathol Bio

People living near mobile phone masts reported more symptoms of headache, sleep disturbance, discomfort, irritability, depression, memory loss and concentration problems the closer they lived to the installation. Study authors recommend that the minimal distance of people from cellular phone base stations should not be < 300 m.

Navarro EA, Segura J, Portoles M, Gomez-Perretta C, The Microwave Syndrome: A preliminary Study. 2003 (Spain) Electromagnetic Biology and Medicine, Volume 22, Issue 2, (2003): 161 – 169

Statistically significant positive exposure-response associations between RFR intensity and fatigue, irritability, headaches, nausea, loss of appetite, sleeping disorder, depressive tendency, feeling of discomfort, difficulty in concentration, loss of memory, visual disorder, dizziness and cardiovascular problems.

Two Important Animal Studies on Radiofrequency Radiation

These studies indicate that government limits are non protective. Government limits are based on the assumption that radiofrequency radiation is only harmful at thermal levels. However, the cancers developed in animals in these studies at radiation levels that were non thermal.

Falcioni et al. 2018, "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 base station environmental emission" Environmental Research Journal

Researchers with the renowned Ramazzini Institute (RI) in Italy performed a large-scale lifetime study of lab animals exposed to environmental levels (comparable to allowable limits from cell towers) of RFR radiation and found the rats developed increased cancers- schwannoma of the heart in male rats. This study confirms the $25 million US National Toxicology Program study which used much higher levels of cell phone radiofrequency (RF) radiation, but also reported finding the same unusual cancers as the Ramazzini- schwannoma of the heart in male rats. In addition, the RI study of cell tower radiation also found increases in malignant brain (glial) tumors in female rats and precancerous conditions including Schwann cells hyperplasia in both male and female rats.

"Our findings of cancerous tumors in rats exposed to environmental levels of RF are consistent with and reinforce the results of the US NTP studies on cell phone radiation, as both reported increases in

the same types of tumors of the brain and heart in Sprague-Dawley rats. Together, these studies provide sufficient evidence to call for the International Agency for Research on Cancer (IARC) to re-evaluate and re-classify their conclusions regarding the carcinogenic potential of RFR in humans," said Fiorella Belpoggi PhD, study author and RI Director of Research.

The Ramazzini study exposed 2448 Sprague-Dawley rats from prenatal life until their natural death to "environmental" cell tower radiation for 19 hours per day (1.8 GHz GSM radiofrequency radiation (RFR) of 5, 25 and 50 V/m). RI exposures mimicked base station emissions like those from cell tower antennas, and exposure levels were far less than those used in the NTP studies of cell phone radiation.

Watch Press Conference

Wyde, Michael, et al. "National Toxicology Program Carcinogenesis Studies of Cell Phone Radiofrequency Radiation in Hsd: Sprague Dawley® SD rats (Whole Body Exposure).Statement on conclusions of the peer review meeting by NIEHS, released after external peer review meeting and the DNA damage presentation.

This 25 million dollar study is the most complex study completed by the NTP and the world's largest rodent study on radiofrequency radiation exposure to date which found long term exposure at non thermal levels associated with brain cancer and schwannomas of the heart in male rats. In addition damage to heart was found in all exposure levels. The full report is expected to be released in Fall 2018.

More Important Studies on Cell Tower Radiation

Cindy L. Russell, 5 G wireless telecommunications expansion: Public health and environmental implications, Environmental Research, 2018, ISSN 0013-9351

Radiofrequency radiation (RF) is increasingly being recognized as a new form of environmental pollution. This article reviews relevant electromagnetic frequencies, exposure standards and current scientific literature on the health implications of 2G, 3G, 4G and 5G.

Effects can also be non-linear. Because this is the first generation to have cradle-to-grave lifespan exposure to this level of man-made microwave (RF EMR) radiofrequencies, it will be years or decades before the true health consequences are known. Precaution in the roll out of this new technology is strongly indicated.

Noa Betzalel, Paul Ben Ishai, Yuri Feldman, The human skin as a sub-THz receiver – Does 5G pose a danger to it or not?, Environmental Research, Volume 163, 2018, Pages 208-216, ISSN 0013-9351,

Researchers have developed a unique simulation tool of human skin, taking into account the skin multi-layer structure together with the helical segment of the sweat duct embedded in it. They found that the presence of the sweat duct led to a high specific absorption rate (SAR) of the skin in

extremely high frequency band that will be used in 5G. “One must consider the implications of human immersion in the electromagnetic noise, caused by devices working at the very same frequencies as those, to which the sweat duct (as a helical antenna) is most attuned. We are raising a warning flag against the unrestricted use of sub-THz technologies for communication, before the possible consequences for public health are explored.”

Mobile phone infrastructure regulation in Europe: Scientific challenges and human rights protection Claudia Roda, Susan Perry, Environmental Science & Policy, Volume 37, March 2014, Pages 204-214.

This article was published in Environmental Science & Policy by human rights experts. It argues that cell tower placement is a human rights issue for children.

“We argue that (1) because protection of children is a high threshold norm in Human Right law and (2) the binding language of the Convention on the Rights of the Child obliges States Parties to provide a higher standard of protection for children than adults, any widespread or systematic form of environmental pollution that poses a long-term threat to a child’s rights to life, development or health may constitute an international human rights violation.

In particular we have explained how the dearth of legislation to regulate the installation of base stations (cell towers) in close proximity to children’s facilities and schools clearly constitutes a human rights concern according to the language of the Convention on the Rights of the Child, a treaty that has been ratified by all European States.

SAFETY ZONE DETERMINATION FOR WIRELESS CELLULAR TOWER Nyakyi et al, Tanzania (2013)

This research looked at the radiation that cell towers emit and states a safety zone is needed around the towers to ensure safe sleeping areas. The authors state that “respective authorities should ensure that people reside far from the tower by 120m or more depending on the power transmitted to avoid severe health effect.”

A cross-sectional case control study on genetic damage in individuals residing in the vicinity of a mobile phone base station. Ghandi et al, 2014 (India):

This cross-sectional case control study on genetic damage in individuals living near cell towers found genetic damage parameters of DNA were significantly elevated. The authors state,” The genetic damage evident in the participants of this study needs to be addressed against future disease-risk, which in addition to neurodegenerative disorders, may lead to cancer.”

Human disease resulting from exposure to electromagnetic fields, Carpenter, D. O. Reviews on Environmental Health, Volume 28, Issue 4, Pages 159172.

This review summarizes the evidence stating that excessive exposure to magnetic fields from power

lines and other sources of electric current increases the risk of development of some cancers and neurodegenerative diseases, and that excessive exposure to RF radiation increases risk of cancer, male infertility, and neurobehavioral abnormalities.

Signifikanter Rückgang klinischer Symptome nach Senderabbau – eine Interventionsstudie. (English-Significant Decrease of Clinical Symptoms after Mobile Phone Base Station Removal – An Intervention Study) Tetsuharu Shinjyo and Akemi Shinjyo, 2014 Umwelt-Medizin-Gesellschaft, 27(4), S. 294-301.

Japanese study Showed Statistically Significant Adverse Health Effects from electromagnetic radiation from mobile phone base stations. Residents of a condominium building that had cell tower antennas on the rooftop were examined before and after cell tower antennas were removed. In 1998, 800MHz cell antennas were installed, then later in 2008 a second set of antennas (2GHz) were installed. Medical exams and interviews were conducted before and after the antennas were removed in 2009 on 107 residents of the building who had no prior knowledge about possible. These results lead researchers to question the construction of mobile phone base stations on top of buildings such as condominiums or houses.

Effect of GSTM1 and GSTT1 Polymorphisms on Genetic Damage in Humans Populations Exposed to Radiation From Mobile Towers. Gulati S, Yadav A, Kumar N, Kanupriya, Aggarwal NK, Kumar R, Gupta R., Arch Environ Contam Toxicol. 2015 Aug 5. [Epub ahead of print]

In our study, 116 persons exposed to radiation from mobile towers and 106 control subjects were genotyped for polymorphisms in the GSTM1 and GSTT1 genes by multiplex polymerase chain reaction method. DNA damage in peripheral blood lymphocytes was determined using alkaline comet assay in terms of tail moment (TM) value and micronucleus assay in buccal cells (BMN). Our results indicated that TM value and BMN frequency were higher in an exposed population compared with a control group and the difference is significant. In our study, we found that different health symptoms, such as depression, memory status, insomnia, and hair loss, were significantly associated with exposure to EMR. Damaging effects of nonionizing radiation result from the generation of reactive oxygen species (ROS) and subsequent radical formation and from direct damage to cellular macromolecules including DNA.

Subjective symptoms, sleeping problems, and cognitive performance in subjects living near mobile phone base stations, Hutter HP et al, (May 2006), Occup Environ Med. 2006 May;63(5):307-13

Found a significant relationship between some cognitive symptoms and measured power density in 365 subjects; highest for headaches. Perceptual speed increased, while accuracy decreased insignificantly with increasing exposure levels.

Oberfeld, A.E. Navarro, M. Portoles, C. Maestu, C. Gomez-Perretta, The microwave syndrome: further

aspects of a Spanish study,

A health survey was carried out in La Ñora, Murcia, Spain, in the vicinity of two GSM 900/1800 MHz cellular phone base stations. The adjusted (sex, age, distance) logistic regression model showed statistically significant positive exposure-response associations between the E-field and the following variables: fatigue, irritability, headaches, nausea, loss of appetite, sleeping disorder, depressive tendency, feeling of discomfort, difficulty in concentration, loss of memory, visual disorder, dizziness and cardiovascular problems.

Bortkiewicz et al, 2004 (Poland), Subjective symptoms reported by people living in the vicinity of cellular phone base stations: review,Med Pr.2004;55(4):345-51.

Residents close to mobile phone masts reported: more incidences of circulatory problems, sleep disturbances, irritability, depression, blurred vision and concentration difficulties the nearer they lived to the mast.

The performed studies showed the relationship between the incidence of individual symptoms, the level of exposure, and the distance between a residential area and a base station.

Wolf R and Wolf D, Increased Incidence of Cancer Near a Cell-phone Transmitter Station, International Journal of Cancer Prevention, (Israel) VOLUME 1, NUMBER 2, APRIL 2004

A significant higher rate of cancer (300% increase) among all residents living within 300m radius of a mobile phone mast for between three and seven years was detected.

900% cancer increase among women alone

In the area of exposure (area A) eight cases of different kinds of cancer were diagnosed in a period of only one year. This rate of cancers was compared both with the rate of 31 cases per 10,000 per year in the general population and the 2/1222 rate recorded in the nearby clinic (area B). The study indicates an association between increased incidence of cancer and living in proximity to a cell-phone transmitter station.

Changes of Neurochemically Important Transmitters under the influence of modulated RF fields – A Long Term Study under Real Life Conditions(Germany), Bucher and Eger, 2011

German study showing elevated levels of stress hormones (adrenaline, noradrenaline), and lowered dopamine and PEA levels in urine in area residents during 1st 6 months of cell tower installation. Even after 1.5 years, the levels did not return to normal.

The Influence of Being Physically Near to a Cell Phone Transmission Mast on the Incidence of Cancer (Umwelt·Medizin·Gesellschaft 17,4 2004) Eger et al, 2004 (Germany)

200% increase in the incidence of malignant tumors was found after five years' exposure in people

living within 400m radius of a mobile phone mast. The proportion of newly developing cancer cases is significantly higher among patients who live within 400 meters of a cell phone transmitter. Early age of cancer diagnosis.

Microwave electromagnetic fields act by activating voltage-gated calcium channels: why the current international safety standards do not predict biological hazard. Martin L. Pall. Recent Res. Devel. Mol. Cell Biol. 7(2014).

“It can be seen from the above that 10 different well-documented microwave EMF effects can be easily explained as being a consequence of EMF VGCC activation: oxidative stress, elevated single and double strand breaks in DNA, therapeutic responses to such EMFs, breakdown of the blood-brain barrier, cancer, melatonin loss, sleep dysfunction, male infertility and female infertility.”

Pall ML. 2015. Microwave frequency electromagnetic fields (EMFs) produce widespread neuropsychiatric effects including depression. J. Chem. Neuroanat. 2015 Aug 20.

Non-thermal microwave/lower frequency electromagnetic fields (EMFs) act via voltage-gated calcium channel (VGCC) activation.

Two U.S. government reports from the 1970s to 1980s provide evidence for many neuropsychiatric effects of non-thermal microwave EMFs, based on occupational exposure studies. 18 more recent epidemiological studies, provide substantial evidence that microwave EMFs from cell/mobile phone base stations, excessive cell/mobile phone usage and from wireless smart meters can each produce similar patterns of neuropsychiatric effects, with several of these studies showing clear dose–response relationships.

Lesser evidence from 6 additional studies suggests that short wave, radio station, occupational and digital TV antenna exposures may produce similar neuropsychiatric effects. Among the more commonly reported changes are sleep disturbance/insomnia, headache, depression/depressive symptoms, fatigue/tiredness, dysesthesia, concentration/attention dysfunction, memory changes, dizziness, irritability, loss of appetite/body weight, restlessness/anxiety, nausea, skin burning/ tingling/dermographism and EEG changes. In summary, then, the mechanism of action of microwave EMFs, the role of the VGCCs in the brain, the impact of non-thermal EMFs on the brain, extensive epidemiological studies performed over the past 50 years, and five criteria testing for causality, all collectively show that various non-thermal microwave EMF exposures produce diverse neuropsychiatric effects.