

# Michigan House Energy Policy Committee 10/4/18 Testimony

## Key Points/References on 5G Associated Health Issues

### \*Sharon Goldberg, MD

\* Andy P. added one additional document from the Journal of Chemical Neuroanatomy to this compendium. This article was not in Sharon's original document.

- 1) Wireless radiation has biological effects on all living things, not just humans. Effects are well documented in plants, animals, insects, and microbes (bacteria, viruses, fungi). These biological effects are clearly proven in the peer reviewed literature, and no longer a subject for debate.<sup>1</sup> The 2012 Bioinitiative Report Color Charts<sup>2</sup> outlines the effects demonstrated from exposures WITHIN the allowable FCC limits – In other words, the FCC guidelines are not health protective.
- 2) Antibiotic resistance has been documented in many studies of wireless radiation exposed bacteria. Important because of the cost of treating drug resistant infections in the USA (estimated at \$20 billion per year excess direct healthcare costs in 2008<sup>3</sup>) and the danger of losing antibiotic efficacy. Also important because of presumed effect on human microbiome.

### 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*

Taheri, M., Mortazavi, S. M. J., Moradi, M., Mansouri, S., Hatam, G. R., & Nouri, F. (2017). *Dose-Response*, 15(1), 1559325816688527.

#### Abstract

Mobile phones and Wi-Fi radiofrequency radiation are among the main sources of the exposure of the general population to radiofrequency electromagnetic fields (RF-EMF). Previous studies have shown that exposure of microorganisms to RF-EMFs can be associated with a wide spectrum of changes ranged from the modified bacterial growth to the alterations of the pattern of antibiotic resistance. Our laboratory at the nonionizing department of the Ionizing and Non-ionizing Radiation Protection Research Center has performed experiments on the health effects of exposure to animal models and humans to different sources of electromagnetic fields such as cellular phones, mobile base stations, mobile phone jammers, laptop computers, radars, dentistry cavitrons, magnetic resonance imaging, and Helmholtz coils. On the other

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<sup>1</sup> BioInitiative Working Group. (2012). Sage C, Carpenter DO, editors. *BioInitiative Report: A Rationale for a Biologically-based Public Exposure Standard for Electromagnetic Radiation* at [www. bioinitiative. org](http://www.bioinitiative.org).

<sup>2</sup> <http://www.bioinitiative.org/rf-color-charts/>

<sup>3</sup> [http://www.tufts.edu/med/apua/consumers/personal\\_home\\_5\\_1451036133.pdf](http://www.tufts.edu/med/apua/consumers/personal_home_5_1451036133.pdf) (accessed 8-5-2013); extrapolated from Roberts RR, Hota B, Ahmad I, et al. Hospital and societal costs of antimicrobial-resistant infections in a Chicago teaching hospital: implications for antibiotic stewardship. *Clin Infect Dis*. 2009 Oct 15;49(8):1175-84

hand, we have previously studied different aspects of the challenging issue of the ionizing or nonionizing radiation-induced alterations in the susceptibility of microorganisms to antibiotics. In this study, we assessed if the exposure to 900 MHz GSM mobile phone radiation and 2.4 GHz radiofrequency radiation emitted from common Wi-Fi routers alters the susceptibility of microorganisms to different antibiotics. The pure cultures of *Listeria monocytogenes* and *Escherichia coli* were exposed to RF-EMFs generated either by a GSM 900 MHz mobile phone simulator and a common 2.4 GHz Wi-Fi router. It is also shown that exposure to RF-EMFs within a narrow level of irradiation (an exposure window) makes microorganisms resistant to antibiotics. This adaptive phenomenon and its potential threats to human health should be further investigated in future experiments. Altogether, the findings of this study showed that exposure to Wi-Fi and RF simulator radiation can significantly alter the inhibition zone diameters and growth rate for *L. monocytogenes* and *E. coli*. These findings may have implications for the management of serious infectious diseases.

- 3) Evidence that all humans are affected by wireless radiation (not just those who self-identify as “electrosensitive”):

## **Heart Rate Variability Affected by Radiofrequency Electromagnetic Field in Adolescent Students**

**Jakub Mísek, 1\* Igor Belyaev, 2,3 Viera Jakusová, 4 Ingrid Tonhajzerová, 5,6 Jan Barabas, 7 and Jan Jakus 1**

Bioelectromagnetics. 39:277–288, 2018. © 2018 Wiley Periodicals, Inc.

This study examines the possible effect of radiofrequency (RF) electromagnetic fields (EMF) on the autonomic nervous system (ANS). The effect of RF EMF on ANS activity was studied by measuring heart rate variability (HRV) during ortho-clinostatic test (i.e., transition from lying to standing and back) in 46 healthy grammar school students. A 1788MHz pulsed wave with intensity of 54\_1.6V/m was applied intermittently for 18min in each trial. Maximum specific absorption rate (SAR<sub>10</sub>) value was determined to 0.405 W/kg. We also measured the respiration rate and estimated a subjective perception of EMF exposure. RF exposure decreased heart rate of subjects in a lying position, while no such change was seen in standing students. After exposure while lying, a rise in high frequency band of HRV and root Mean Square of the Successive Differences was observed, which indicated an increase in parasympathetic nerve activity. Tympanic temperature and skin temperature were measured showing no heating under RF exposure. No RF effect on respiration rate was observed. None of the tested subjects were able to distinguish real exposure from sham exposure when queried at the end of the trial. In conclusion, short-term RF EMF exposure of students in a lying position during the ortho-clinostatic test affected ANS with significant increase in parasympathetic nerve activity compared to sham exposed group.

- 4) Diabetes and electromagnetic radiation exposure: a) Living closer to cell tower is associated with higher blood sugar/hemoglobin A1C b) Exposure to Wi-fi frequencies of 2.4 GHz is one of the methods used in animal laboratories to create a diabetic animal model for use in testing efficacy of various interventions/nutrients.

## **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

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*Int. J. Environ. Res. Public Health* **2015**, *12*, 14519-14528

**Abstract:** Installation of mobile phone base stations in residential areas has initiated public debate about possible adverse effects on human health. This study aimed to determine the association of exposure to radio frequency electromagnetic field radiation (RF-EMFR) generated by mobile phone base stations with glycated hemoglobin (HbA1c) and occurrence of type 2 diabetes mellitus. For this study, two different elementary schools (school-1 and school-2) were selected. We recruited 159 students in total; 96 male students from school-1, with age range 12–16 years, and 63 male students with age range 12–17 years from school-2. Mobile phone base stations with towers existed about 200 m away from the school buildings. RF-EMFR was measured inside both schools. In school-1, RF-EMFR was 9.601 nW/cm<sup>2</sup> at frequency of 925 MHz, and students had been exposed to RF-EMFR for a duration of 6 h daily, five days in a week. In school-2, RF-EMFR was 1.909 nW/cm<sup>2</sup> at frequency of 925 MHz and students had been exposed for 6 h daily, five days in a week. 5–6 mL blood was collected from all the students and HbA1c was measured by using a Dimension Xpand Plus Integrated Chemistry System, Siemens. The mean HbA1c for the students who were exposed to high RF-EMFR was significantly higher ( $5.44 \pm 0.22$ ) than the mean HbA1c for the students who were exposed to low RF-EMFR ( $5.32 \pm 0.34$ ) ( $p = 0.007$ ). Moreover, students who were exposed to high RF-EMFR generated by MPBS had a significantly higher risk of type 2 diabetes mellitus ( $p = 0.016$ ) relative to their counterparts who were exposed to low RF-EMFR. It is concluded that exposure to high RF-EMFR generated by MPBS is associated with elevated levels of HbA1c and risk of type 2 diabetes mellitus.

## Radiofrequency radiation emitted from Wi-Fi (2.4 GHz) causes impaired insulin secretion and increased oxidative stress in rat pancreatic islets

Ali Masoumi, Narges Karbalaei, S.M.J Mortazavi & Mohammad Shabani

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### Abstract

**Purpose:** There is a great concern regarding the possible adverse effects of electromagnetic radiation (EMR). This study investigated the effects of EMR induced by Wi-Fi (2.45GHz) on insulin secretion and antioxidant redox systems in the rat pancreas.

**Materials and methods:** Adult male Sprague-Dawley rats in the weight range of 230 to 260 g were divided into control, sham, Wi-Fi exposed groups. After long term exposure (4 h/day for 45 days) to Wi-Fi electromagnetic radiation, plasma levels of glucose and insulin during intraperitoneal glucose tolerance test were measured. Islet insulin secretion and content, lipid

peroxidation and antioxidant status in pancreas of rats were determined.

**Results:** Our data showed that the weight gain in the WI-FI exposed group was significantly lower than the control group ( $p < 0.05$ ). Wi-Fi (2.45 GHz) exposed group showed hyperglycemia. Plasma insulin level and glucose-stimulated insulin secretion from pancreatic islet were significantly reduced in the Wi-Fi exposed group. EMR emitted from Wi-Fi caused a significant increase in lipid peroxidation and a significant decrease in GSH level, SOD and GPx activities of the pancreas.

**Conclusion:** these data showed that EMR of Wi-Fi leads to hyperglycemia, increased oxidative stress and impaired insulin secretion in the rat pancreatic islets.

**Keywords:** Insulin secretion, oxidative stress, electromagnetic radiation, Wi-Fi.

## Effects of olive leaf extract on metabolic disorders and oxidative stress induced by 2.45 GHz WIFI signals

Salah, M. B., Abdelmelek, H., & Abderraba, M. (2013).

*Environmental toxicology and pharmacology*, 36(3), 826-834

### Highlights

- The exposition to the radio frequencies (2.45 GHz) induced metabolic disorders
- The exposition to the radio frequencies (2.45 GHz) induced and diabetic-like status.
- The exposition to the radio frequencies (2.45 GHz) induced oxidative stress.
- Olive leaves extract prevented against metabolic alterations.
- Olive leaves extract enhanced antioxidant responses.

### Abstract

We investigated the effect of olive leaves extract administration on glucose metabolism and oxidative response in liver and kidneys of rats exposed to radio frequency (RF). The exposure of rats to RF (2.45 GHz, 1 h/day during 21 consecutive days) induced a diabetes-like status. Moreover, RF decreased the activities of glutathione peroxidase (GPx, -33.33% and -49.40%) catalase (CAT, -43.39% and -39.62%) and the superoxide dismutase (SOD, -59.29% and -68.53%) and groups thiol amount (-62.68% and -34.85%), respectively in liver and kidneys. Indeed, exposure to RF increased the malondialdehyde (MDA, 29.69% and 51.35%) concentration respectively in liver and kidneys. Olive leaves extract administration (100 mg/kg, *ip*) in RF-exposed rats prevented glucose metabolism disruption and restored the activities of GPx, CAT and SOD and thiol group amount in liver and kidneys. Moreover, olive leaf extract administration was able to bring down the elevated levels of MDA in liver but not in kidneys. Our investigations suggested that RF exposure induced a diabetes-like status through

alteration of oxidative response. Olive leaves extract was able to correct glucose metabolism disorder by minimizing oxidative stress induced by RF in rat tissues.

- 5) Diabetes and EMF's – a general history of the associations going back to the 1800's plus additional references to research linking the two from the 1960's and 1970's can be found in: Firstenberg, Arthur. *The Invisible Rainbow: a History of Electricity and Life*. AGB Press Inc.
- 6) Diabetes epidemic – cost of treating diagnosed diabetes in the USA = \$327 billion/year. 1 in 7 healthcare dollars is spent treating diabetes and its complications. 4,110 Americans per day are diagnosed with the disease and 137 enter treatment for end stage renal disease (Hemodialysis) a diabetes associated complication.<sup>4</sup>
- 7) End stage renal disease requires either hemodialysis or a kidney transplant and is an automatic qualifier for Medicare for eligible people. ESRD IS INCREASING BY 5% PER YEAR IN THE USA. ESRD sufferers are 1% of the Medicare budget but consume 7% of the resources due to the high cost of hemodialysis treatment (\$89,000 per patient, per year).<sup>5</sup>
- 8) Wireless radiation – associations with widespread deterioration of mental health and its associated epidemics of suicide, gun violence, and opioid addiction. The CDC must start investigating our costliest epidemics in the context of EMF exposures.

**Pall, M. L. (2016). Microwave frequency electromagnetic fields (EMFs) produce widespread neuropsychiatric effects including depression.** *Journal of chemical neuroanatomy*, 75, 43-51.

**ABSTRACT**

Non-thermal microwave/lower frequency electromagnetic fields (EMFs) act via voltage-gated calcium channel (VGCC) activation. Calcium channel blockers block EMF effects and several types of additional evidence confirm this mechanism. Low intensity microwave EMFs have been proposed to produce neuropsychiatric effects, sometimes called microwave syndrome, and the focus of this review is whether these are indeed well documented and consistent with the known mechanism(s) of action of such EMFs. VGCCs occur in very high densities throughout the nervous system and have near universal roles in release of neurotransmitters and neuroendocrine hormones. Soviet and Western literature shows that much of the impact of non-thermal microwave exposures in experimental animals occurs in the brain and peripheral nervous system, such that nervous system histology and function show diverse and substantial changes. These may be generated through roles of VGCC activation, producing excessive neurotransmitter/neuroendocrine release as well as oxidative/nitrosative stress and other responses. Excessive VGCC activity has been shown from genetic polymorphism studies to have roles in producing neuropsychiatric changes in humans. 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

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<sup>4</sup> American Diabetes Association data

<sup>5</sup> <https://pharm.ucsf.edu/kidney/need/statistics>

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.

## Biological effects from exposure to electromagnetic radiation emitted by cell tower base stations and other antenna arrays

Levitt, B. B., & Lai, H. (2010). Biological effects from exposure to electromagnetic radiation emitted by cell tower base stations and other antenna arrays. *Environmental Reviews*, 18(NA), 369-395.

**Abstract:** The siting of cellular phone base stations and other cellular infrastructure such as roof-mounted antenna arrays, especially in residential neighborhoods, is a contentious subject in land-use regulation. Local resistance from nearby residents and landowners is often based on fears of adverse health effects despite reassurances from telecommunications service providers that international exposure standards will be followed. 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. The objective of this paper is to review the existing studies of people living or working near cellular infrastructure and other pertinent studies that could apply to long-term, low-level radiofrequency radiation (RFR) exposures. While specific epidemiological research in this area is sparse and contradictory, and such exposures are difficult to quantify given the increasing background levels of RFR from myriad personal consumer products, some research does exist to warrant caution in infrastructure siting. Further epidemiology research that takes total ambient RFR exposures into consideration is warranted. Symptoms reported today may be classic microwave sickness, first described in 1978. Nonionizing electromagnetic fields are among the fastest growing forms of environmental pollution. Some extrapolations can be made from research other than epidemiology regarding biological effects from exposures at levels far below current exposure guidelines.

- 9) The opioid epidemic and radiofrequency radiation – Compelling biological plausibility for an association can be found in the literature. a) RFR exposure activates endogenous opioids in the brain – in other words, triggers the same pathways that heroin and morphine do. b) Clear links with depression from decades of research. Clinically, one rarely sees addiction in happy people. The common denominator in many cases of addiction, as related by addiction experts, is that addicts often report “not feeling good/ok/normal until the first time they had the drug they became addicted to (be it alcohol, heroin, etc.).

**Paper presented at the "Workshop on Possible Biological and Health Effects of RF Electromagnetic Fields", Mobile Phone and Health Symposium, Oct 25-28, 1998, University of Vienna, Vienna, Austria.**

## **NEUROLOGICAL EFFECTS OF RADIOFREQUENCY ELECTROMAGNETIC RADIATION**

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### **OUR RESEARCH ON NEUROLOGICAL EFFECTS OF RFR**

[...When the nervous system or the brain is disturbed, e.g., by RFR, morphological, electrophysiological, and chemical changes can occur. A significant change in these functions will inevitably lead to a change in behavior. Indeed, neurological effects of RFR reported in the literature include changes in blood-brain-barrier, morphology, electrophysiology, neurotransmitter functions, cellular metabolism, calcium efflux, responses to drugs that affect the nervous system, and behavior [for a review of these effects, see Lai, 1994 and Lai et al., 1987a].

Our research on the effects of RFR exposure on the nervous system covers topics from DNA damage in brain cells to behavior. My research in this area began in 1980 when I investigated the effects of brief exposure to RFR on the actions of various drugs that act on the nervous system. We found that the actions of several drugs- amphetamine, apomorphine, morphine, barbituates, and ethyl alcohol- were affected in rats after 45 min of exposure to RFR [Lai et al., 1983; 1984 a,b]. One common feature of these responses was that they seemed to be related to the activity of a group of neurotransmitters in the brain known as the endogenous opioids [Lai et al., 1986b]. These are compounds that are generated by the brain and behave like morphine. We proposed that exposure to RFR activates endogenous opioids in the brain of the rat [Lai et al., 1984c]. One interesting finding was that RFR could inhibit morphine withdrawal in rats [1986a, which led me to speculate as to whether low-intensity RFR could be used to treat morphine withdrawal and addiction in humans. When I was in Leningrad, USSR in 1989, a scientist informed me that he had read my paper on 'RFR decreased morphine withdrawal in rats', and he had been using RFR to treat morphine withdrawal in humans. Also, unknown to us at that time was that the 'endogenous opioid hypothesis' could actually explain the increase of alcohol consumption in RFR-exposed rats that we reported in 1984 [Lai et al., 1984b]. In the summer of 1996, the United States Food and Drug Administration approved the use of the drug naloxone for the treatment of alcoholism. Naloxone is a drug that blocks the action of endogenous opioids. Increase in endogenous opioid activity in the brain can somehow cause alcohol-drinking behavior. In addition, our finding that RFR exposure alters the effect of alcohol on body temperature of the rat [Lai et al., 1984b] was replicated by Hjeresen et al. [1988, 1989] at an SAR half of what we used...]<sup>6</sup>

Further, detailed information on opioid effects and radiofrequency radiation can be found in the NEUROLOGICAL EFFECTS OF RADIOFREQUENCY ELECTROMAGNETIC RADIATION chapter of the following book, written by Dr. Henry Lai:

Lin, J. C. (Ed.). (1994). *Advances in electromagnetic fields in living systems* (Vol. 1, pp. 17-88). NY & London: Plenum Press.

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<sup>6</sup> <http://www.emrpolicy.org/science/forum/laivienna.pdf>

10) Epidemic of mass shootings. The science, including the review articles cited above document anger, aggression, psychosis, difficulty with impulse control and mood lability among individuals exposed to radiofrequency radiation.<sup>7</sup> Children and young adults are particularly susceptible.

## Journal of Chemical Neuroanatomy

Volume 75, Part B, September 2016, Pages 43-51

# Microwave frequency electromagnetic fields (EMFs) produce widespread neuropsychiatric effects including depression

Author links open overlay panel [Martin L. Pall](#)  
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## Highlights

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Microwave EMFs activate [voltage-gated Ca<sup>2+</sup> channels](#) (VGCCs) concentrated in the brain.

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Animal studies show such low level MWV EMFs have diverse high impacts in the brain.

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VGCC activity causes widespread neuropsychiatric effects in humans (genetic studies).

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<sup>7</sup> Pall, M. L. (2016). Microwave frequency electromagnetic fields (EMFs) produce widespread neuropsychiatric effects including depression. *Journal of chemical neuroanatomy*, 75, 43-51.

26 studies have EMFs assoc. with neuropsychiatric effects; 5 criteria show causality.

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MWW EMFs cause at least 13 neuropsychiatric effects including depression in humans.

## Abstract

Non-thermal microwave/lower frequency electromagnetic fields (EMFs) act via voltage-gated calcium channel (VGCC) activation. Calcium channel blockers block EMF effects and several types of additional evidence confirm this mechanism. Low intensity microwave EMFs have been proposed to produce neuropsychiatric effects, sometimes called microwave syndrome, and the focus of this review is whether these are indeed well documented and consistent with the known mechanism(s) of action of such EMFs. VGCCs occur in very high densities throughout the nervous system and have near universal roles in release of neurotransmitters and neuroendocrine hormones. Soviet and Western literature shows that much of the impact of non-thermal microwave exposures in experimental animals occurs in the brain and peripheral nervous system, such that nervous system histology and function show diverse and substantial changes. These may be generated through roles of VGCC activation, producing excessive neurotransmitter/neuroendocrine release as well as oxidative/nitrosative stress and other responses. Excessive VGCC activity has been shown from genetic polymorphism studies to have roles in producing neuropsychiatric changes in humans. 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.