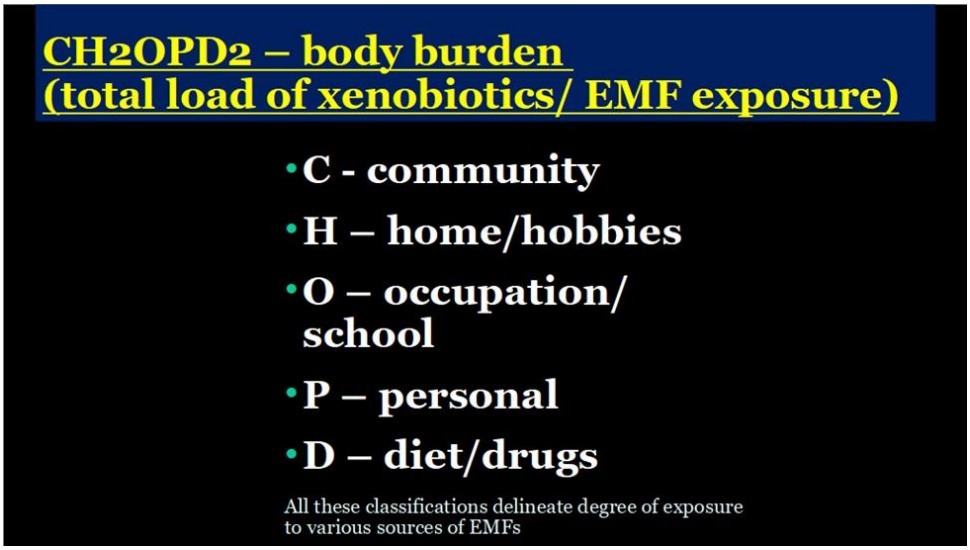


Figure 3: (Marshall et al., 2002)

References

Andrianome S, Hugueville L, de Seze R, Hanot-Roy M, Blazy K, Gamez C, Selmaoui B. Disturbed sleep in individuals with idiopathic environmental intolerance attributed to electromagnetic fields (IEI-EMF): Melatonin assessment as a biological marker. Bioelectromagnetics. 2016 Apr;37(3):175-82.

Belpomme D, Irigaray P. Electrohypersensitivity as a Newly Identified and Characterized Neurologic Pathological Disorder: How to Diagnose, Treat, and Prevent It. International Journal of Molecular Sciences. 2020 Jan;21(6):1915.

Belpomme, Dominique, Christine Campagnac, and Philippe Irigaray. "Reliable disease biomarkers characterizing and identifying electrohypersensitivity and multiple chemical sensitivity as two etiopathogenic aspects of a unique pathological disorder." Reviews on environmental health 30.4 (2015): 251-271.

Baliatsas C, Van Kamp I, Lebret E, et al. Idiopathic environmental intolerance attributed to electromagnetic fields (IEI-EMF): A systematic review of identifying criteria. BMC Public Health. 2012;12(1).

Belpomme, Dominique, Christine Campagnac, and Philippe Irigaray. "Reliable disease biomarkers characterizing and identifying electrohypersensitivity and multiple chemical sensitivity as two etiopathogenic aspects of a unique pathological disorder." Reviews on environmental health 30.4 (2015): 251-271.

Bhat, Kumar and Gupta. Effects of mobile phone and mobile phone tower radiations on human health. 2013

Bray RI, Fancy DH. Clinical Practice Guidelines for EHS - Proceedings of a Symposium of the Impacts of Wireless Technology on Health. Environmental Health Clinic, Women's College Hospital, University of Toronto. October, 2020.

Bray RI, Marshall LM Total Toxic Load. Teaching Tool.

Marshall LM, Bray RI Assessment Questionnaire and Exposure History https://static1.squarespace.com/static/593f8894e3df288fc64b6cf0/t/598bbabdf14aa18c52a6dcce/1502329836033/Environmental+Health+Clinic+Pre-Visit+Questionnaire.pdf

De Luca C, Thai JC, Raskovic D, et al. Metabolic and genetic screening of electromagnetic hypersensitive subjects as a feasible tool for diagnostics and intervention. Mediators Inflamm. 2014;2014:924184. doi:10.1155/2014/924184

The DNA Company. https://www.thednacompany.com/

EUROPAEM Guideline 2015 for the prevention, diagnosis and treatment of EMF-related health problems and illnesses. Belyaev I. Dean A. Eger H. Hubmann G. Jandrisovits R. et al. Rev Environ Health. 2015; 30(4):337-371.

Genuis SJ, Lipp CT. Electromagnetic hypersensitivity: fact or fiction? Sci Total Environ. 2012;414:103-12.

Gomez-Perretta et al. Subjective symptoms related to GSM radiation from mobile phone base stations, BMJ, 2014

Hallberg Ö, Oberfeld G. Letter to the editor: will we all become electrosensitive?. Electromagnetic Biology and Medicine. 2006 Jan 1;25(3):189-91.

Harris, W. E., Herbert J. Semler, and Herbert E. Griswold. "Reversed reciprocating paroxysmal tachycardia controlled by guanethidine in a case of Wolff-Parkinson-White syndrome." American heart journal 67.6 (1964): 812-816.

Havas, M. (2014). Electrosmog and Electrosensitivity: What Doctors Need to Know to Help their Patients Heal. Anti-Aging Therapeutics Volume XV.

Havas M. Radiation from wireless technology affects the blood, the heart, and the autonomic nervous system. Reviews on Environmental Health. 2013 Nov 1;28(2-3):75-84.

Institute for Functional Medicine. Textbook of Functional Medicine. 2010.

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. Volume 16. Issue 2-3. August 2009.

Johansson O. Electrohypersensitivity: a functional impairment due to an inaccessible environment. Reviews on environmental health. 2015 Dec 1;30(4):311-21.

Johansson O. Electrohypersensitivity: state-of-the-art of a functional impairment. Electromagnetic biology and medicine. 2006 Jan 1;25(4):245-58.

Leitgeb N, Schrottner J. Electrosensibility and electromagnetic hypersensitivity. Bioelectromagnetics. 2003;24(6):387-94.

Maes B. Building Biology Evaluation Guidelines. Inst. Building Biol.+ Sustainability IBN, Rosenheim, Germany. SBM-2015. 2015.

Maes B. Standard of building biology testing methods. Inst. Building Biol.+ Sustainability IBN, Rosenheim, Germany, Tech. Rep. SBM-2008. 2008.

Marshall L, Weir E, Abelsohn A, Sanborn MD. Identifying and managing adverse environmental health effects: 1. Taking an exposure history. Cmaj. 2002 Apr 16;166(8):1049-55.

Pall ML. How to approach the challenge of minimizing non-thermal health effects of microwave radiation from electrical devices. Int. J. Innov. Res Eng. Manag (IJIREM). 2015 Sep;2(5):71-6.

Pall ML. Microwave frequency electromagnetic fields (EMFs) produce widespread neuropsychiatric effects including depression. Journal of Chemical Neuroanatomy. 2016 Sep 1;75:43-51.

Pall ML. Wi-Fi is an important threat to human health. Environmental research. 2018 Jul 1;164:405-16.

Park and Knudson. Medically Unexplained Physical Symptoms. Statistics Canada 2007

Rea WJ. Chemical Sensitivity. Vol 1. Boca Raton. Lewis Publishers. 1992.

Right to Know, CCOHS https://www.ccohs.ca/oshanswers/legisl/responsi.html

Sanborn M, Grierson L, Upshur R, Marshall L, Vakil C, Griffith L, Scott F, Benusic M, Cole D. Family medicine residents' knowledge of, attitudes toward, and clinical practices related to environmental health: Multi-program survey. Canadian Family Physician. 2019 Jun 1;65(6):e269-77.

Sears ME. Chelation: harnessing and enhancing heavy metal detoxification—a review. The Scientific World Journal. 2013 Jan 1;2013.

Sears, Margaret E. "The Medical Perspective on Environmental Sensitivities" Canadian Human Rights Commission. 2007.

Selye H. (1946). The general adaptation syndrome and the diseases of adaptation. *The Journal of clinical endocrinology and metabolism*, *6*, 117–230. https://doi.org/10.1210/jcem-6-2-117

Stein Y, Udassin IG. Electromagnetic hypersensitivity (EHS, microwave syndrome)–Review of mechanisms. Environmental Research. 2020 Mar 30:109445.

Tran MT, Arendt-Nielsen L, Kupers R, Elberling J. Multiple chemical sensitivity: on the scent of central sensitization. International journal of hygiene and environmental health. 2013 Mar 1;216(2):202-10.

WHO, Electromagnetic Fields and Public Health, December 2005

https://static1.squarespace.com/static/593f8894e3df288fc64b6cf0/t/598bbabdf14aa18c52a6dcce/1502329836033/Environmental+Health+Clinic+Pre-Visit+Questionnaire.pdf

Implications of International Agency for Research on Cancer (IARC) Position

Anthony B Miller MD Professor Emeritus, Dalla Lana School of Public Health, University of Toronto, Canada

We have to be extremely cautious about increasing the population's exposure to radiofrequency radiation (RFR). The telecom industry ignores the fact that the International Agency for Research on Cancer of the World Health Organization categorized in 2011 all RFR, including that emitted by cell phones and Wi-Fi from cell towers and routers as in some schools and many homes, as a possible (Group 2B) carcinogen, a grouping that also includes lead and DDT (IARC 2011). Since then new science has emerged, both human and animal, confirming that RFR causes cancer.

The human evidence comprises three important sets of case-control (human) studies of mobile phone use and brain cancer:

- The multi-country INTERPHONE study which found a 2-fold increased risk of glioma after 10+ years of regular use of cell phones, with a dose-response relationship (Interphone Study Group, 2010)
- Several studies by Hardell and his colleagues in Sweden (one of the first countries to introduce cell phones) showing 2- to 5-fold increased risk of glioma after prolonged use, especially when exposure began early in life (Hardell and Carlberg, 2015)
- A large study (CERENAT) in France, which found a 5-fold increased risk of glioma after 5+ years use (Coureau et al, 2014).

Interphone – Appendix 2 for Glioma

Time since start of regular use (years)	Cases	Controls	OR	95% CI
1-1.9	93	159	1.00	
2-4	460	451	1.68	1.16-2.41
5-9	468	491	1.52	1.06-2.22
10+	190	150	2.18	1.43-3.31

Figure 1

Relative Risk Estimates for Glioma Associated with Ten or More Years of Mobile Phone Use

Study	Exposure, in years of use	RR/OR	95% CI	Design
Benson et al, 2013 (UK)	>10	0.8	0.5-1.1	Cohort
Hardell et al, 2013 (Sweden)	10-15 >25	1.4 3.0	1.3-3.5 1.7-5.2	Case-control

Figure 2

Cerenat (France)– 231 cases, 446 controls (Coureau et al, 2014)

Brain cancer	Exposure period	OR	95% CI
Glioma	After 2 years	2.9	1.4-5.9
	After 3 years	3.0	1.5-6.3
	After 5 years	5.3	2.1-13.2
Ipsilateral glioma	All	2.1	0.7-6.1
Meningioma	All	2.6	1.0-6.1

Figure 3

These studies all show that the lower the exposure, the less the risk. Although an increased risk of glioma was not reported from a cohort study in the UK (with some misclassification of exposure) there was a doubling of risk of acoustic neuroma (vestibular Schwannoma) with ten or more years of mobile phone use (Benson et al, 2013), as was also found in a case-control study by Hardell et al, 2013, though not by Moon et al, 2014 from Korea. However, a case-control study of brain tumors in adolescents using operator records for exposure in Nordic countries found more than a doubling of risk after 2.8 years since initial subscription for mobile phone use (Aydin et al, 2011).

RFR is probably also an avoidable cause of Breast Cancer, based upon seven unusual clinical case reports of women who kept cell phones in their bras, supported by exposure modeling and toxicology (West et al, 2013).

The incidence of parotid or salivary gland tumors has tripled in Israel: 1 in 5 under age 20 (Czerninski et al, 2011). A rise in the incidence of glioblastoma in the temporal and frontal regions of the brain has been reported from the UK (Philips et al, 2018), while the incidence of neuro-epithelial brain cancers has significantly increased in children, adolescents, and young adults from birth to 24 years in the United States (Gittleman et al, 2015; Ostrom et al, 2016).

Increase in Parotid Gland Tumors in Israel over 30 Years

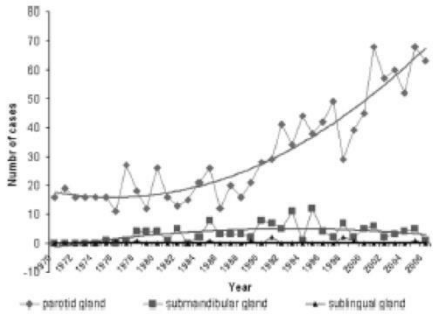


FIGURE. For trend analyses, we added regression lines and calculated R^2 values. Parotid gland cancer: $R^2 = 0.83$; Submandibular gland cancer: $R^2 = 0.36$; Sublingual gland cancer: $R^2 = 0.02$.

Source: Epidemiology, 22, p.130, *January 2011*

Figure 4

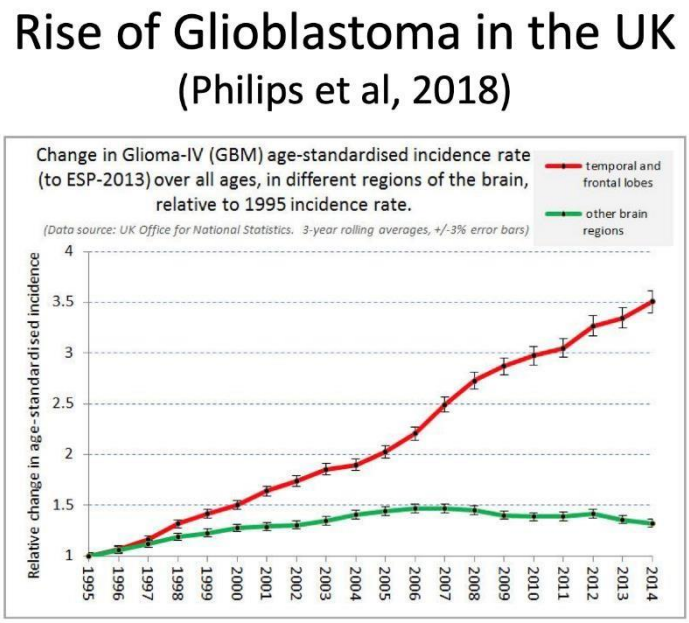


Figure 5

Tumor promotion by exposure to radiofrequency electromagnetic fields (RF-EMF) below exposure limits for humans in RF-EMF exposed mice were first reported in 2010. Lerchl et al (2015) replicated the study with higher numbers of mice per group. They could fully confirm the previous results. No clear dose–response relationship was evident. Lerchl et al (2015) hypothesized that metabolic changes are responsible for the effects observed. Critical evidence of carcinogenicity of RFR in animals was reported by the National Toxicology Program (US). In male Hsd:Sprague Dawley SD rats exposed to GSMmodulated cell phone RFR at 900 MHz, there was "clear evidence" of carcinogenic activity based on incidence of malignant Schwannoma in the heart and some evidence of carcinogenic activity based on incidence of malignant glioma in the brain. In male Hsd:Sprague Dawley SD rats exposed to CDMAmodulated cell phone RFR at 900 MHz, there was "clear evidence" of carcinogenic activity based on incidence of malignant Schwannoma in the heart and some evidence of carcinogenic activity based on incidence of malignant glioma in the brain. Multiple organs (e.g., brain, heart) also had evidence of DNA damage. These findings were supported by a Life-span Carcinogenic Study from the Ramazzini Institute, in which 2,448 male and female Sprague-Dawley rats had whole-body exposure for 19 hours per day to a 1.8 GHz GSM far field of 0, 5, 25, 50 V/m from prenatal life until natural death. This reproduced the environmental exposure to RFR generated by 1.8 GHz GSM antenna of radio base stations of mobile phones. The findings were a statistically significant increase in the incidence of heart Schwannomas in treated male rats at 50 V/m, a non-significant increase in the incidence of heart Schwann cell hyperplasia in treated male and female rats at 50 V/m, and a non-significant increase in the incidence of malignant glial tumors in treated female rats at 50 V/m (Falcioni et al, 2018).

My colleague Paul Héroux, of McGill University, has suggested that 5G and the Internet of Things (IoT) is a Trojan horse, with millions of mini-cell towers soon to be installed every 150 meters in our neighbourhoods which will invade the privacy of every home. Optical fiber is safer, healthier, and faster. With optical fiber, everyone could enjoy a communication speed ultimately 10,000 times faster than wireless, less vulnerable to hacking, and harmless to the health of humans and other species.

An IARC advisory committee recently recommended that RFR should be re-reviewed with high priority. An extensive literary search will be conducted for relevant peer-reviewed publications, members (and chair) of a Working Group will be selected by the IARC Director and the head of the Monographs program, and the members of the working group will be given specific tasks, and then will meet for eight days in Lyon, to reach a conclusion on the carcinogenicity of RFR.

I and many other scientists now believe that RFR should be categorized as a Group 1 Human Carcinogen, in the same Group as cigarette smoking, asbestos exposure, and X-Rays. Government standards must be changed to reflect this. RFR is now ubiquitous, and those who use cell phones or are otherwise exposed to Wi-Fi are increasing the risk of cancer in their bodies, especially after prolonged exposure or exposure beginning in childhood. Even if the risk per individual is low, it is widely distributed and could become a major public health problem, especially if the planned introduction of 5G proceeds. If 5G is rolled out we can expect to see an increase in all of these conditions. A moratorium on the rollout of 5G is essential.

References

Aydin, D., et al. Mobile phone use and brain tumors in children and adolescents: a multicenter casecontrol study. J. Natl. Cancer Inst. 2011; 103: 1264-76.

Benson, V.S., et al. for the Million Women Study Collaborators. Mobile phone use and risk of brain neoplasms and other cancers: prospective study. Int. J. Epidemiol 2013; 42:792-802.

Coureau, G., et al. Mobile phone use and brain tumours in the CERENAT case-control study. Occup. Environ. Med 2014; 71: 514-22.

Czerninski R, Zini A, Sgan-Cohen HD. Risk of parotid malignant tumors in Israel (1970-2006). Epidemiology 2011: 22:130-1. doi: 10.1097/EDE.0b013e3181feb9f0.

Falcioni, L., Bua, L., Tibaldi, E., et al. Report of final results regarding brain and heart tumors in SpragueDawley rats exposed from prenatal life until natural death to mobile phone radiofrequency field representative of a 1.8 GHz GSM base station environmental emission. Environmental Research 2018; 17(1):50.

Gittleman, H.R., et al. Trends in central nervous system tumor incidence relative to other common cancers in adults, adolescents, and children in the United States, 2000 to 2010. Cancer, vol. 121, no. 1, 2015, pp. 102-12.

Hardell, L. and Carlberg M. 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 2015; 22:1-13.

Hardell, L., M. Carlberg, F. Söderqvist and Kjell H. Mild. Pooled analysis of case-control studies on acoustic neuroma diagnosed 1997-2003 and 2007-2009 and use of mobile and cordless phones. Int. J. Oncol. 2013; 43: 1036-44.

IARC Monographs on the evaluation of carcinogenic risks to humans. Non-ionizing radiation, Part 2: Radiofrequency Electromagnetic fields. Lyon: International Agency for Research on Cancer, vol. 102, 2013.

INTERPHONE Study Group. Brain tumour risk in relation to mobile telephone use: results of the INTERPHONE international case-control study. Int. J. Epidemiol. 2010; 39: 675-94.

Lerchl, A., Klose, M., Grote, K., et al. Tumor promotion by exposure to radiofrequency electromagnetic fields below exposure limits for humans. Biochem Biophys Res Commun 2015; 459(4):585-90.

Moon, I.S., et al. Association between vestibular schwannomas and mobile phone use. Tumor Biol. 2014; 35: 581-7.

National Toxicology Program (2018a). NTP Technical Report on the Toxicology and Carcinogenesis Studies in Hsd:Sprague-Dawley SD Rats Exposed to Whole-Body Radio Frequency Radiation at a Frequency (900 MHz) and Modulations (GSM and CDMA) Used by Cell Phones. NTP TR 595. https://ntp.niehs.nih.gov/ntp/about_ntp/trpanel/2018/march/tr595peerdraft.pdf.

National Toxicology Program (2018b). NTP Technical Report on the Toxicology and Carcinogenesis Studies in B6C3F1/N Mice Exposed to Whole-Body Radio Frequency Radiation at a Frequency (1800 MHz) and Modulations (GSM and CDMA) Used by Cell Phones. NTP TR 596. https://ntp.niehs.nih.gov/ntp/about_ntp/trpanel/2018/march/tr596peerdraft.pdf .

Philips, A., Henshaw, D.L., Lamburn, G., O'Carroll, M.J. Brain Tumours: Rise in Glioblastoma Multiforme Incidence in England 1995-2015 Suggests an Adverse Environmental or Lifestyle Factor. J Environ Public Health 2018; 7910754. doi: 10.1155/2018/7910754.

Ostrom, Q.T., Gittleman, H., de Blank, P.M. et al. Adolescent and Young Adult Primary Brain and Central Nervous System Tumors Diagnosed in the United States in 2008-2012. Neuro-Oncology 2016; 18, suppl. 1: 1–50.

West, J.G., et al. Multifocal Breast Cancer in Young Women with Prolonged Contact between Their Breasts and Their Cellular Phones. Case Rep Med. 2013, no. 354682.

EMFs 101: Impacts on Health in the Community

Magda Havas PhD Professor Emerita, Trent University, Peterborough, Canada

Today I am going to really focus on three things: electrosmog; electrohypersensitivity; and electromagnetic hygiene. Elecromagnetic hygiene is part of the solution for those people who have developed a sensitivity and don't want to become triggered.

Electromagnetic frequencies can be understood through analysis of the electromagnetic spectrum. The spectrum is based on frequency, with low frequency on the left and high frequencies on the right. Different parts of the spectrum are given different names, and it is important to focus on radiofrequency microwaves and millimeter waves, part of the 5G system which has a larger bandwidth and higher frequencies.

The spectrum is split into two groups: ionizing radiation and nonionizing radiation. We have no issues scientifically with ionizing radiation, We know that it is harmful. The controversy revolves around nonionizing radiation. Many physicists without biological backgrounds do not believe this form of energy is active, or harmful; however, those with biological or medical backgrounds can more readily appreciate how the entirety of the electromagnetic spectrum has a biological impact.

A salient issue, currently, is how electrosmog exposure is increasing. The utilizable form of electricity at the turn of the last century was transmitted at 50 and 60 cycles per second (Hertz). Initially, it started at 25, which caused a flicker in light bulbs, so they increased the frequency to 60 cycles. Artificial radiofrequency came with the invention of the radio — not necessarily by Marconi, who is often given the credit, but by Tesla, who preceded him. We were first exposed to artificial sources of microwaves during World War II with the invention of radar to track enemy aircrafts. Now the most recent development in terms of electromagnetic exposure is that part of the spectrum called “millimeter waves”, part of the 5G system and an “Internet of Things” or IoT.

Consequently, the increase in electrosmog, or the pervasiveness of electromagnetic fields, is exponential. One way of illustrating this change is with of the world.

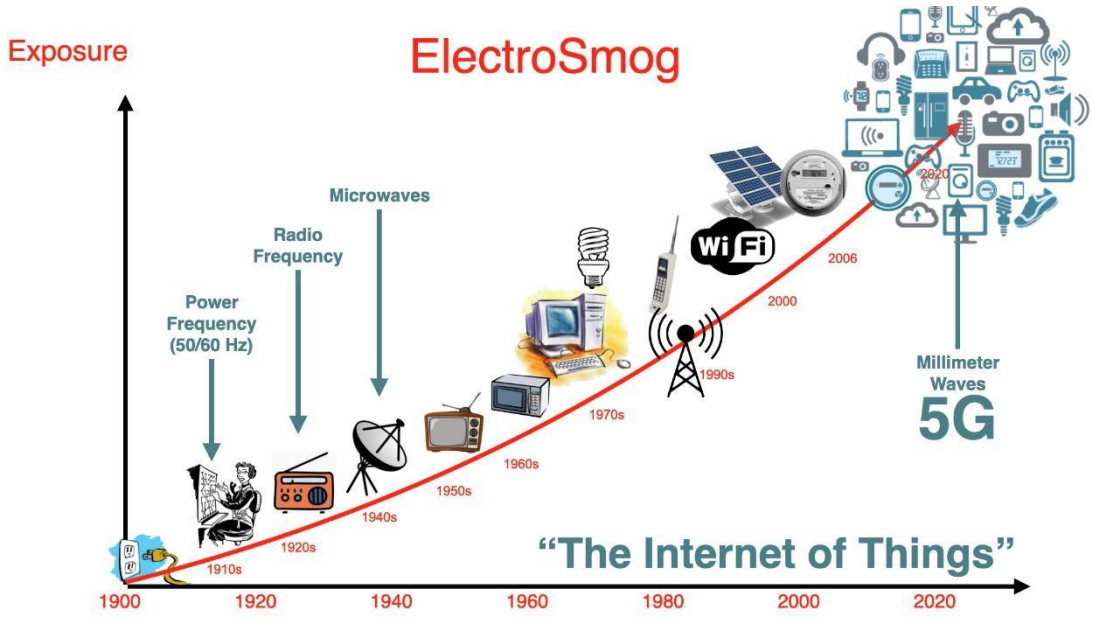


Figure 1

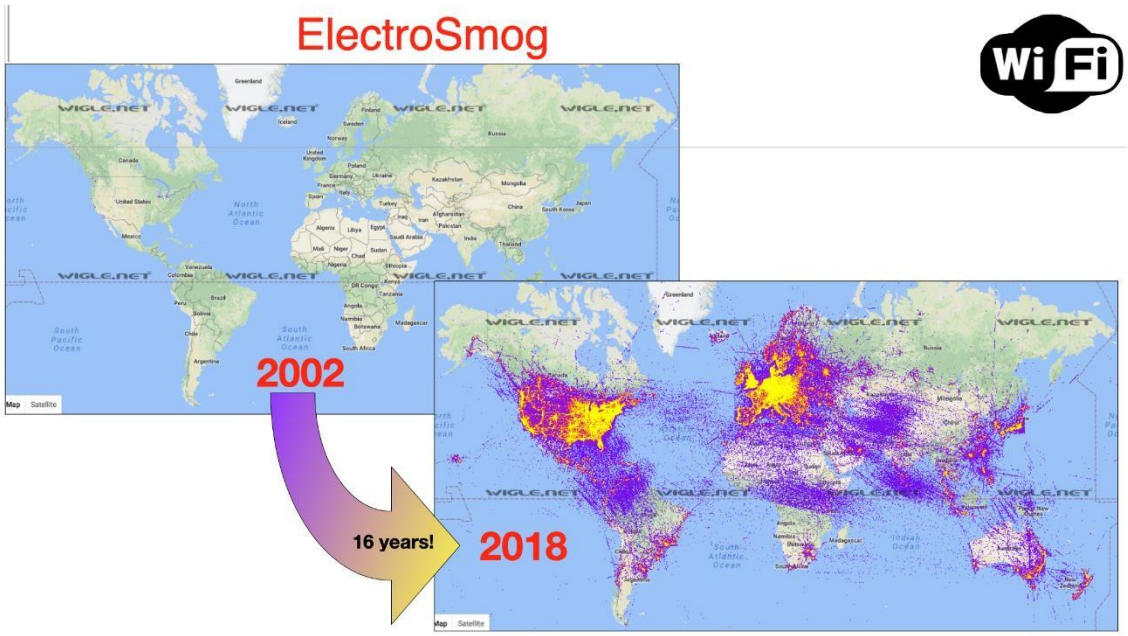


Figure 2

Blue spots are areas with Wi-Fi radiation back in 2002. Wi-Fi has not been used in the general population for a long time, being initially used by governments, military, and universities. In 2018, over the course of 16 years, the proliferation of blue spots demonstrates a massive explosion of Wi-Fi—in classrooms, in city parks, in city streets, and in the cell phone and other Wi-Fi technology of our homes— which now constitutes a very high level of cumulative radiation.

The good news is that most of our exposure is self-generated. The exposure from cell towers, 5G transmitters or smart meters is thrust upon us with little or no choice. Yet, some people have been able to get their smart meters replaced with analog meters, or moved farther away from their home. I know an individual who goes into homes and monitors the impacts of radiation of those residents, helping them reduce their exposure. The key technologies causing the highest exposure in our homes are our cell phones, Wi-Fi, and cordless phones. These can be replaced with wire technology; however, other individuals have wireless security systems, baby monitors, Wii games, and personal wearable technology. These technologies cumulatively increase exposure to microwave and radiofrequency radiation.

Figure 3

With cell phones, radiation drops very quickly with distance. If you hold the cell phone away from your head a few inches, and don't store it on your body, it will make a big difference. Yet, when it comes to Wi-Fi hotspots and cell towers, we have no choice. We have whole-body exposure 24 hours a day. For this reason, I am much more concerned about cell towers than cell phones, as with cell phones you have a choice by determining how often you use it.

Microwave frequencies penetrate walls. This is why one can get service inside one's home, and pick up Wi-Fi from neighbouring homes as well. Metals can reflect, block, or focus radiofrequency radiation. Some people who are electrically sensitive cannot wear metal jewelry for example, because it has that particular effect. Keeping metal out of your bedroom is most important. If you keep that area "clean" during the night, your body can heal. Yet, if you have metal springs in your mattress they will act like antennas. If there's radiofrequency in your bedroom, from something you have generated or from something outside, the metal springs are going to focus the electromagnetic energy in your body while you sleep.

We know microwave-exposed water is how a microwave oven works. This is why you can put a potato in the oven and cook them, but not dried rice. If you turn on a microwave oven in your kitchen—most ovens leak—it will emit radiation that will also bounce off other metal objects. If you stand directly in front of the microwave oven, you are getting the lion's share of exposure. If you do microwave your food, which

is not something I would recommend, it is important to leave the room and walk as far away from it as possible in your home.

People exposed to electrosmog are getting sick with electrohypersensitivity. One of the best studies that document electrohypersensitivity was conducted by Santini (2001)[1] in Spain. About 70% of the people living within 10 meters of a cell tower, shown in red, experienced fatigue very often. Who lives within 10 meters of a cell antenna? An example is in an apartment building, where the people who lived on the top floor became sick just a few months after it was installed, and had to move out. At 300 meters, 27% experienced fatigue very often. Other symptoms experienced included sleep disturbances and headaches—part of the spectrum for electrohypersensitivity. Of note is that these symptoms are also more commonly experienced as we age. I call this "rapid aging syndrome."

Health effects of EMFs seem to fit into four different categories. The first is cancer which was first reported in 1979 for children exposed to magnetic fields from wires outside their home. Cancer is associated with broadcast antennas and radar, especially if individuals have worked or lived near these installations [2]. Secondly, brain tumors and head-related cancers are associated with cell phones, with head cancers being associated in people who live within 300 meters to 500 meters from a cell tower. [3]The third issue is reproduction, first recorded with miscarriages in video display terminal operators, mostly women who were typing as secretaries using a visual screen. The most recent reproductive cases are with sperm damage and the use of cell phones or laptops sitting on the perineum[4]. The fourth category is neurological and hormonal disturbances associated with electro-hypersensitivity. These effects were first reported at the turn of the 20th century as neurasthenia, a weakening of the nervous system frequently experienced by telephone operators.

Telephone operators won a court case against Bell Canada, and spending time in their job was reduced due to symptoms. Likewise, during World War II, men working at radar installations experienced microwave sickness, or radiowave illness;[5] screen dermatitis where people would actually break out into rash. More recently, they have also reported heart palpitation as symptoms of electrohypersensitivity.[6]

[1] Santini R et al. Study of the health of people living in the vicinity of mobile phone base stations. Occup Med (Lond) 51(6):410413, 2001.

[2] Lester, J.R. and D.F. Moore. 1982. Cancer Mortality and Air Force Bases. Journal of Bioelectricity 1(1): 72-82.

[3] Pachuau L. RF radiation from mobile phone towers and their effects on human body. Indian Journal of Radio & Space Physics (IJRSP), 2017.

[4] Gorpinchenko O. The influence of direct mobile phone radiation on sperm quality. Central European Journal of Urology. 2014; 67(1):65-71.

[5] The microwave syndrome or electro-hypersensitivity: historical background. Carpenter DO. Reviews on Environmental Health. 2015; 30(4), 217-222.

[6] Electrohypersensitivity (EHS) is an Environmentally-Induced Disability that Requires Immediate Attention. Havas, M. J Sci Discov(2019); 3(1):jsd18020; DOI:10.24262/jsd.3.1.18020

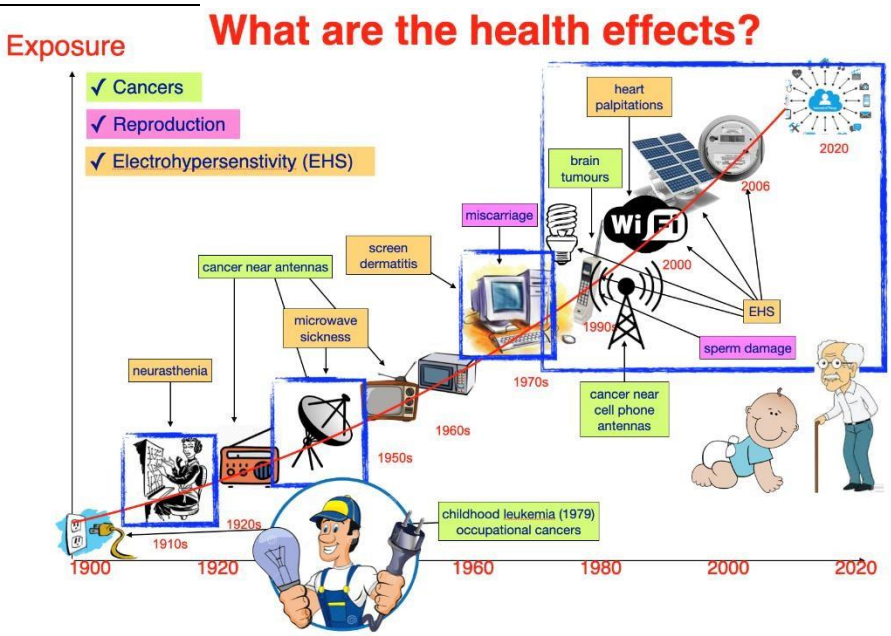


Figure 4

Whereas, initially EMF exposures were limited to occupations, currently everyone is exposed as the levels are increasing, and sources are ubiquitous. They are virtually everywhere, and it is incredibly difficult to get away from them. In my opinion, we are witnessing an emerging health crisis. Chronic illness is on the increase. It is concerning that the illnesses we associate with the elderly are being picked up in increasingly younger and younger people. The doctors I interact with increasingly tell me a lot of the symptoms people are coming in with are not responding to medication. In other words, they increasingly have patients coming in who they simply cannot treat. Certainly one contributing reason physicians cannot treat patients could be because they are constantly bathed in electromagnetic pollution and have poor electromagnetic hygiene.

Using mold as an example, no one would question the harmful effects of having serious mold in your home. Likewise, you would not live next to an oil refinery. Few of us relate a "smart home" to poor electromagnetic hygiene, yet, cumulatively, electromagnetic technologies are a significant form of poor, and underregulated, electromagnetic hygiene. We do not need to treat the symptoms, we need to deal with the original cause of the problem. Everyday antennae are being placed very close to homes where the levels of radiation inside buildings end up being very high, yet, Health Canada is doing absolutely nothing to protect the public.

We do not really know how many people in the world are electrically hypersensitive, but the general scientific consensus is less than 10%.[7] Perhaps somewhere between 1 and 5% have severe sensitivity. Roughly a third of the population have mild to moderate symptoms when they are exposed. If we take the population of Toronto, this is almost 200,000 people who have severe sensitivity, and in Ontario, almost 500,000. In Canada, we are talking over a million people with severe sensitivity. This group is really going to suffer when 5G comes in, as 5G adds another dimension of exposure, not only millimeter waves, but also lower frequencies. It does not replace 4G, it is layered on top of all the other generation technologies that we have.

To explain electrosensitivity, I use the flood analogy. If the level of water is low, there is no effect, or very minimal effect. Currently, about a third of the population is treading water, which means they are using up

a lot of energy just to maintain homeostasis. Once they exhaust their energy, that is when illnesses come in, as bodies simply cannot cope. If you are under the waterline, you are classified as electrically hypersensitive, which continues to increase. If more and more people cannot work, we are going to be in dire straits. If 5G becomes a tsunami—what some people are predicting—even Noah's Ark is not going to make a difference. 5G is untested. We do not know exactly what is going to come with it, but we know for sure that it is biologically active. There is absolutely no reason why this part of the spectrum would not be biologically active when every other part of the electromagnetic spectrum is also.

Some people say that electrical hypersensitivity is psychosomatic. While there is a psychosomatic element to it, as there is to all illness, we have tremendous scientific evidence that there are physiological changes occur in the body as a direct result of electromagnetic radiation. We have done research examining the effects on the heart, the autonomic nervous system, and the blood. If you prick your finger and examine the blood under the microscope, there is no rouleaux formation in a clean electromagnetic environment, whereas Wi-Fi, a cordless phone, or any kind of microwave radiation for 10 minutes causes these formations.[8]

[7] Electrohypersensitivity as a Newly Identified and Characterized Neurologic Pathological Disorder: How to Diagnose, Treat, and Prevent It. Belpomme D. Philippe I. Int. J. Mol. Sci. 2020; 21(6),1915

[8] Havas, M. (2014). Electrosmog and Electrosensitivity: What Doctors Need to Know to Help their Patients Heal. Havas M. AntiAging Therapeutics Volume XV. 2014.

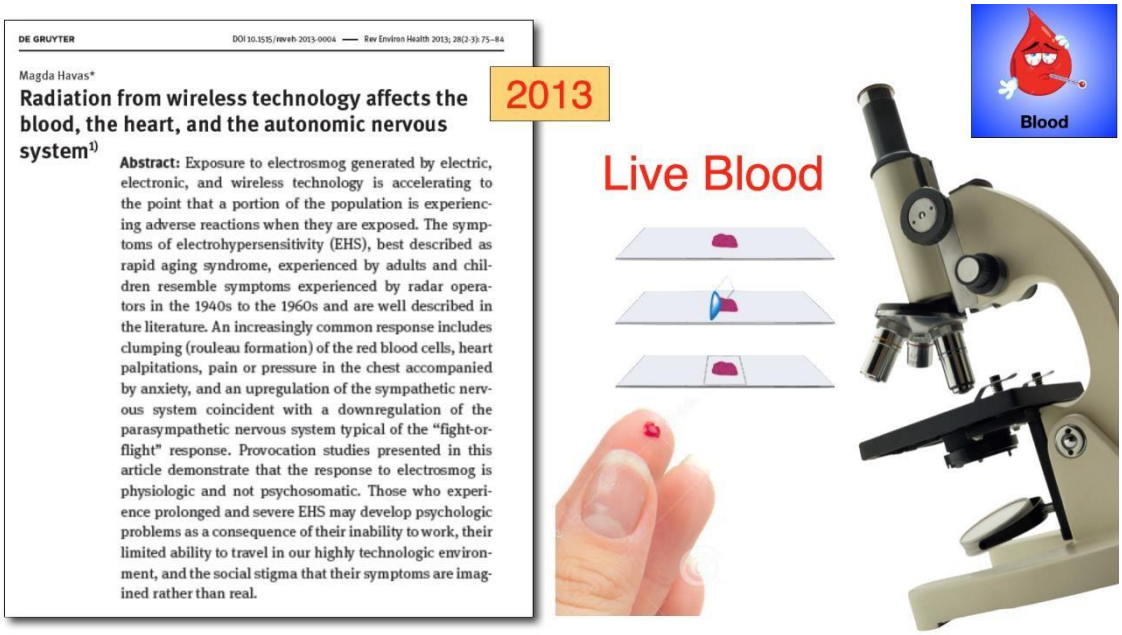

DE GRUYTER
DOI 10.1515/reveh-2013-0004 — Rev Environ Health 2013; 28(2-3): 75–84
Magda Havas*
Radiation from wireless technology affects the blood, the heart, and the autonomic nervous system[1)]
Abstract: Exposure to electrosmog generated by electric, electronic, and wireless technology is accelerating to the point that a portion of the population is experiencing adverse reactions when they are exposed. The symptoms of electrohypersensitivity (EHS), best described as rapid aging syndrome, experienced by adults and children resemble symptoms experienced by radar operators in the 1940s to the 1960s and are well described in the literature. An increasingly common response includes clumping (rouleau formation) of the red blood cells, heart palpitations, pain or pressure in the chest accompanied by anxiety, and an upregulation of the sympathetic nervous system coincident with a downregulation of the parasympathetic nervous system typical of the "fight-or-flight" response. Provocation studies presented in this article demonstrate that the response to electrosmog is physiologic and not psychosomatic. Those who experience prolonged and severe EHS may develop psychologic problems as a consequence of their inability to work, their limited ability to travel in our highly technologic environment, and the social stigma that their symptoms are imagined rather than real.
2013
Live Blood
Blood

Figure 5

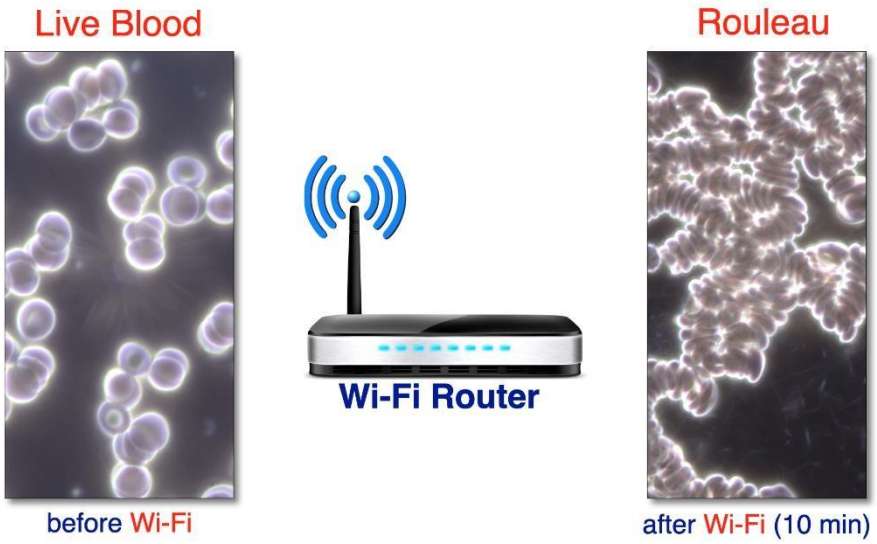


Figure 6

I would classify myself as being electrically hypersensitive, despite not always knowing when I am exposed. Yet, if this is happening to my blood, it's going to certainly interfere with the ability of blood to circulate. Symptoms may vary from individual to individual. In very severe cases, it could actually lead to a stroke or heart attack. While not everyone responds in this way—there are people who do—if you can monitor it with pre- and post-exposure this is one way of diagnosing someone with electrohypersensitivity.

What are some of the solutions? The acronym I use is "RIDE" for treating people who are electrically hypersensitive. **Reduce** your exposure; build up your **Immune** system; **Detoxify** your body, get rid of toxins in a safe way rather than quickly; and slowly deal with **Emotional** trauma experienced because of loss of access to many places, and lack of support by friends and family.[9] Stress takes on many forms including physical, chemical, or emotional. It is a known factor in disease causation. If you are a person who sees a cell tower and reacts strongly emotionally, you are doing damage to your body, regardless of whether you are exposed to radiation; therefore, it is critical to minimize that stress to avoid the fight-orflight response. Consequently, the upregulation of sympathetic nervous system leads to poor sleep and hence chronic fatigue during the day. A lot of healing is done during the night and that is why it is so important to keep an electromagnetically clean bedroom. As described in the work of Dr. Hans Salye , "Every stress leaves an indelible scar. And the organism pays for the survival after a stressful situation by becoming a little older." Thus, when I said rapid aging syndrome, there is physiological evidence which actually supports this claim at the cellular level.[10]

Heart rate variability is a way of testing the autonomic nervous system. I have published peer-reviewed research on this in a double-blind sham-controlled study. We asked, does radiation from a cordless phone affect the heart? The cordless phone we used emitted radiation constantly when plugged into an electrical outlet. Subjects did not know when they were exposed and when they were not. Dr. Jeffrey Marrongelle, an expert on heart rate variability in Pennsylvania, analyzed the data and did not know who was exposed or when.

---

[9] Dirty Electricity Elevates Blood Sugar Among Electrically Sensitive Diabetics and May Explain Brittle Diabetes. Havas, M. Electromagnetic Biology and Medicine. Vol. 27(2), pp. 135-146. 2008.

[10] Havas, M. (2014). Electrosmog and Electrosensitivity: What Doctors Need to Know to Help their Patients Heal. Havas M. AntiAging Therapeutics Volume XV. 2014.

Three different periods of heart rate variability of a person lying flat on a massage table or a bed preexposure were observed: 58, 56, and 58 beats per minute. This person did not respond to the sham exposure, and had absolutely no autonomic response to the radiation. A different subject's, supine heart rate went from 68 to 122 beats per minute as soon as cordless phone is plugged in. This subject reacted to the radiation not knowing when it was turned on. Another different subject had an increase in heart rate with exposure to the phone. When considering the autonomic nervous system, we see up-regulation of the sympathetic and down regulation of the parasympathetic during exposure. This is a typical fight-or-flight response.

I have worked with a lot of teachers, and they tell me that anxiety levels in the classroom are astronomical and unprecedented. I have a feeling that at least part of that is because of the Wi-Fi available in the classroom, the fact that kids can use their cell phones, and sometimes you have antennas in your classrooms as well. Children are complaining of heart palpitations. In some cases, they have had medical monitoring of it as well. Two of them died. The youngest was a 13 year old and they're showing that cardiac arrest in this particular community was 40 times higher than the national average. This happened after Wi-Fi was placed in the school. This situation is very serious. The schools are taking it seriously. While they are not admitting it is Wi-Fi, they are putting in defibrillators as a precaution.[11]

We have known about this since 1969, if not earlier, when workers in the microwave field had to have cardiac testing ahead of time. Perhaps that is what we should be doing with students and teachers at the beginning of the school year to see if anyone has a problem with SVT, or any other heart condition, that they not be exposed to the microwave radiation in their learning environment.

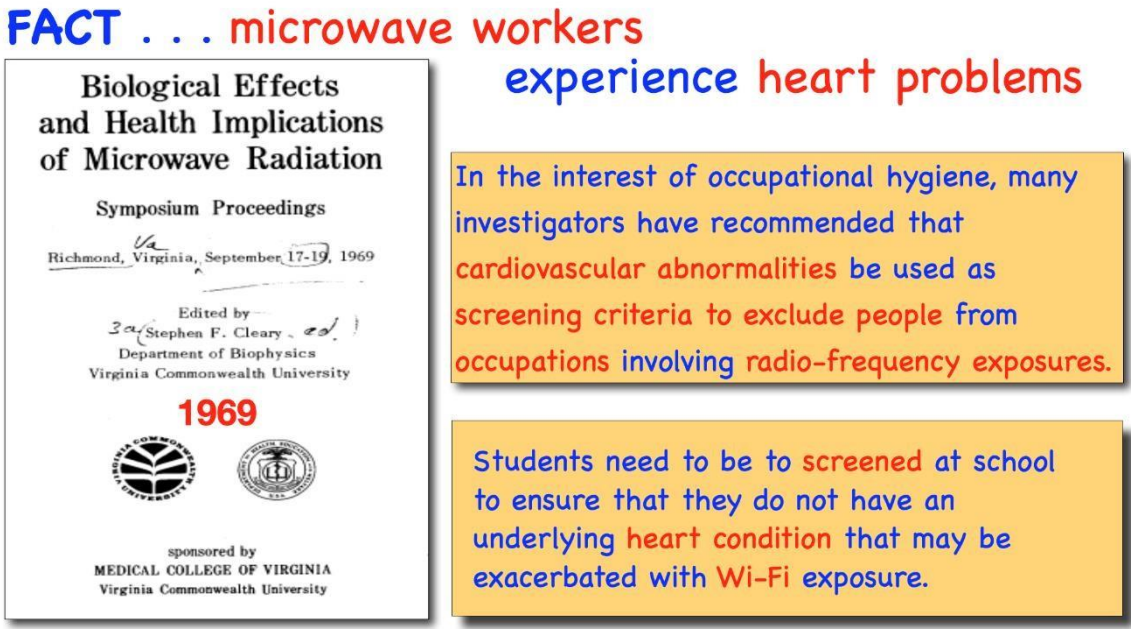


Figure 7

[11] Reversed reciprocating paroxysmal tachycardia controlled by guanethidine in a case of Wolff-Parkinson-White syndrome. Harris WE. Semler HJ. Griswold HE. American heart journal 67.6 (1964): 812-816.

There is technology that will help reduce exposure. Shield your smart meter, put film on your windows, reduce exposure by painting walls, and put a canopy around your bed. There are 12 easy steps to electromagnetic hygiene. There are different types of electrosmog—we have just focused on one: radiofrequency radiation. We have a website called electrosensitivesociety.com. Sheena Symington is the Director. We are hoping to help people who are sensitive, as well as help healthcare practitioners. We

---

really need other practitioners understanding these phenomena and knowing how to give advice and manage related illnesses. I really believe that electromagnetic hygiene is the missing link to vibrant health. If you can get rid of electrosmog exposure, a lot of people will have improved health as a result.

Wireless (MW/RF) radiation harms without heating: How we know, and implications

[Summary of presentation May 31, 2019, updated January 2020]

Meg Sears PhD Sr Clinical Research Associate, Ottawa Hospital Research Institute Chair, Prevent Cancer Now

Introduction

With the goal to connect everything to everything else, wireless devices such as cell phones, Wi-Fi, antenna installations, and an increasing plethora of devices in the "Internet of Things" are projected to reach one million per square kilometer,[12] all transmitting and receiving data carried on microwave or radiofrequency radiation (MW/RFR).

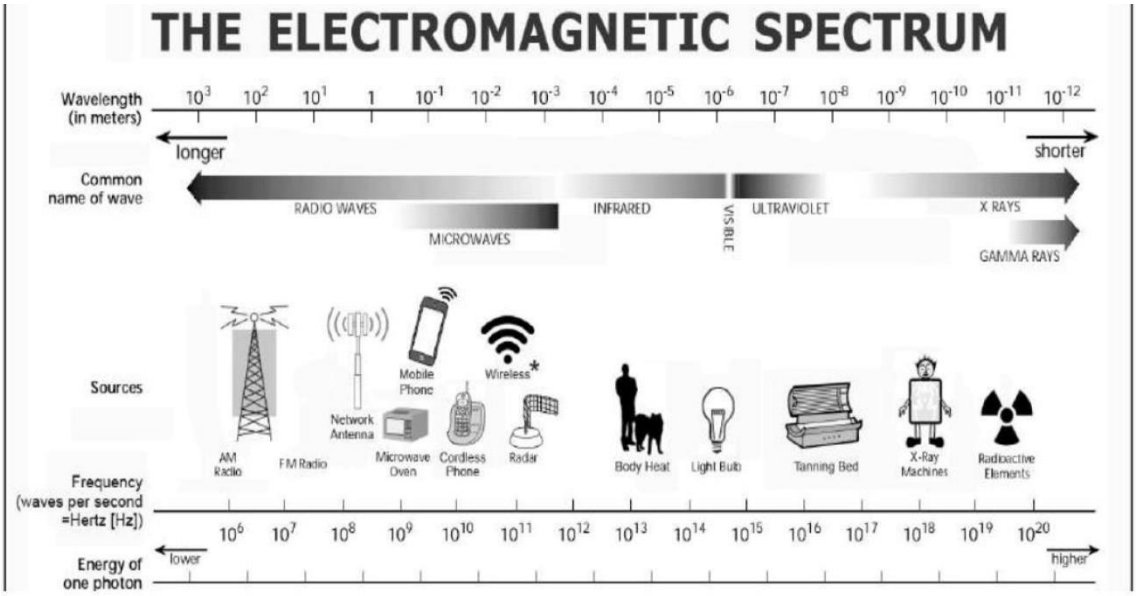


Figure 1

Health Canada's *Safety Code 6* asserts that exposures pose acceptable risks, as long as the level of radiation does not heat tissues excessively. No effects documented at lower exposure levels are

[12] Sharma L, Javali A, Sarkar S, Tengshe R, Jha MK, Routray SK. Optical Wireless Hybrid Networks for 5G. In: Janyani V, Singh G, Tiwari M, d'Alessandro A, editors. Optical and Wireless Technologies. Singapore: Springer; 2020. p. 65–71. (Lecture Notes in Electrical Engineering).

considered by regulators to be both substantially "adverse" and "established,"[2,13]although this guideline was criticized as not being rigorously developed.[14]

MW/RFR is "nonionizing" radiation, meaning that a single photon does not remove an electron from an atom. Visible light is also nonionizing, yet the eye can sense exquisitely low exposures—even single photons.[15] It is not unreasonable that even low levels of nonionizing photons of MW/RFR, transmitting information with rapid and irregular fluctuations of electromagnetic fields (interlinked electrical and magnetic fields), have biological effects.

Health Canada's "no cooking = no harm" premise is challenged by observations of adverse effects from exposures simulated in laboratories and in real life that include impacts on male fertility, early life development, cancer, and amplification of effects of chemical toxicants (e.g., co-carcinogenicity, and effects of lead on child behaviour).[16,17]

Bridging this disconnect between the regulatory premise regarding harms and the scientific observations of effects below regulatory thresholds, experimental observations include subcellular oxidative stress and DNA damage,[18,19] and interaction with calcium channels through membranes,[10] which may precipitate observed adverse effects and dysfunction.[20]

Basic research in inanimate systems, however, is another line of evidence that MW/RFR exerts effects independent of heating. This has received less attention in the context of health effects of radiation for telecommunications. "Microwave catalysis" —acceleration of chemical reactions at comparable or even lower temperatures than achieved with heating such as a steam jacket—may underlie observations in more complex, living systems.

Chemistry, the basis of life

[13] A Review of Safety Code 6 (2013): Health Canada's Safety Limits for Exposure to Radiofrequency Fields | The Royal Society of Canada [Internet]. [cited 2018 Sep 8]. Available from: https://rsc-src.ca/en/expert-panels/rsc-reports/review-safety-code-6-2013health-canadas-safety-limits-for-exposure-to

[14] House of Commons Canada, "Standing Committee on Health, Evidence," Number 058, 2nd Session, 41st parliament, April 2015, http://www.ourcommons.ca/DocumentViewer/en/41-2/HESA/meeting-58/evidence

[15] Tinsley JN, Molodtsov MI, Prevedel R, Wartmann D, Espigulé-Pons J, Lauwers M, et al. Direct detection of a single photon by humans. Nat Commun [Internet]. 2016 Jul 19 [cited 2020 Jan 16];7. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4960318/

[16] Miller AB, Sears ME, Morgan LL, Davis DL, Hardell L, Oremus M, et al. Risks to Health and Well-Being From Radio-Frequency Radiation Emitted by Cell Phones and Other Wireless Devices. Front Public Health [Internet]. 2019 [cited 2019 Aug 13];7. Available from: https://www.frontiersin.org/articles/10.3389/fpubh.2019.00223/full

[17] Belyaev I, Dean A, Eger H, Hubmann G, Jandrisovits R, Kern M, et al. EUROPAEM EMF Guideline 2016 for the prevention, diagnosis and treatment of EMF-related health problems and illnesses. Reviews on Environmental Health [Internet]. 2016 [cited 2017 Mar 14];31(3):363–397. Available from: https://www.degruyter.com/view/j/reveh.ahead-of-print/reveh-2016-0011/reveh-20160011.xml?format=INT

[18] Yakymenko I, Tsybulin O, Sidorik E, Henshel D, Kyrylenko O, Kyrylenko S. Oxidative mechanisms of biological activity of lowintensity radiofrequency radiation. Electromagn Biol Med. 2016;35(2):186–202.

[19] Blank M, Goodman RM. Electromagnetic fields and health: DNA-based dosimetry. Electromagnetic Biology and Medicine [Internet]. 2012 Dec 1 [cited 2019 May 27];31(4):243–9. Available from: https://doi.org/10.3109/15368378.2011.624662 [10] Pall ML. Wi-Fi is an important threat to human health. Environmental Research. 2018 Jul;164:405–16.

[20] Terzi, M., Ozberk, B., Deniz, O. G., & Kaplan, S. (2016). The role of electromagnetic fields in neurological disorders. *Journal of chemical neuroanatomy*, *75*, 77-84.

Medically, life is defined on the basis of myriad chemical and electro-chemical reactions and interactions. In order to understand at the most fundamental level how energy from wireless devices can have biological effects, it is helpful to consider effects of MW/RFR on biochemistry.

A chemical reaction is the joining up or breaking apart of atoms and molecules, as electrons shift. As shown in Figure 1, each reaction is via a "transition state" with specific alignment of molecule(s). The

[2] Health Canada, Government of Canada. Limits of Human Exposure to Radiofrequency Electromagnetic Energy in the Frequency Range from 3 kHz to 300 GHz. Safety Code 6 [Internet]. 2015 [cited 2017 Mar 24]. Available from: http://www.hc-sc.gc.ca/ewhsemt/consult/_2014/safety_code_6-code_securite_6/final_finale-eng.php

speed and reversibility of a reaction is determined in part by the changes in energy to achieve the transition state (the "activation energy"), and to form reaction product(s). Some reactions may proceed in multiple possible ways, with a number of products, and product distribution is related to steric (geometric) issues and energetics. Reversibility of reactions and equilibrium states depend upon a number of factors, including the activation energy for the reverse reaction.

Acceleration of chemical reactions, or *catalysis*, occurs when the activation energy required to initiate reaction of molecule(s) is lowered. Catalysis of (bio)chemical reactions is well known and additives may be used by chemical engineers and chemists for more rapid, complete, and sometimes more specific chemical conversion. Catalysis also occurs with low-level MW exposure.[21,22,23] Microwave catalysis was described by chemists and chemical engineers roughly a half-century ago; a 2001 review with 603 references describes hundreds of long-standing "microwave assisted" chemical reactions,[24] and journal *Current Microwave Chemistry* reports on these effects and efficiencies in chemistry, including biochemistry.[16] For example, a biochemical medical test develops in less than 5 minutes with MW exposure, versus 18 hours using conventional heating,[25] and MW radiation is used to accelerate enzymatic alteration of DNA.[26]

There is distinct cognitive dissonance when commercial enterprises can exploit a phenomenon that Health Canada insists does not occur.

[21] Zhou J, Xu W, You Z, Wang Z, Luo Y, Gao L, et al. A new type of power energy for accelerating chemical reactions: the nature of a microwave-driving force for accelerating chemical reactions. Sci Rep [Internet]. 2016 Apr 27 [cited 2017 Jan 11];6. Available from: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4846869/

[22] Kishimoto F, Matsuhisa M, Kawamura S, Fujii S, Tsubaki S, Maitani MM, et al. Enhancement of anodic current attributed to oxygen evolution on α-Fe2O3 electrode by microwave oscillating electric field. Sci Rep [Internet]. 2016 Oct 14 [cited 2017 Jan 15];6. Available from: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC5064412/

[23] Kokel A, Schäfer C, Török B. Application of microwave-assisted heterogeneous catalysis in sustainable synthesis design. Green Chemistry [Internet]. 2017 [cited 2018 May 25];19(16):3729–51. Available from: http://xlink.rsc.org/?DOI=C7GC01393K

[24] Lidström P, Tierney J, Wathey B, Westman J. Microwave assisted organic synthesis—a review. Tetrahedron [Internet]. 2001 Nov 5 [cited 2017 Jan 15];57(45):9225–83. Available from: http://www.sciencedirect.com/science/article/pii/S0040402001009061 [16] Current Microwave Chemistry. [cited 2019 Feb 7]. Available from: https://benthamscience.com/journals/current-microwavechemistry/

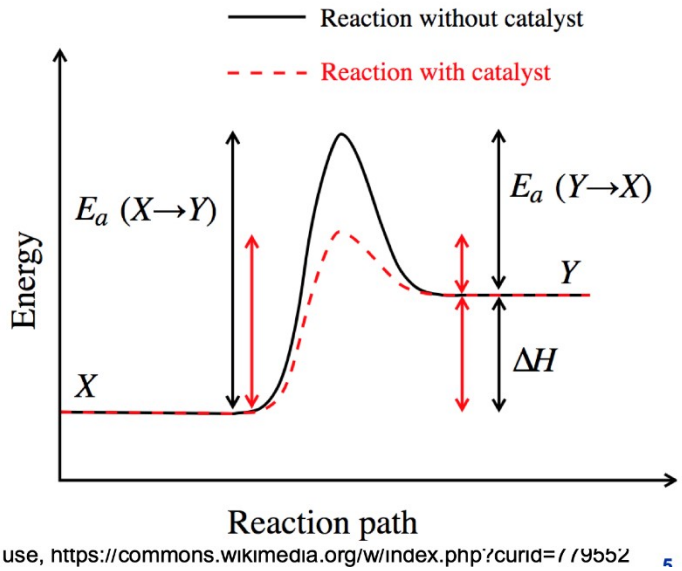
[25] Ahirwar R, Tanwar S, Bora U, Nahar P. Microwave non-thermal effect reduces ELISA timing to less than 5 minutes. RSC Adv. 2016 Feb 18;6(25):20850–7.

[26] Das RH, Ahirwar R, Kumar S, Nahar P. Microwave-mediated enzymatic modifications of DNA. Analytical Biochemistry [Internet]. [cited 2019 May 21];471:26–8. Available from: https://www.academia.edu/22412981/Microwavemediated_enzymatic_modifications_of_DNA

SPEEDING UP CHEMICAL REACTIONS – *CATALYSIS*

Metabolic pathways + molecular synthesis = chemical reactions

- The "energy of activation" E_a has to be overcome for a reaction to proceed.
- Higher activation energy means slower reactions.
- Changing the activation energy changes rates, and steady-state concentrations.
- Enzymes are catalysts that speed up biochemical reactions, mostly by aligning the chemical building blocks.
- Microwave radiation is also a catalyst.



P. Lidström et al. Microwave assisted organic synthesis—a review, Tetrahedron. 57 (2001) 9225–9283. doi:10.1016/S0040-4020(01)00906-1.

Figure 2: Reaction Pathway and Chemical Catalysis E_a = energy of activation; X = chemical reactant(s); Y = chemical product(s); (delta) ΔH = change in free energy between reactants X and products Y

Microwave radiation affects molecules that have an uneven electrical charge distribution, called *polar* molecules. This is seen in everyday life, in microwave ovens, with efficient heating of water (in H_2O the

oxygen O atom is more negatively charged while the hydrogen H atoms are more positively charged) and poor heating of oil that has a uniform electrical charge distribution. Heating is the result of vibration of polar molecules.

Microwave catalysis can be optimized in multi-phase systems, with non-polar chemicals dispersed in the reaction mixtures. It is thought that reactants may more readily align on the interface between a polar (e.g., aqueous) and non-polar (e.g., oil or lipid) substance in a suspension. This affects not only the speed of reactions but also the identities of chemical products when more than one outcome is possible.

MW/RFR effects in living systems

Catalysis does not occur equally for all biochemical reactions,[13] so in living systems, the differential acceleration of some reactions may disrupt the finely tuned biochemical cascades of metabolism, genetic replication, transcription into proteins, signal transmission along nerves, etc. The resulting molecular damage, chemical imbalances, and dysfunction would be consistent with observed biochemical (e.g., DNA damage, increased ion flux through membranes, and oxidative stress) and health effects in humans, animals, plants, and isolated cells.[27]

Membranes surrounding cells, as well as subcellular features such as mitochondria and nuclei, are phospholipid bilayers, with polar phosphate groups on the surfaces and long lipid (non-polar) molecules intertwined in the center of the membrane. Differential effects of MW/RFR on polar versus non-polar materials sheds light on the profound effects of MW/RFR on membranes, as the non-polar lipid bilayer is relatively unaffected whereas the polar phospho- groups on the surfaces of membranes, as well as other polar groups listed above, vibrate under the influence of the radiation. This causes stress and potential degradation of membranes and other structures.

[27] Markkanen, A. (2009). Effects of electromagnetic fields on cellular responses to agents causing oxidative stress and DNA damage. *Kuopio Univ Environ Sci*, *253*(1), 1-59.

MW/RFR AND LIPID BILAYER MEMBRANES

- Broad implications for function -

- Localized heating of polar constituents causes lipid bilayer membrane damage, shedding of proteins, leakage of ionophores
- Disruption of membrane-associated reactions (metabolism, synthesis of macromolecules) in mitochondria, ribosomes, nucleus, endoplasmic reticulum, etc.
- Disruption of barriers – e.g., blood-brain barrier
- Myelin damage
- Testes damage
- Eye damage

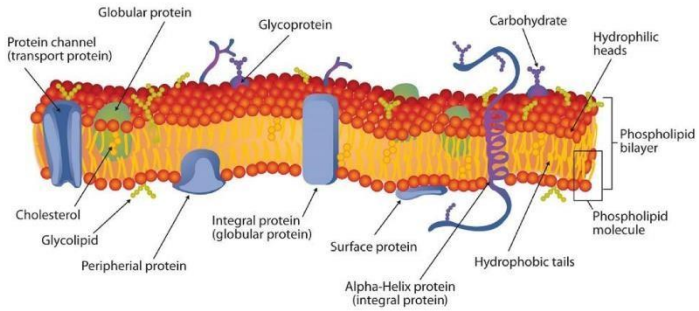


Figure 3

Membrane-embedded systems of enzymes are key features for metabolism, synthesis, and catabolism, for example in the mitochondria, ribosomes, nucleus, and endoplasmic reticulum. Tissues with rapid metabolism and growth, such as in the testes, are affected.[28,29] Proteins embedded in cell membranes, such as transport channels, can be affected, and their stable location in the lipid membrane will be disturbed. Dr. Martin Pall has compiled a large body of research on effects of MW/RFR on calcium channels and increased "leakage" of cations (particularly calcium) across membranes, with beneficial (e.g., enhanced bone growth) or adverse effects.[30]

Amino acids in proteins, DNA, enzymes, receptors, and pores to transfer ions and chemicals are embedded in membranes. All of these have non-uniform charge distributions that are key to their

[28] La Vignera S, Condorelli RA, Vicari E, D'Agata R, Calogero AE. Effects of the Exposure to Mobile Phones on Male Reproduction: A Review of the Literature. Journal of Andrology [Internet]. 2012 May 6 [cited 2017 Mar 4];33(3):350–6. Available from: http://onlinelibrary.wiley.com/doi/10.2164/jandrol.111.014373/abstract

[29] Adams JA, Galloway TS, Mondal D, Esteves SC, Mathews F. Effect of mobile telephones on sperm quality: A systematic review and meta-analysis. Environment International [Internet]. 2014 Sep [cited 2017 Mar 27];70:106–12. Available from: http://www.sciencedirect.com/science/article/pii/S0160412014001354

[30] Pall ML. Electromagnetic fields act via activation of voltage-gated calcium channels to produce beneficial or adverse effects. J Cell Mol Med [Internet]. 2013 Aug [cited 2019 Jun 27];17(8):958–65. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3780531/

structures and functions. These interact with MW/RFR, which is electro*magnetic* radiation, with fluctuating electric and magnetic fields. Barnes and Greenebaum describe theoretically and experimentally how very low magnetic fields affect chemical reactions and cellular dysfunction.[31]

Nerves are surrounded by fatty, electrically inert, insulating myelin. The polar structures associated with electrical nerve signal conduction interact with fluctuating electromagnetic fields while the myelin doesn't, causing stress and breakdown of the interface between the interior nerve and its myelin sheath. Children's and adolescents' nervous systems and myelin are still developing, making them more vulnerable to harm from MW/RFR.[32]

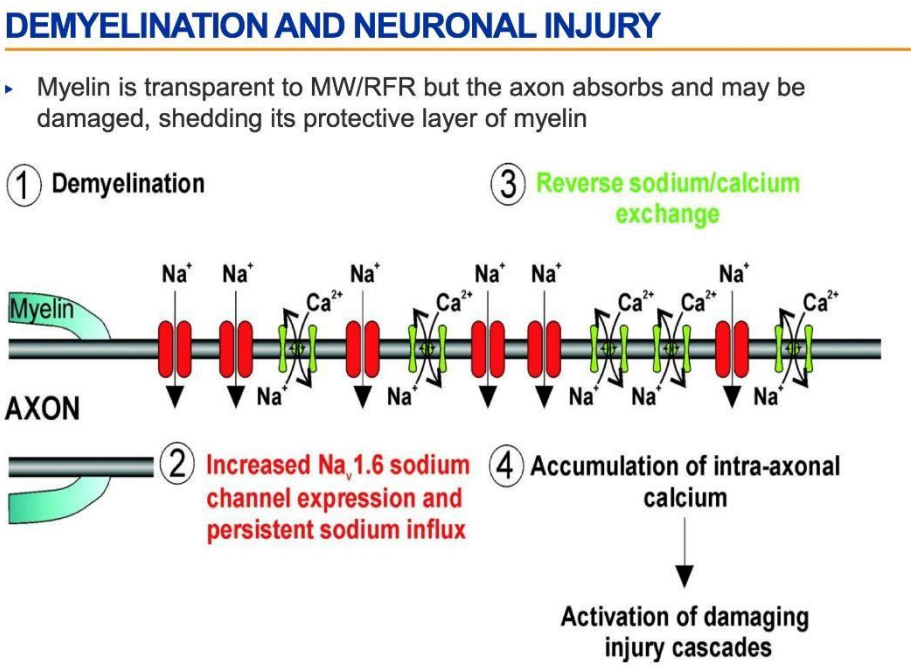


Figure 4

Polarization of membranes and maintenance of concentration differentials of various molecules is central to the function of the nervous system—both of transmission of the action potential along the axon and increased calcium release via damaged channels at the synapse. Interestingly, calcium channel-blocking medications may help to ameliorate some neuropsychiatric symptoms associated with MW/RFR in sensitive individuals.[33]

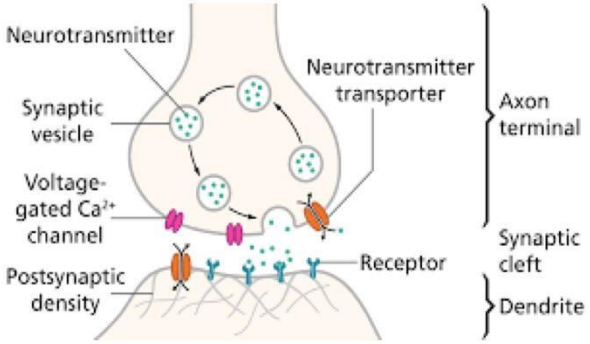
[31] Barnes F, Greenebaum B. Some Effects of Weak Magnetic Fields on Biological Systems: RF fields can change radical concentrations and cancer cell growth rates. IEEE Power Electronics Magazine [Internet]. 2016 Mar [cited 2017 Mar 26];3(1):60–8. Available from: http://ieeexplore.ieee.org/document/7425396/

[32] Redmayne M, Johansson O. 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;17(5):247–58.

[33] Pall ML. Microwave frequency electromagnetic fields (EMFs) produce widespread neuropsychiatric effects including depression. Journal of Chemical Neuroanatomy [Internet]. 2016 Sep [cited 2017 Jan 13];75, Part B:43–51. Available from: http://www.sciencedirect.com/science/article/pii/S0891061815000599

MEMBRANES - VOLTAGE GATED CALCIUM CHANNELS

- VGCC are present at a very high density in the nervous system and are responsible for releasing neurotransmitters and neuroendocrine hormones
- Cardiac and neurological symptoms result; there is a possible role for calcium channel blockers for treatment



Pall. 2015 "Microwave frequency electromagnetic fields (EMF's) produce widespread neuropsychiatric effects including depression," *J Chem Neuroanatomy 75*

Figure 5

Decades of research has repeatedly demonstrated DNA damage, both single- and double-strand breaks, in laboratory cultures, blood cells, buccal scrapings, and sperm. Blank and Goodman proposed a DNAbased metric to assess health effects of MW/RFR based on protein synthesis resulting from stress response.[8] A 2019 review of DNA damage measurements in cell cultures of human or animal cells called into doubt this finding, indicating that smaller studies are more likely to result in positive findings.[34] Unfortunately, in grading of the evidence the authors failed to consider funding,[35] baseline DNA status, or the fact that genotoxicity has been poorly predicted using tissue culture studies.[36]

[34] Vijayalaxmi, Prihoda TJ. Comprehensive Review of Quality of Publications and Meta-Analysis of Genetic Damage in Mammalian Cells Exposed to Non-Ionizing Radiofrequency Fields. rare [Internet]. 2018 Oct [cited 2019 Jun 27];191(1):20–30. Available from: http://bioone.org/journals/Radiation-Research/volume-191/issue-1/RR15117.1/Comprehensive-Review-of-Qualityof-Publications-and-Meta-Analysis-of/10.1667/RR15117.1.full

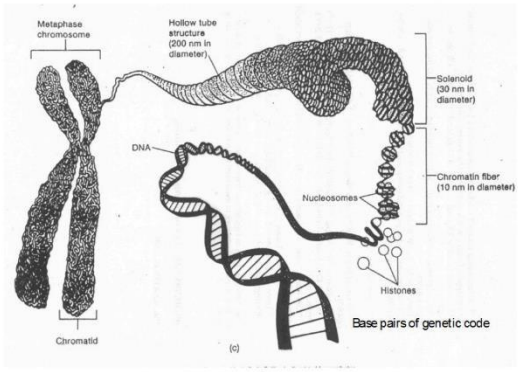
[35] Huss A, Egger M, Hug K, Huwiler-Müntener K, Röösli M. Source of Funding and Results of Studies of Health Effects of Mobile Phone Use: Systematic Review of Experimental Studies. Environmental Health Perspectives [Internet]. 2007 Jan [cited 2019 Jun 6];115(1):1–4. Available from: https://ehp.niehs.nih.gov/doi/10.1289/ehp.9149

[36] Corvi R, Madia F. In vitro genotoxicity testing–Can the performance be enhanced? Food and Chemical Toxicology [Internet]. 2017 Aug 1 [cited 2019 Jun 27];106:600–8. Available from: http://www.sciencedirect.com/science/article/pii/S0278691516302903

DNA DAMAGE

- Decades of research has repeatedly demonstrated DNA damage, both single- and double-strand breaks – e.g., in blood cells, buccal scrapings and sperm
- Blank and Goodman proposed a DNA-based metric to assess health effects of MW/RFR based on protein synthesis resulting from stress response

DNA image from Dr. Blank's submission to Canadian Parliamentary Committee, 2015



Human DNA: 2 meters long, 3 billion base pairs, many loop sizes

Blank & Goodman. 2012. Electromagnetic fields and health: DNA-based dosimetry, Electromagnetic Biology and Medicine, 31:4, 243-249, DOI: 10.3109/15368378.2011.624662

Figure 6

In the face of plummeting male fertility,[37] evidence that cell phones in pockets and laptops on laps damage sperm and impair fertility[17,18] provides strong reasons for changes in technologies and strong precautionary advice.

[37] Levine H, Jørgensen N, Martino-Andrade A, Mendiola J, Weksler-Derri D, Mindlis I, et al. Temporal trends in sperm count: a systematic review and meta-regression analysis. Hum Reprod Update [Internet]. [cited 2017 Jul 26];1–14. Available from: https://academic.oup.com/humupd/article/doi/10.1093/humupd/dmx022/4035689/Temporal-trends-in-sperm-count-a-systematicreview

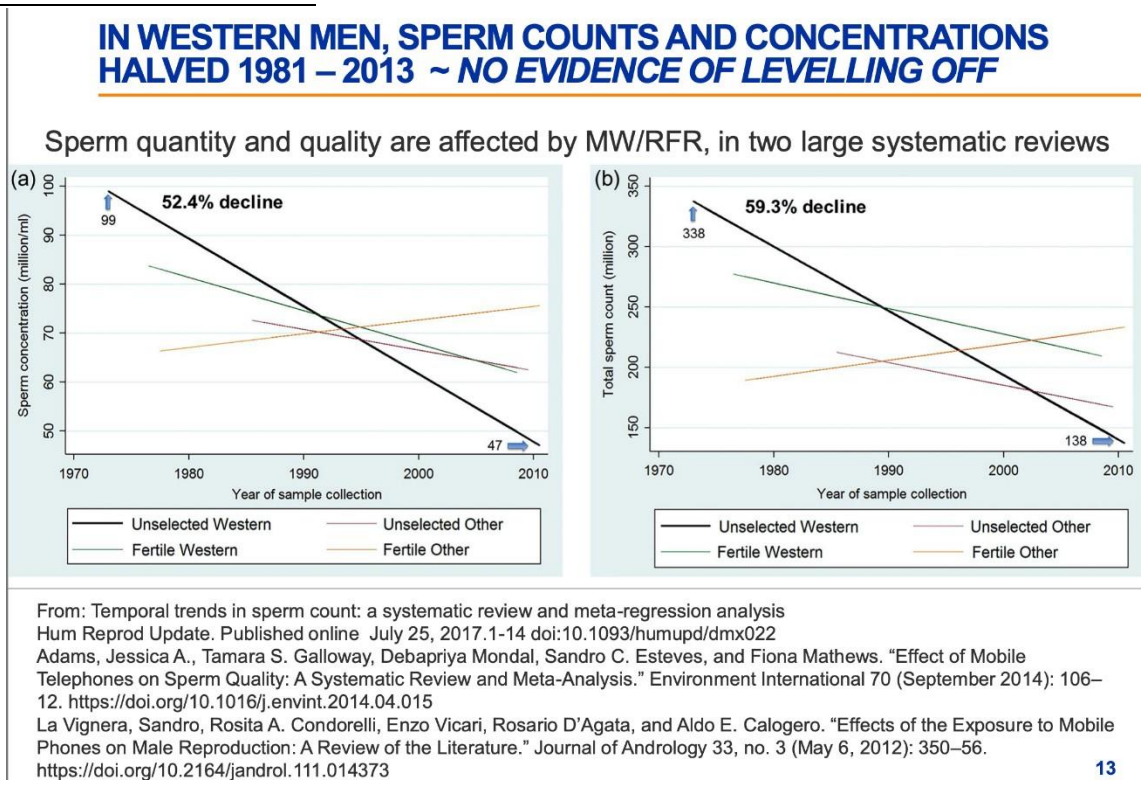


Figure 7

Another membrane, the blood brain-barrier is impaired with exposure to MW/RFR. Enhanced toxicity of lead has been observed in a study of 2,422 Korean school children, where the children in the quartile with both highest cell phone call times and highest blood lead levels exhibited significantly greater attention deficit hyperactivity disorder symptoms.[30] Potentiation of toxicities of other exposures by MW/RFR has

also been observed in animal studies, particularly of chemical[38,32] as well as gamma radiation[39] cocarcinogens.

Public health and costs

In Canada public health is declining, such that the historical diseases of aging are no longer the diseases of the aged. Chronic diseases and cancers (associated with obesity) are increasing in younger Canadians.[40] At the same time, public health care costs reached $260 billion in 2019, and are increasing faster than the gross domestic product. In addition are private costs, lost opportunities and productivity, and heartache.

[30] Byun Y-H, Ha M, Kwon H-J, Hong Y-C, Leem J-H, Sakong J, et al. Mobile Phone Use, Blood Lead Levels, and Attention Deficit Hyperactivity Symptoms in Children: A Longitudinal Study. PLOS ONE [Internet]. 2013 Mar 21 [cited 2019 May 18];8(3):e59742. Available from: https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0059742

A 2018 review of biological and health effects of MW/RFR concluded that rapidly increasing levels of MW/RFR poses serious global threats.[9] The review found at least 10 reviews demonstrating the following effects associated with typical exposures to MW/RFR:

- Cellular DNA damage
- Changes in testis structure, lowered sperm quantity and quality
- Neurological/neuropsychiatric effects
- Apoptosis/cell death
- Calcium overload • Endocrine effects.

Is this an *experiment*?

Some characterise the unprecedented, rapid escalation of RFR from personal use of wireless devices, WiFi, intensive deployment of "small cell" antennae throughout communities, increasing installations on existing towers, and widespread coverage of natural areas from satellites in orbit as an "experiment." They deride being treated like lab rats.

In fact, today's rapid deployment of novel technologies with more frequency bands and complex modulations in intensive arrays is worse than an "experiment." We are not tracking exposures to more and more wireless devices and connectivity in nurseries and schools, homes and the community, at work and at play, including around and for use by very young children.

[38] Lerchl A, Klose M, Grote K, Wilhelm AFX, Spathmann O, Fiedler T, et al. Tumor promotion by exposure to radiofrequency electromagnetic fields below exposure limits for humans. Biochem Biophys Res Commun. 2015 Apr 17;459(4):585–90. [32] Tillmann T, Ernst H, Streckert J, Zhou Y, Taugner F, Hansen V, et al. Indication of cocarcinogenic potential of chronic UMTSmodulated radiofrequency exposure in an ethylnitrosourea mouse model. International Journal of Radiation Biology. 2010 Jul
1;86(7):529–41.

[39] Soffritti M, Giuliani L. The carcinogenic potential of non-ionizing radiations: The cases of S-50 Hz MF and 1.8 GHz GSM radiofrequency radiation. Basic & Clinical Pharmacology & Toxicology [Internet]. [cited 2019 Jun 27];0(0). Available from: https://onlinelibrary.wiley.com/doi/abs/10.1111/bcpt.13215

[40] Brenner DR, Ruan Y, Shaw E, O'Sullivan D, Poirier AE, Heer E, et al. Age-standardized cancer-incidence trends in Canada, 1971–2015. CMAJ [Internet]. 2019 Nov 18 [cited 2019 Nov 18];191(46):E1262–73. Available from: https://www.cmaj.ca/content/191/46/E1262

Environmental exposures and effects on birds and insects, critical to ecosystems, are little known. Simplistic research and campaigns focus on one factor at a time rather than integrating radiation, pesticides, climate change, and habitat loss.

Characterisation of rollout of 5G / "Internet of Things," with untested exposures and expected adverse effects, is unscientific.

An ethical "experiment" would entail:

1. a justifiable hypothesis that there will be "no adverse effect";
2. approval of experimental design and data collection for exposed and unexposed populations;
3. ethics approvals, that are mandatory for all human and animal experimentation;
4. informed consent from every participant (that is, everyone);
5. interim analysis to halt the experiment at the first sign of problems; and
6. analyses, public reporting of results, and discussion and implementation of logical next steps.

None of this is in place. There is no "unexposed population." What is unfolding is unscientific, even reckless. As with other harmful exposures, vested interests downplay effects and ascribe them to other factors. Meanwhile, harms to human health increase, countered only at great personal cost by those who both recognize the sources of their symptoms and have the wherewithal to address exposures. In this complex world, with sufficient data collection (personal exposures are not measured or recorded today), effects on human and ecological health might eventually be broadly recognized—hopefully before considerable harm has accrued.

Healthier solutions

Wireless mobile communications offer hazards as well as conveniences. Although public health advantages of mobile communications in emergency response are self-evident, the risk/hazard trade-off is not met for a plethora of applications that could be physically connected. Examples include Internet and intranet connections in schools and the workplace, sensors and transmitters for fixed applications such as in buildings,[41] frivolous applications in toys for all ages, and applications or entertainment that could be downloaded through a fixed connection before utilization.

Just because you *can* do something wirelessly, doesn't mean that you *should.* Optical fiber is being developed as a "backbone" for Internet with higher speed and bandwidth, and lower latency. Fiber needs to reach the "fingers and toes" across communities and throughout buildings. Fiber (including wires) is more reliable, secure, resilient, and results in much lower greenhouse gas emissions than wireless.[42] Deployment of MW/RFR-emitting satellites for extensive, remote coverage will cause untold ecological harm to insects, birds, and higher fauna as a result of the radiation, atmospheric ozone layer damage from launches,[43] and disruption of weather forecasting,[38] stargazing, and astronomy.[44]

---

[41] Clegg FM, Sears M, Friesen M, Scarato T, Metzinger R, Lee Russell C, et al. Building science and radiofrequency radiation: What makes smart and healthy buildings. Building and Environment [Internet]. 2019 Aug 6 [cited 2019 Sep 4];106324. Available from: http://www.sciencedirect.com/science/article/pii/S0360132319305347

[42] Schoechle T. Re-Inventing Wires: The Future of Landlines and Networks [Internet]. National Institute for Science, Law & Public Policy. Washington DC, USA; 2018 [cited 2019 May 27]. Available from: http://electromagnetichealth.org/wpcontent/uploads/2018/05/Wires.pdf

[43] Ross M, Toohey D, Peinemann M, Ross P. Limits on the Space Launch Market Related to Stratospheric Ozone Depletion. Astropolitics [Internet]. 2009 Mar 5 [cited 2020 Jan 18];7(1):50–82. Available from: https://doi.org/10.1080/14777620902768867

[38] Witze A. Global 5G wireless networks threaten weather forecasts. Nature [Internet]. 2019 Apr 26 [cited 2019 May 15];569:17. Available from: http://www.nature.com/articles/d41586-019-01305-4

[44] Staedter T. Stargazers fight to save the dazzling dark [Internet]. Experience Magazine. 2020 [cited 2020 Jan 20]. Available from: https://expmag.com/2020/01/stargazers-fight-to-save-the-dazzling-dark/