# An Invisible Web of Energy: The impact of radiofrequency/ microwave technology on our health

**By Dr. Deborah Kennedy, MBA, ND**

Recently, the CBC reported that parents in Ontario were concerned about wireless fidelity (wi-fi) installations in their children's elementary school since many of their children were complaining about experiencing headaches, dizziness, nausea, and loss of balance.[1] While Lakehead University has stated that they will not expand their wi-fi networks on their Thunder Bay and Orilla campuses until there is greater clarity regarding the health effects, if any.[2]

## The Issue

In 2008 there were approximately 8,000 cell phone towers in Canada.[3] These towers are installed on existing structures such as the roof tops of buildings or as free standing structures. The Canadian Cellular Towers Map website (http://www.ertyu.org/steven_nikkel/cancellsites.html) provides a Google map of the cell phone tower locations. Viewing this map gives one a sense of the density of cell phone towers in Canada. The energy emitted by cell phone towers and wi-fi is a radiofrequency (RF) of 2.45 Giga Hertz (GHz). This is the same frequency that microwave ovens use, though at a much lower power intensity.[4]

The demand for wireless connectivity grows daily. Communities plan "hotspots", businesses wi-fi-enable their offices, schools wi-fi-enable their campuses, and we, our own homes. Mobile networks are increasing to ensure the cell phone coverage consumers desire. Additional RF exposure also comes from Digitally Enhanced Cordless Telecommunications (DECT) portable cordless telephones, baby and security monitors.

It is not difficult to imagine that as we move through our day, we encounter these RF fields from multiple locations with varying intensity and duration that children, in wi-fi enabled classrooms, are constantly surrounded by RF radiation during the school day.

## Background

Electric fields are produced as a result of voltage and measured as volts per meter (V/m). Electric fields can be shielded and the strength of the electric field can be diminished by trees, buildings and the like. Magnetic fields are generated as a result of current flowing through a wire. It is measured in micro Tesla (μT) or Gauss (G).[5] Magnetic fields can and do penetrate trees, buildings, and essentially all physical objects. Electrical and magnetic fields occur together when current is flowing through a device. The strength of both of these types of fields lessens the further away you are from the point of origin.

Radiofrequency radiation is non-ionizing radiation in the 300 to 3000 MHz (3 GHz) range of the electromagnetic spectrum.[4] This frequency range is below the visible light spectrum, and much lower in frequency than gamma and x-ray radiation. These latter two forms are known as ionizing radiation and have the ability to damage DNA as ionizing radiation causes chromosome breakage.

Microwave energy has a 2.45 GHz frequency, and the radiofrequency band ranges from approximately 3 kHz to 300 GHz.[6] Historically, the primary concern regarding radiofrequency/microwave frequency are the thermal effects that this electromagnetic radiation has on biological tissue. As a result, exposure guidelines have been set by a variety of different agencies. In Canada, these guidelines are set out in Limits of Human Exposure to Radiofrequency Electromagnetic Energy in the Frequency Range from 3 kHz to 300 GHz - Safety Code 6 (2009).[7] Other countries have established their own guidelines for RF exposure. The World Health Organization in 1996 established the International EMF Project to assess the scientific evidence of possible health effects of electromagnetic fields (EMF) in the 0 to 300 GHz range.

Many public health organizations and advocacy groups are concerned that the established guidelines do not provide sufficient protection for the public. There is a growing body of evidence, albeit conflicting, that suggests that low level exposure insufficient to cause thermal effects of RF radiation, can and does nevertheless have an impact on biological tissue and physiological functions. The Bioinitiative Project report, released in 2007, calls for guidelines that also take into consideration exposure to non-thermal effects of RF radiation and an implementation of the precautionary principle.[4] The precautionary principle, "… applies where scientific evidence is insufficient, inconclusive or uncertain and preliminary scientific evaluation indicates that there are reasonable grounds for concern that the potentially dangerous effects on the environment, human, animal or plant health may be inconsistent with the high level of protection chosen by the EU."[8]

## Key facts

- Radiofrequency (RF) radiation involves not just cell phones but includes other sources such as cell phone towers, wi-fi networks, and some baby and security monitors. Unlike cell phones where the concerns involve RF exposure to the head, these emissions encompass whole body exposure and chronic low level exposure.
- As technology implementations increase and becomes more widespread, our exposure to RF radiation increases both in terms of duration and intensity.
- Exposure to low level RF radiation has demonstrated negative effects on sleep, memory and learning, cells of the immune system and behaviour. Children are thought to be particularly susceptible as they are still in their growth and development phase.
- There are currently no exposure guidelines that address the non thermal and chronic exposure limits to RF fields. Many concerned scientists, health care practitioners, advocacy groups and parents are advocating for the precautionary principle regarding this technology and for future research into appropriate standards.
- A potential emerging illness is electromagnetic hypersensitivity disorder, characterized by a range of symptoms from headaches, nausea, and loss of balance to memory and focus problems.

## Possible health impacts of RF fields

### *Sleep, Learning/Memory and other symptoms*

The role of sleep in humans is critical. In addition to providing the necessary time for regeneration and healing, sleep is implicated in learning and memory.[9] Melatonin is an important hormone in the body, helping to maintain the appropriate circadian rhythms of the body. In addition to controlling sleep, melatonin is a potent antioxidant and plays a role in learning and memory.[4, 10] Extremely low frequency (ELF) exposure has been found to reduce the amount of melatonin released from the pineal gland and reduced urinary excretion of melatonin metabolites in post menopausal women who reside close to RF transmitters.[10]

Santini et al conducted a survey of 530 people, comparing those that lived within 300 metres of cellphone towers with those outside this range. The survey assessed 18 non-specific health symptoms. There were significant differences between the two groups. Those within the 300 metre range complained more frequently regarding headaches, sleep disturbances, depression and loss of memory versus those outside 300 metres.[11]

In a second study, Hutter et al evaluated 365 subjects who had lived for at least one year within range one of 10 cellular towers in Austria.[12] Subjects were asked to complete the Zerssen scale, an assessment of depression symptoms, the Pittsburgh sleeping scale, for sleep problems, and cognitive performance tests. After the testing was complete, the field strength of high frequency EMF fields in the bedroom was assessed. Their findings suggest that with increasing field strength there were greater complaints associated with headaches and poor performance tests.[12] They found no significant effect on sleep quality.

A much earlier study conducted by Kolodynski and Kolodynska, in children chronically exposed to frequencies from radio towers found that the exposed children had poor memories and attention problems versus children who were not exposed to these emissions.[13]

### *Free radical generation and immune system impacts*

The Risk Evaluation of Potential Environmental Hazards from Low Frequency Electromagnetic Field Exposure Using Sensitive *in vitro* Methods (REFLEX) report assessed the biological effects of RF EMF fields using sophisticated and diverse research methodologies.[14] The results of these *in vitro* studies demonstrated that RF EMF fields promote the generation of heat shock proteins within cells.[14] Additional evidence for this phenomena has been reported by Leszczynski et al.[15] The formation of heat shock proteins represents a cellular stress response. In HL-60 cells, RF EMF radiation did increase free radical generation. The *in vitro* results regarding RF EMF impact on DNA cell cycles and apoptosis were inconclusive.[14]

Eger et al assessed cancer incidence in a stable, closely-knit community in Naila, Germany over a 10 year period, from 1993 to 2004, after the installation of a cellular tower.[16] The researchers compared the occurrence of cancer among the residence within 400 metres of the tower versus those living outside the 400 metre radius. The cancer rate tripled within the 400 metre zone in the time period from 1999 to 2004.[16] The location of the cancer within the body was variable, however, those within the 400 meter radius did develop cancer at a younger age.

Some individuals report adverse skin reactions upon exposure to RF fields. Upon examination, the most common findings are increases in mast cell markers, such as histamine.[17] Often, mast cell degranulation and release of histamine is associated with immune system responses to allergenic substances. Johansson has developed the "mast cell hypothesis" to explain these dermatological reactions, hypothesizing that it is the body's immune response to the detection of a foreign substance, the low level RF field.[18]

### *Behavioural impact*

The association between mobile telephone and mental health behaviours in children and adolescents was recently studied for the first time by Thomas et al. Dosimetry measurements of RF field exposure over a 24 hour period were taken in 3,000 children and adolescents concurrent with mental behaviour assessments using the Strengths and Difficulties questionnaire (SDQ). The SDQ assesses overall behavioural problems, including emotional, conduct, hyperactivity and peer relationship problems. The RF exposures were quartiled and the highest quartile was associated with overall behavioural problems for adolescents (OR 2.2; 95% CI 1.1–4.5) but not for children (1.3; 0.7–2.6).[19]

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### *Children*

The concern for children is multi-faceted. The impact on normal growth and development of children of chronic exposure to low intensity RF fields is unknown. Children are being exposed to these RF fields at younger ages versus adults. Given this, their lifetime exposure will be much higher than for the adult population.[20] There is a paucity of research on the potential effects of chronic low level RF emissions in children.

## An emerging illness?

Electromagnetic hypersensitivity (EHS) is associated with a wide variety of symptoms. The symptoms range from headaches, joint pain, inability to focus, feeling wired, and sleep disorders and are reported by individuals during exposure to EMF fields.[21] For many, their symptoms are debilitating and affect their quality of life.

The points raised in this article's section on possible health impacts do suggest some mechanisms to explain the symptoms experienced by people who report EHS symptoms. However, the aetiology of EHS is unknown and the percentage of individuals impacted varies by region.[22] For example, California and Sweden report prevalence rates of 3.2 % and 1.5% respectively, while in Germany it is as high as 10%.[23-25] Sweden is the only country that recognizes EHS as a disability.[4, 21]

Attempts have been made to evaluate these EHS phenomena though controlled studies. Generally, a group of EHS individuals and controls have been tested to assess their ability to detect the presence of low intensity RF fields. In most of these studies, EHS individuals have not always reliably detected the presence of these low level emissions, and therefore many researchers have discounted the problem.[22]

## Addressing the problem

How can naturopathic doctors help? Firstly, we can believe EHS suffers and their reported symptoms. This is not the first illness for which medical science has not yet confirmed an aetiology. Fibromyalgia and multiple chemical sensitivities serve as examples of illnesses that 15 years ago were not recognized as such.[21] There is, as yet, no treatment for EHS except for avoidance. However, naturopathic doctors are guided by the therapeutic order and the first two steps in the therapeutic order may provide some assistance:

Remove the obstacles to cure.

- Replace wi-fi in the home and office with wired Internet connectivity and telephones. Avoid the use of portable telephones.
- When using your computer, turn off the wireless card when not connected to the Internet.
- Be aware of the location of cell phone towers where you/your patients live and work. Check out the cell phone tower map.
- Find RF-free zones in the home/community and spend time in these areas.
- Some studies have looked at heavy metal exposure in individuals with EHS symptoms, however, elevated levels were not seen in those with EHS.[26] This may not always be the case as these assessments were not provocative.
- Following the principle of "First, do not harm." Be informed and active in your community regarding the appropriate uses of technology.

Establish a healthy regimen.

- Reduce the body's sensitivity to food and other chemical substances.
- Ensure that the body emunctories are working effectively.
- Balance the immune system so that it is less reactive to the possible effects of RF exposure.

## About the Author

Deborah is a licensed naturopathic doctor in the province of Ontario and a graduate of the Canadian College of Naturopathic Medicine (CCNM). Deborah completed a two-year residency at CCNM deepening her experience with patient care. Deborah is the recipient of a three-year career development grant from the Sickkids Foundation and is pursuing a PhD in Pharmaceutical Science at the University of Toronto working under the supervision of Dr. Gideon Koren, Director of the Motherisk program at The Hospital for Sick Children. At CCNM, Deborah continues her research activities involved in the development of Lung Cancer Guidelines (a CIHR supported initiative), where her focus is on the interactions between natural health products and pharmaceutical drugs used to treat lung cancer. In addition to maintaining a part-time private practice, Deborah continues to work as a teaching assistant at the College in Integrative Therapeutics, Principles in Research and Emergency Medicine. Deborah is also a member of the Editorial Board of the International Journal of Naturopathic Medicine.

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