

The Evolving Picture of EMR and Its Biological Effects

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Background

During the last number of years, the issue of electromagnetic fields (EMFs) and Radio frequencies (RF), collectively termed Electromagnetic radiation (EMR) has received a lot of conflicting attention in the media. As a naturopathic doctor, building biologist and environmental consultant, my hope is that this paper will help clarify and demystify some of the issues around EMR in addition to providing information around sources, potential risks and how to minimize exposure.

Public exposure to non-ionizing radiation has increased dramatically during the last 20 years, particularly to RF radiation which comes from wireless transmission devices. For the first time in history, more than 4 billion people worldwide are holding microwave transmitters (cell phones/cordless phones) next to their heads for minutes to hours every day.¹ Wireless technologies have intensified the electromagnetic environment with unprecedented levels of RF that have risen ten-fold to a hundred-fold in many urban areas due to wireless transmission for cellular phones.^{2,3} In some cases wi-fi networks blanket entire cities with RF fields called Wi-Max. As primary health care providers, it is important that we have a clear understanding of EMR as a potential concern and possible bio-toxin which can contribute to the development of symptoms, disease and perhaps function as an obstacle to cure. Moreover, limiting one's chronic exposure to EMR may be one of the most important aspects of prevention.

The spectrum of electromagnetic frequencies encompasses a range of electric, magnetic and radio frequencies which span a spectrum from slower to faster cycles per second. The electromagnetic spectrum begins at one end with non-ionizing fields and proceeds to include ionizing radiation such as X-Rays, gamma rays and cosmic rays. The two principle types of EMFs discussed in this paper are extremely low-frequency electromagnetic fields (ELF-EMF), which are produced when electrical power is transmitted and distributed and radiofrequency/microwave radiation (RF), which is a faster frequency produced by cell phones, cordless phones and all other wireless devices.

Sources

Sources of EMR are many in our homes, work, learning and public environments. Let's first look at how to identify and measure these fields. Then let's look at the signs, symptoms and disease states that have been associated with EMR. This article does not address laboratory assessment tools, for example, blood, saliva and urine tests, for diagnosing EMR influences, simply because it is not known how these diag-

nostic tools might apply. This article does not review different treatment options, as the possible effects of EMR are far-reaching, from insomnia to electro sensitivity to leukemia.

Naturopathic doctors know that the treatment for those suffering from these symptoms and diseases is individual-based and must be addressed accordingly. Prudent avoidance of known and controllable sources of EMR is crucial to treatment and prevention. By removing EMR sources, especially in one's sleeping area, it is clinically seen that many health issues improve. This article reviews how as primary care physicians NDs can identify possible signs and symptoms that are suggestive of EMR effects and how to limit EMR exposure. Very similar to the effects of removing an allergen from a person's environment, the body has a greater opportunity to heal without being in a state of biological stress under the continual influence of that allergen.

Sources of electric, magnetic and electromagnetic fields include any electrical device. Inside the built environment this includes any appliance, electrical wiring, electric panel boxes and electronics. The strongest fields come from the stove, microwave, refrigerator, electrical wall/baseboards heaters, dimmer switches, TVs and computers. Other sources include: hair dryers, electrical exercise machines, electrical blankets, clock radios, electric instruments, electrical tools and air conditioners. It is best not to stand close to, sleep next to or sit for periods of time close to these devices. It is important to note that even if an electrical device is turned off there is still an electric field emitted from the appliance as long as it is plugged in. There is no magnetic field emitted from an appliance unless it is turned on, in which case there are both electric and magnet fields present. EMF sources outside a building include high voltage power transmission lines carrying electricity from power generating plants to communities and power distribution lines, that bring electricity into the house, schools and workplaces. On the higher end of the electromagnetic frequency spectrum there are radio frequencies emitted from wi-fi, baby monitors, hydro Smart Meters on homes, fluorescent lighting, cordless phones, cell phones and cell towers.

Electric fields can be measured with electric field meters. Magnetic fields can be measured by a gauss meter. Radio Frequencies can be measured by RF meters. These meters can be purchased at www.safelivingtechnologies.ca or in finding a Building Biologist (also known as a Bau Biologist), one can have their living, work and/or learning environment inspected and measured with recommendations as to how to create a healthier space. A list of certified Bau Biologists, as well as courses on EMF can be found at www.buildingbiology.net.

Research

It is significant that many of the studies conducted on radio frequencies have been financed by the communications industry. This is a conflict of interest and as a recent Swiss analysis on cellular phone studies states, the source of research funding has affected the reporting of results. Specifically, those studies funded by the telecommunications industry were least likely to report a statistically significant result.⁴

There is also the limitation that EMF studies cannot be performed on humans. As there is a possible disease contributing effect of EMF, human rights laws protect scientific experiments from being conducted on humans. Thus, double-blinded placebo-based research has been conducted almost entirely on animals. Conclusions from these studies are limited in their application to human populations because of the differences in species. Many studies have microscopically examined the effects on EMR on human cells, in particular human DNA, however this form of research limits our scope of causal conclusions of how EMR affects the whole organism.

Epidemiological studies have been used to study the potential biological effects of EMFs. This form of research is also inherently limited. With epidemiological studies, human groups are examined over a period of time and patterns are analysed within these specific groups. The limitation with epidemiological research is that direct causal relationships cannot be made; only inferences, correlations and possible links can be concluded as there are too many variables at play with groups of people in their own natural environments. Another limitation with epidemiological research is that in order to see any potential patterns, people need to be examined over a period of time greater than 10 years, which has been the assessed minimum amount of time that it takes to note significant developments of disease patterns in populations. The long and costly nature of these studies significantly delays the implementation of corrective public health measures.

This then brings us to the complex issue of public health standards. It has been stated by many that the existing standards for non-ionizing radiation are inadequate to protect public health and do not include any possibility of long-term effects which are the most common type of exposure and is most likely to produce effects on health, including cancer. Existing standards for ELF-EMF are set at 904 milligauss. However, science has shown that cancer risk may begin to increase at only two milligauss.⁵ Similarly, standards for cell phones are erroneously based on acute exposure and on thermal effect alone. The assumption is that unless RF exposure is strong enough to heat human tissue within 30 minutes, it is safe. Standards for personal wireless devices such as cell phones are based solely on absorbed heat into the skull, a measured unit called the Specific Absorption Rate (SAR). The Canadian and U.S. standard for cell phones is 1.6 watts per kilogram [W/kg], which is not sufficiently protective given evidence that health effects may occur at lower levels.⁶

In summation, we have a combination of limiting research, which takes a long time to conduct and informs inadequate public health standards. We also have modern societies

depending on the use of electricity and radiofrequency communications. Anything that restricts this would have potentially significant economic consequences. In the last 20 years, we have experienced globally massive technological advancements in wireless technologies and products that have fuelled a massive public demand. Add the fact that the electric utility and communications industries have enormous financial and political influence. It could be said that we have a nicely insulated and protected system. Some analysts suggest that situation mirrors the distortion of science pioneered by the tobacco, lead and asbestos industries and the subsequent delay in public health protection.

Signs and Symptoms

When examining research results from a number of reputable studies, it can be stated that there is a growing body of evidence, nothing one study could accomplish by itself, that strongly suggests that chronic low-exposure to non-ionizing radiation from radio frequency/microwave (RF) and extremely low frequency electromagnetic fields (ELF-EMF) may increase the risk of adverse health effects in children and adults.⁷ Substantial evidence suggests that ELF-EMF and RF can damage DNA, modify gene expression, and lead to altered cellular function as well as cancer.⁷ Recently, one of the largest international cell phone studies conducted by the INTERPHONE Study Group under the World Health Organization found an increased risk of malignant brain tumours called gliomas. These tumours are found at double the expected rate at only 10 years latency (time between exposure and diagnosis of cancer) when cell phones were used predominantly on one side of the head (laterality).^{8, 9} Further studies from Sweden and other parts of the world, including meta-analyses of studies conducted, have similarly shown an elevated risk of developing acoustic neuromas (a tumor on the nerve that passes from the inner ear to the brain related to hearing and balance). Similar to the Interphone study, these studies also showed an increased incidence of gliomas when cell and cordless phones were used for more than 10 years and predominantly on one side of the head.¹⁰⁻¹³ The International Association for Research on Cancer (IARC) classifies ELF-EMF as a Group 2B carcinogen (possible human carcinogen). This classification was made based on 25 years of study between the association between exposure to ELF-EMF and the risk of childhood leukemia. The IARC concluded that high (above 4 milligauss) and prolonged average levels of ELF-EMF exposure were associated with increased risk of childhood leukemia.^{14, 5} They further found evidence that suggests an increased risk of childhood leukemia following maternal occupational exposure to ELF-EMF during pregnancy. In adults, the IARC found that men who work in electrical occupations have an increased risk of breast cancer.¹⁵⁻¹⁷ Two studies in Sweden found that women who were both exposed to high-voltage power lines at work and at home had a higher risk of developing breast cancer than those exposed just at home.^{18, 19} A new study from China suggests that genetic variability in DNA repair mechanisms may make some children more susceptible to leukemia when chronically exposed to ELF-EMF during prenatal development.²⁰

UPDATE

EDITORIAL

CASE REVIEW

PRACTICE

RESEARCH

The Evolving Picture of EMR and Its Biological Effects, continued

With regard to what is empirically seen in practice, the following symptoms are commonly reported by patients claim to be 'reacting' to ELF - EMF and RF: insomnia, heart palpitations, fatigue, cold and/or tingling extremities, burning skin, unexplained dizziness and loss of balance, headaches, hyperactive behaviour, learning disabilities and difficulty concentrating. Others have noted a worsening of multiple chemical sensitivity reactions and allergy symptoms, sinusitis and sinus infections, and hormone irregularities. Other interesting findings that have been documented by Dr. Magda Havas, PhD from Trent University in Peterborough, Canada are elevated glucose levels in diabetics and Rouleaux formation, or clumping of live red blood cells, within 10 minutes of working on a computer, cordless or cellular phone. There is also a growing awareness of a syndrome called electrohypersensitivity syndrome (EHS) or electro sensitivity (ES). With this syndrome, any combination of symptoms present when the subject is around EMR. The term "radio-wave sickness" was historically used by Russian doctors to describe an occupational illness developed by large numbers of workers exposed to microwave or radiofrequency radiation. The symptoms were called "neurasthenic" and are similar to some of the symptoms associated with EHS.²⁰ EHS behaves similarly to an allergic condition. Unfortunately there are few EMR-free zones making finding a relief challenging. There are numerous associations and organizations, particularly in Europe, which have formed for the purpose of support, sharing information and promoting awareness for this syndrome. In Sweden EHS is a recognized disability.²¹

Specific to RF, children and adolescents seem to be more at risk than adults. Researchers have suggested that it could be because children's brains are still developing and their skulls are much smaller and thinner than adults allowing RF to penetrate more deeply into the brain. This may increase children's risk of developing brain cancer in early adulthood.^{22, 23} In June 2008, an international panel of physicians and scientists endorsed an appeal in relation to the use of mobile phones. The appeal included an analysis of recent studies and 10 precautionary measures.²⁴ As a result the governments of Germany, France, Austria, and the UK, the European Environmental Agency and the Russian National Committee on Non-ionizing Radiation Protection have warned the public to reduce wireless exposures and warned against cell phone use by children.²⁵⁻³⁰

Testing and Mitigation

It is unclear why some people are affected by EMR while others seem impervious to feeling any effects. Perhaps it is related to a combination of factors such as individual constitution, nutritional status, stress, pre-existing conditions, level of toxic burden, dysbiosis and general sensitivity. It has been clinically seen that one's level of hydration and mineral status plays a factor in whether one is more or less conductive and therefore susceptible to the effects of EMR. It has also been clinically seen that those with a diagnosis of multiple chemical sensitivities, autism, Lyme disease, fibro myalgia and chronic fatigue syndrome are more sensitive to EMR.

The EMFs from surrounding wiring, appliances, and electron-

ics in our bedroom and in rooms above, below and adjacent to our bedrooms are amplified by our metal bed systems. While lying in bed, we can measure our body voltage with a meter called a Body Voltage Multi Meter. With levels above 20 milli Volts (mV) we begin to see biological effects. A reading of less than 20 mV is considered to be extremely low, is almost never naturally found and is rarely accomplished. Instead, common measurements of body voltage are in the thousands of milli Volts. At higher levels of body voltage electro sensitivity symptoms have clinically been seen to resolve or greatly reduce as a result of lowering the subject's evening body voltage. The most thorough method of addressing an elevated body voltage is firstly to have one's body voltage assessed by a professional EMR specialist, and secondly to turn off the electrical circuits that have been determined are negatively affecting one's body voltage. This can be accomplished via a "demand switch" – a remote control switch that connects to specific circuits and disables them on demand. From an environmental medical and building biology perspective, ensuring the body's voltage is kept below 100mV at night as well as mitigating any RF in sleeping areas are two of the most important considerations. It is widely recognized that sleep is a critical state for our bodies to rest, heal and regenerate. It is understood that if a restful and regenerative state at night can be achieved, people are better able to cope with the biological stressors they encounter during the day. Thus it is important to ensure as natural an environment as possible at night.

RF in sleeping areas first must be measured by an RF meter to assess the level of radio frequencies. A reading below 1 microwatt per metre squared ($\mu\text{W}/\text{m}^2$) is ideal. For readings above 50 $\mu\text{W}/\text{m}^2$ it is recommended to block the RF from coming into the sleeping area. First look to mitigate sources inside the building like wi-fi, cordless phones, CFLs and fluorescent lighting and baby monitors. Materials to block RF from outside sources include RF film for windows, RF shielding material which can be used to make a bed canopy or curtains. There is also RF shielding paint which can be used, however it must be properly grounded and no EMR sources can be used from within the space as the RF paint will magnify it. For a complete list of recommendations for limiting EMR daily exposure please see the article on page 17 called "Physician Heal Thyself – Walking the Talk of EMF-RF".

Conclusion

NDs need to continue investigating the effects of EMR. We are only beginning to discover the possible cumulative long-term effects of this relatively new potential biological risk. We need to familiarize ourselves with the problems around interpretation and conclusions with respect to the current and future research. We need to understand that much of the research that has been conducted suggests that there are potential risks associated with chronic exposure to EMR. As NDs we must also personally and professionally exercise prudent and cautionary avoidance to limit our exposure. Our first tenet of naturopathic medicine is to "First Do No Harm" and as such we need to exercise avoidance of EMR exposure where possible in the public spaces that we are responsible

for. Moreover, we must educate the public about the possible risks associated with EMR. As a profession we must support unbiased research, and legislation to strengthen national and international standards for non-ionizing radiation to ensure that children and the unborn are adequately protected; standards that reflect the state of the science regarding the complexity of disease causation, and that reflect the range of exposure where people live, work and play.

EMR Reading Recommendations for NDs and Their Patients

Waugh, Jim. Living Safely with Electromagnetic Radiation – A Complete Guide for Protecting Your Health. Castle Mountain Publishing, BC, 2010. ISBN 978-0-9865099-0-2

Baker LaPorte, Paula. Prescriptions for a Healthy House – A Practical Guide for Architects, Builders and Homeowners. New Society Publishers, BC, 2001. ISBN 0-86571-434-7

Thompson, Athena. Homes That Heal and those that don't. New Society Publishers, BC, 2004. ISBN 0-86571-511-4

Carlo, George and Schram, Martin Cell Phones – Invisible Hazards in the Wireless Age. Carroll & Graf Publishers, NY, 2001.

Adams, Casey. Electromagnetic Health: Making Sense of the Research and Practical Solutions for Electromagnetic Fields (EMF and RF). (see www.amazon.com)

Fisher, Howard. The Invisible Threat: The Risks Associated with EMFs and Effective Interventions (Kindle e-book, see www.amazon.com)

About the Author

Caroline has been a practicing Naturopath since 2000 and has focused much of her practice on Auricular Medicine and Environmental Medicine. In 2007 she became a certified Building Biologist and Environmental Consultant. She has also received certification in Environmental Medicine. She and her husband Scot Appert own and operate BioHealthy Homes, a consulting and building company focusing on healthy natural ecological building. Caroline practices in Muskoka, Ontario and Seattle, Washington. They are both currently enrolled in a sustainable MBA program at The Bainbridge Graduate Institute in Washington. Caroline can be reached at Caroline@BioHealthyHomes.com.

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