

Wireless in Education - Background and References

To accompany the May 31, 2011 Comment of The EMR Policy Institute on the joint position statement, "Technology in Early Childhood Programs: Serving Children from Birth Through Age 8," of the National Association for the Education of Young Children (NAEYC) and the Fred Rogers Center for Early Learning and Children's Media (FRCELCM) at Saint Vincent College.

The References are divided into two separate attachments to keep the file sizes manageable for e-mail transmission and downloading.

Attachment 2

*** Copies of these documents are provided herein.

*** Abstracts of the following research papers are provided herein. Full texts are available upon request:

Abdel-Rassoul, G., El-Fateh, O.A., Salem, M.A., Micgael, A., Farahat, F., and Salem, E. 2007. Neurobehavioral effects among inhabitants around mobile phone base stations. *Neurotoxicology*, **28**(2): 434-440.

Agwar, A., Deepinder, F., Sharma, R., Ranga, G., Li, J. 2008. Effects of cell phone usage on semen analysis in men attending infertility clinic: an observational study. *Fertility and Sterility*, **89**(1): 124-128.

Agwar, A. *et al.*, 2009. Cell phones: modern man's nemesis? *Reproductive Healthcare*, **18**(1): 148-157.

Divan, H., Kheifets, L., Obel, C., Olsen, O. 2008. Prenatal and Postnatal Exposure to Cell Phone Use and Behavioral Problems in Children. *Epidemiology*, **19**(19): 523-529.

Eger, H., Jahn, H. 2010. Specific Health Symptoms and Cell Phone Radiation in Selbitz (Bavaria, Germany) – Evidence of a Dose-Response Relationship. Originally published in German in *umwelt-medizin-gesellschaft*, Feb. 2010: 130-139.

Havas, M., Olstad, A. 2008. Power quality affects teacher well-being and student behavior in three Minnesota schools. *Science of the Total Environment*, **402** (2-3): 157-162.

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

Kane, R. C. A Possible Association Between Fetal/neonatal Exposure to Radiofrequency Electromagnetic Radiation and the Increased Incidence of Autism Spectrum Disorders (ASD). 2004. *Medical Hypotheses*, **62**: 195-197.

Milham, S., Morgan, L. 2008. A New Electromagnetic Exposure Metric: High-Frequency Voltage Transients Associated with Increased Cancer Incidence in Teachers in a California School. *American Journal of Industrial Medicine*, **51**: 579-586.

Milham, S. 2009. Historical evidence that electrification caused the 20th century epidemic of “diseases of civilization.” *Medical Hypotheses*, **74**(2): 337-345.

Statements and Resolutions from scientific experts, panels, and medical professionals and government entities

May 27, 2011 - Resolution 1815 (2011) adopted by the Council of Europe - The potential dangers of electromagnetic fields and their effect on the environment:

<http://assembly.coe.int/Mainf.asp?link=/Documents/AdoptedText/ta11/eRES1815.htm>

One must respect the precautionary principle and revise the current threshold values; waiting for high levels of scientific and clinical proof can lead to very high health and economic costs, as was the case in the past with asbestos, leaded petrol and tobacco.

According to parliamentarians, governments should for children in general, and particularly in schools and classrooms, give preference to wired Internet connections, and strictly regulate the use of mobile phones by schoolchildren on school premises, and put in place information and awareness-raising campaigns on the risks of potentially harmful long-term biological effects on the environment and on human health, especially targeting children, teenagers and young people of reproductive age.

April 2011 – Resolution of the Russian National Committee on Non-ionizing Radiation Protection – Electromagnetic Fields From Mobile Phones: Health Effects on Children and Teenagers at:

http://www.iemfa.org/images/pdf/RNCNIRP_Resolution_2011.pdf

Prevention of childhood and juvenile diseases from exposure to EMF sources is of paramount social and economic importance. It is one of the bases for public health policy for the nation in the near- and long-term future.

February 3, 2011 – Seletun Scientific Statement issued - According to the international scientists, the **Seletun Scientific Panel**:

It has become obvious that new, biologically-based public exposure standards are urgently needed to protect long-term public health worldwide. Current public-safety EMF-exposure guidelines used world wide, based on physics models and calculations, currently only protect for damage generated by a heating effect. With respect to prolonged, low-intensity exposures that nowadays frequently occur, but do not have a heating effect, the guidelines, say the scientists, are inadequate and obsolete. See:

<http://www.iemfa.org/index.php/publications/seletun-resolution>

July 21, 2009 – AUVA Report released by the Austrian Social Insurance for Occupational Risks. “Investigation of Nonthermal Effects of Electromagnetic Radiation in the Cell Phone Frequency Range.” Nonthermal effects confirmed. Exposure limits challenged. Precaution demanded.

<http://www.buildingbiology.ca/>

2009 – Porto Alegre Resolution www.icems.eu/docs/resolutions/Porto_Alegre_Resolution.pdf

2009 - London Resolution http://www.icems.eu/docs/resolutions/London_res.pdf

2008 - Venice Resolution <http://www.icems.eu/resolution.htm>

2006 - Benevento Resolution http://www.icems.eu/benevento_resolution.htm

2002 - Freiburger Appeal <http://www.starweave.com/freiburger/>

2002 - Catania Resolution http://www.icems.eu/docs/resolutions/Catania_res.pdf

2000 - Salzburg Resolution http://www.salzburg.gv.at/salzburg_resolution_e.pdf

1998 – Vienna Resolution http://www.icems.eu/docs/resolutions/Vienna_Resolution_1998.pdf

June 2, 2009 – Los Angeles County Board of Supervisors Resolution challenging the federal Telecommunications Act of 1996's preemption of local authority to base antenna siting decisions on environmental effects of radiofrequency radiation was adopted by a unanimous vote.

www.cloutnow.org/lacbos/

May 26, 2009 - Los Angeles Unified School District Resolution on Wireless Telecommunication Installations was adopted by unanimous vote of the LAUSD Board of Education.

www.cloutnow.org/lausd/

April 2, 2009 - European Parliament Resolution on health concerns associated with electromagnetic fields www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//TEXT+TA+P6-TA-2009-0216+0+DOC+XML+V0//EN

March 4, 2009 Memorandum - Opinion of the Russian National Committee on Non-Ionizing Radiation Protection. www.scribd.com/doc/13429602/EMF-of-Mobile-Telephones-Children-Belong-to-a-Group-of-Increased-Risk

Sept. 25, 2008 - U. S. Congressional Hearing convened by Congressman Dennis Kucinich - Chair of the Subcommittee on Domestic Policy of the House Committee on Oversight and Government Reform - Tumors and Cell Phone Use: What the Science Says.

<https://house.resource.org/110/org.c-span.281358-1.pdf>

Witness Ronald Herberman MD of the University of Pittsburgh Cancer Institute testified that government statistics show an increase in the incidence of brain cancer over the last ten years, particularly among 20-29 year-olds. <http://www.microwavenews.com/kucinich.html>

July 2008 - University of Pittsburgh Cancer Institute Advisory on Cellphone Safety – Dr. Ronald Herberman MD and Professor Devra Davis PhD. See:

<http://www.environmentaloncology.org/node/201#10Precautions>

April 2008 – Russian National Committee on Non-Ionizing Radiation Protection (RNCNIRP) Recommendation to Limit Children's Use of Cell Phones. See: <http://www.kinder-und-mobilfunk.de/downloads/appellrcnirpengl.pdf>

January 2008 - U.S. National Academies of Science-National Research Council (NAS/NRC) released its report entitled: *Identification of Research Needs Relating to Potential Biological or Adverse Health Effects of Wireless Communication*. See Section on Dosimetry and Exposure. See complete report at: http://www.nap.edu/catalog.php?record_id=12036#toc. From the Report Description:

Some needs and gaps identified at the workshop include: (1) characterization of exposures from wireless devices and RF base station antennas in juveniles, children, fetuses, and pregnant women and (2) evaluation of devices that use newer technologies (e.g., texting, web-surfing).

Commentary and Analysis

*** May 2011 – The EMR Policy Institute – Precautionary Advice to Reduce Electromagnetic Radiation Exposures from Wireless Devices - For Perinatal Health Professionals, Parents and Educators. Prepared for the 22nd Annual Conference of Partners in Perinatal Health, Norwood, Massachusetts. Document attached.

*** May 2011 - Andrew Goldsworthy MD – How Electromagnetically-induced Cell Leakage May Induce Autism. Document attached.

May 5, 2011 - Don Maisch PhD - Submission to the World Health Organization's International Agency for Research on Cancer (IARC) on its radiofrequency radiation cancer assessment process. The problem of conflict of interest and commercial influence in WHO agencies and the need for public interest representation. <http://www.emfacts.com/papers/>

*** March 2011 - The EMR Policy Institute Wireless Survey- How Much Wireless Radiation Are Your Brain and Body Exposed to 24/7? Prepared for the Environmental Action 2011 Conference, Waltham, Massachusetts. Document attached.

June 23, 2010 – Don Maisch PhD Doctoral Dissertation - The Procrustean Approach: Setting Exposure Standards for Telecommunications Frequency Electromagnetic Radiation. An examination of the manipulation of telecommunications standards by political, military, and industrial vested interests at the expense of public health protection. <http://www.emfacts.com/papers/>

*** April 29, 2010 – Andrew Goldsworthy MD's Witness Statement at the request of the Canadian House of Commons Standing Committee on Health:
It would be wise to halt the roll-out of new wireless technologies and withdraw from sale particularly hazardous items such as DECT baby monitors which radiate continuously next to a very young children . . . until testing can be used to assess the biological safety of both new and existing wireless technologies. <http://www.scribd.com/doc/31647477/Andrew-Goldsworthy-Witness-Statement-April-2010>

April 7, 2008 – The French National Library in Paris gives up WiFi for hard-wired internet connections. The choice came because of the superior data transmission speed of wired connections as well as the decision to take precautions against exposing the library's 1 million frequent visitors annually and 2,500 staff members to RF radiation given recently published

scientific papers demonstrating genotoxic effects from such exposures. www.next-up.org/pdf/FranceNationalLibraryGivesUpWiFi07042008.pdf

February 18, 2008 - *MacOpinion* - Cellphone and Wireless Computer Networking Safety Revisited. This Charles Moore column (he writes for the on-line *MacOpinion* journal), updating his 1999 column on this subject, is one of the strongest on keeping wireless away from schools until the science questions are answered. Moore is a "techy" who promotes computers for schools and businesses and is asking all of the pertinent questions. He has given The EMR Policy Institute permission to distribute this article.

www.macopinion.com/index.php/site/more/cellphone_and_wireless_computer_networking_safety_revisited/

Users will usually be exposed to emissions from wireless LANs [WiFi networks] for much longer periods of time than all but the most addicted cellphone users. Could the cumulative effect ultimately be as bad or worse? I'd like to know before I expose myself and my loved ones to wireless networking emissions. Microwaves are generally known to be unfriendly to living tissue, and it occurs that zapping yourself with them on an ongoing basis, even at low levels, is not the brightest plan . . .

My kids are grown, but if they were still of school age, I would not want them sitting in classrooms full of wireless enabled computers every day.

*** 2001 - Robert C. Kane, BSEE, MSEE, PhD, Former Motorola Senior Research Scientist and Technical Staff Member - On Second-Hand RF Radiation. Document attached.

Web Sites

www.emrpolicy.org - Schools Page Science Pages News Pages

www.microwavenews.com/ "Research is moving so fast in this field that newsletters are the only way to keep up. *Microwave News* and *VDT News*, both edited by Louis Slesin, are widely acclaimed by all sides as the best sources of reliable and current information."
— *Whole Earth Catalog*

www.wifiinschools.org.uk/ - Working for Safe Technologies for Nurseries, Schools and Colleges

www.environmentalhealthtrust.org/ - Learn why many nations ban young children from using cell phones and warn that teenagers should not use cell phones next to their heads but should text message.

www.grassrootsinfo.org/cellphones.html - Grassroots is a New York-based non-profit organization founded in 2000 with a mission to educate the public about the links between common environmental exposures and human health, and to empower individuals to act as catalysts for change within their own communities.

www.whyfry.org - [Government and organizations ban or warn against WiFi](#)



Neurobehavioral effects among inhabitants around mobile phone base stations

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Abstract

Background: There is a general concern on the possible hazardous health effects of exposure to radiofrequency electromagnetic radiations (RFR) emitted from mobile phone base station antennas on the human nervous system.

Aim: To identify the possible neurobehavioral deficits among inhabitants living nearby mobile phone base stations.

Methods: A cross-sectional study was conducted on (85) inhabitants living nearby the first mobile phone station antenna in Menoufiya governorate, Egypt, 37 are living in a building under the station antenna while 48 opposite the station. A control group (80) participants were matched with the exposed for age, sex, occupation and educational level. All participants completed a structured questionnaire containing: personal, educational and medical histories; general and neurological examinations; neurobehavioral test battery (NBTB) [involving tests for visuomotor speed, problem solving, attention and memory]; in addition to Eysenck personality questionnaire (EPQ).

Results: The prevalence of neuropsychiatric complaints as headache (23.5%), memory changes (28.2%), dizziness (18.8%), tremors (9.4%), depressive symptoms (21.7%), and sleep disturbance (23.5%) were significantly higher among exposed inhabitants than controls: (10%), (5%), (5%), (0%), (8.8%) and (10%), respectively ($P < 0.05$). The NBTB indicated that the exposed inhabitants exhibited a significantly lower performance than controls in one of the tests of attention and short-term auditory memory [Paced Auditory Serial Addition Test (PASAT)]. Also, the inhabitants opposite the station exhibited a lower performance in the problem solving test (block design) than those under the station. All inhabitants exhibited a better performance in the two tests of visuomotor speed (Digit symbol and Trailmaking B) and one test of attention (Trailmaking A) than controls. The last available measures of RFR emitted from the first mobile phone base station antennas in Menoufiya governorate were less than the allowable standard level.

Conclusions and recommendations: Inhabitants living nearby mobile phone base stations are at risk for developing neuropsychiatric problems and some changes in the performance of neurobehavioral functions either by facilitation or inhibition. So, revision of standard guidelines for public exposure to RFR from mobile phone base station antennas and using of NBTB for regular assessment and early detection of biological effects among inhabitants around the stations are recommended.

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Keywords: Neurobehavioral effects; Mobile phone base stations; Radiofrequency radiations (RFR)

1. Introduction

There is a general concern about the possible hazardous health effects of exposure to radiofrequency radiations (RFR) emitted from mobile phone base station antennas. Disturbance of the nervous system leads to behavioral changes and may serve as an early indicator of disturbances in regulatory functions of many

systems (Lai and Singh, 1994). Exposure of the neural tissue to RFR can cause electrophysiological changes in the nervous system (Navakatikian and Tomashevskaya, 1994; Velizarov et al., 1999). Some studies have suggested that RFR induce tissue heating leads to tissue damage (Gajsek et al., 2002; Preece et al., 1999). Some effects are observed among mobile phone users at low intensity and after repeated exposure (Hyland, 2000). The efflux of calcium ions from brain tissue is an important neurochemical effect of RFR as calcium ion plays an important role in the functions of the nervous system such as the release of neurotransmitters (Dutta et al., 1989). Experimental studies on

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Effect of cell phone usage on semen analysis in men attending infertility clinic: an observational study

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Objective: To investigate the effect of cell phone use on various markers of semen quality.

Design: Observational study.

Setting: Infertility clinic.

Patient(s): Three hundred sixty-one men undergoing infertility evaluation were divided into four groups according to their active cell phone use: group A: no use; group B: <2 h/day; group C: 2–4 h/day; and group D: >4 h/day.

Intervention(s): None.

Main Outcome Measure(s): Sperm parameters (volume, liquefaction time, pH, viscosity, sperm count, motility, viability, and morphology).

Result(s): The comparisons of mean sperm count, motility, viability, and normal morphology among four different cell phone user groups were statistically significant. Mean sperm motility, viability, and normal morphology were significantly different in cell phone user groups within two sperm count groups. The laboratory values of the above four sperm parameters decreased in all four cell phone user groups as the duration of daily exposure to cell phones increased.

Conclusion(s): Use of cell phones decrease the semen quality in men by decreasing the sperm count, motility, viability, and normal morphology. The decrease in sperm parameters was dependent on the duration of daily exposure to cell phones and independent of the initial semen quality. (Fertil Steril® 2008;89:124–8. ©2008 by American Society for Reproductive Medicine.)

Key Words: Cell phone, electromagnetic radiations, sperm parameters, male infertility

Cell phones have become indispensable devices in our daily life. These phones operate between 400 MHz and 2000 MHz frequency bands and emit radiofrequency electromagnetic waves (EMW). Reports of potential adverse effects of radiofrequency EMW on brain, heart, endocrine system, and DNA of humans and animals are widely reported in the literature. Electromagnetic waves alter brain electroencephalographic activity and cause disturbance in sleep (1); cause difficulty in concentration, fatigue, and headache (2); and increase reaction time in a time-dependent manner (3). They increase the resting blood pressure (4) and reduce the production of melatonin (5). They are also implicated in DNA strand breaks (6). However, the concern that cell phone use might have

adverse impacts on the semen quality has not been extensively addressed.

Infertility affects approximately 15% of couples of reproductive age, and with nearly half of these cases resulting from male factor infertility this area of research is of great interest to both physicians and research scientists (7, 8). The relationship between cell phone use and male infertility remains unclear. Harmful EMW emitted from cell phones may interfere with normal spermatogenesis and result in a significant decrease in sperm quality. There are two reports available that show an effect of cell phones on sperm motility in humans (9, 10). Animal studies indicate that EMW may have a wide range of damaging effects on the testicular function and male germ line (11, 12). Electromagnetic waves can affect reproductive function through both thermal and non-thermal effects (13).

The objective of the present study was to assess the effects of cell phone use on various sperm parameters among patients undergoing infertility evaluation at a male infertility clinic. Our goal was to better understand the role of cell phone use in male infertility and assess the need for any

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Review

Cell phones: modern man's nemesis?



Ashok Agarwal is a Professor in the Lerner College of Medicine at Case Western Reserve University and the Director of Center for Reproductive Medicine, and the Clinical Andrology Laboratory at The Cleveland Clinic, Cleveland, Ohio, United States. He has published over 400 scientific articles, reviews and book chapters in different areas of andrology, male/female infertility and fertility preservation. His research program is known internationally for its focus on disease-oriented cutting edge research in the field of human reproduction. His team has presented over 700 papers at national and international meetings and more than 150 scientists, clinicians and biologists have received their training in his laboratory.

Dr Ashok Agarwal

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Abstract

Over the past decade, the use of mobile phones has increased significantly. However, with every technological development comes some element of health concern, and cell phones are no exception. Recently, various studies have highlighted the negative effects of cell phone exposure on human health, and concerns about possible hazards related to cell phone exposure have been growing. This is a comprehensive, up-to-the-minute overview of the effects of cell phone exposure on human health. The types of cell phones and cell phone technologies currently used in the world are discussed in an attempt to improve the understanding of the technical aspects, including the effect of cell phone exposure on the cardiovascular system, sleep and cognitive function, as well as localized and general adverse effects, genotoxicity potential, neurohormonal secretion and tumour induction. The proposed mechanisms by which cell phones adversely affect various aspects of human health, and male fertility in particular, are explained, and the emerging molecular techniques and approaches for elucidating the effects of mobile phone radiation on cellular physiology using high-throughput screening techniques, such as metabolomics and microarrays, are discussed. A novel study is described, which is looking at changes in semen parameters, oxidative stress markers and sperm DNA damage in semen samples exposed *in vitro* to cell phone radiation.

Keywords: biophysics, cell phone, general health, infertility, radiofrequency electromagnetic waves, RF-EMW

Introduction

Cell phone usage has increased by leaps and bounds in the past decade and a half. From being a luxury limited to the wealthy, cell phones have become a commodity, virtually indispensable in daily lives. However, every technological advance and its overuse have a negative aspect. The increase in popularity of cell phones is accompanied by a growing concern regarding the harmful effects of cell phone radiation (radiofrequency electromagnetic waves; RF-EMW) exposure on human health. An earlier report of the Independent Expert Group on Mobile Phones, established by the UK government, summarized the relevant studies on the biological effects of RF-EMW (Huber *et al.*, 2000). Since then, a flurry of scientific activities has attempted to define and quantify the adverse effects of RF-EMW. Despite the increasing number of reports concerning the effects of RF-EMW on various biological systems, no satisfactory mechanism has been proposed to explain the effects of this radiation (Feychting, 2005). Although cell phone companies constantly reassure their subscribers about the safety of their

product, reports based on animal and human experiments showing adverse effects of cell phones on biological systems have surfaced.

According to various reports, excessive cell phone usage has led to fatigue, headache, decreased concentration and local irritation and burning (Sandstrom *et al.*, 2001). The possible role of cell phone exposure on tumour induction also has been proposed in an epidemiological study (Hardell *et al.*, 2006). Recent studies also have highlighted the role of cell phone exposure on sperm motility, morphology and viability, thus proposing a reduction in male fertilizing potential (Agarwal *et al.*, 2008). Other reports suggest that RF-EMW may lead to DNA damage and chromosomal instability (Diem *et al.*, 2005). Even though the current research may have been inconclusive, it still has been successful in providing preliminary data and identifying trends on both sides of the argument that cell phone exposure may lead to harmful effects on human health. These

Prenatal and Postnatal Exposure to Cell Phone Use and Behavioral Problems in Children

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Background: The World Health Organization has emphasized the need for research into the possible effects of radiofrequency fields in children. We examined the association between prenatal and postnatal exposure to cell phones and behavioral problems in young children.

Methods: Mothers were recruited to the Danish National Birth Cohort early in pregnancy. When the children of those pregnancies reached 7 years of age in 2005 and 2006, mothers were asked to complete a questionnaire regarding the current health and behavioral status of children, as well as past exposure to cell phone use. Mothers evaluated the child's behavior problems using the Strength and Difficulties Questionnaire.

Results: Mothers of 13,159 children completed the follow-up questionnaire reporting their use of cell phones during pregnancy as well as current cell phone use by the child. Greater odds ratios for behavioral problems were observed for children who had possible prenatal or postnatal exposure to cell phone use. After adjustment for potential confounders, the odds ratio for a higher overall behavioral problems score was 1.80 (95% confidence interval = 1.45–2.23) in children with both prenatal and postnatal exposure to cell phones.

Conclusions: Exposure to cell phones prenatally—and, to a lesser degree, postnatally—was associated with behavioral difficulties such as emotional and hyperactivity problems around the age of school entry. These associations may be noncausal and may be due to unmeasured confounding. If real, they would be of public health concern given the widespread use of this technology.

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Exposure to radiofrequency fields is increasingly common, but the potential influence on health has not been thoroughly investigated, especially in children. Between 2003 and 2008, there were more than 900 million new cell phone subscribers worldwide, with a total of more than 2 billion subscribers.¹ Fetuses and children may be more vulnerable than adults to external exposures in general.² In 2000, the Stewart Report recommended a precautionary approach to the use of cell phones until more detailed and scientifically robust information became available, especially for children.³ Numerous reviews, including 1 by the World Health Organization,⁴ stress the need for studies in children and on cognitive effects, because of the importance of cognitive abilities and learning in early development.

Most epidemiologic studies of exposure to radiofrequency fields have focused on brain and acoustic cancers as outcomes^{5–11} or on subjective symptoms such as headaches.^{12,13} A number of laboratory studies have examined physiologic effects after short-term exposure,^{14–18} but a variety of other outcomes are yet to be investigated, and none has included potentially susceptible populations such as fetuses and very young children.

Children are potentially exposed during fetal life by maternal use of cell phones and then later in childhood when they themselves become users of cell phones. Exposures early in life may have particular importance because this is during vulnerable stages of brain development.

There is limited information on the association between radiofrequency field exposure during pregnancy and reproductive outcomes (spontaneous abortions, birth weight, sex ratio, and congenital malformations), mostly from occupational studies. Occupational exposures are typically much higher than exposures from cell phone use. Some studies have reported increased risk of spontaneous abortions and congenital malformations, although these results come from poorly designed studies.¹⁹

Since no established mechanism is known for radiofrequency exposure—except for what may be caused by an increased temperature in the exposed regions—it is impossible to exclude any health outcomes from consideration. Experimental research indicates exposure might affect nonspecific neurologic performance such as attention. In a preliminary cross-sectional analysis of 13 year-olds in the MoRPhEUs study, differences in certain cognitive abilities related to cell phone use were observed (Rodney Croft personal communication, 16 December 2007).

Specific Health Symptoms and Cell Phone Radiation in Selbitz (Bavaria, Germany)—Evidence of a Dose-Response Relationship

Horst Eger and Manfred Jahn

In January 2009 the administration of the Bavarian Municipality of Selbitz gathered relevant data from 251 residents as part of a health survey. Subsequently, the data were assessed based on the exposure levels of cell phone radiation.

In a next step, the exposure levels based on residential location and available RF measurements of local cell phone radiation levels were used to classify participants into exposure groups.

The mean radiation exposure level of the highest exposure group in Selbitz (1.2 V/m) was substantially higher than that of the study population in the QUEBEB study (1) of the German Mobile Phone Programme (mean value 0,07 V/m). For such symptoms as sleep problems, depressions, cerebral symptoms, joint problems, infections, skin problems, cardiovascular problems as well as disorders of the visual and auditory systems and the gastrointestinal tract, a significant dose-response relationship was observed in relation to objectively determined exposure levels. The impact of microwave radiation on the human nervous system serves as an explanation.

Carried out without outside funds, the study presented here provides a protocol concept that allows physicians and municipalities to cooperate and assess the potential human health impact of cell phone base stations located within residential areas.

Keywords: symptoms, cell phone radiation, wireless technologies, dose-response relationship

Participating offices: Dr. Brömel/Pozder, Schulstraße 4, 95197 Schauenstein;
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Deutsche Zusammenfassung

In der bayerischen Stadt Selbitz wurden im Januar 2009 zuerst durch die Gemeinde im Rahmen einer Gesundheitsbefragung relevante Daten von 251 Einwohnern erfasst und anschließend daran nach Belastungsstärken durch Mobilfunkwellen ausgewertet.

Die Belastungswerte wurden in einem zweiten Schritt an hand von Wohnort und vorliegenden Messdaten der örtlichen Mobilfunkstrahlung zur Stratifizierung der Teilnehmer in Belastungsgruppen verwendet.

Die mittlere Strahlenbelastung der höchstbelasteten Gruppen in Selbitz (1,2 V/m) lag deutlich höher als die untersuchte Studienpopulation der QUEBEB-

available at www.sciencedirect.comwww.elsevier.com/locate/scitotenv

Power quality affects teacher wellbeing and student behavior in three Minnesota Schools

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ABSTRACT

BackgroundPoor power quality (dirty electricity) is ubiquitous especially in schools with fluorescent lights and computers. Previous studies have shown a relationship between power quality and student behavior/teacher health.

ObjectivesThe purpose of this study is to determine the ability of power line filters to reduce dirty electricity in a school environment and to document changes in health and behavior among teachers and students.

MethodWe installed Graham Stetzer filters and dummy filters and measured power quality in three Minnesota Schools. Teachers completed a daily questionnaire regarding their health and the behavior of their students for an 8-week period. Teachers were unaware of which filters were installed at any one time (single blind study).

ResultsDirty electricity was reduced by more than 90% in the three schools and during this period teacher health improved as did student behavior in the middle/elementary schools. Headaches, general weakness, dry eyes/mouth, facial flushing, asthma, skin irritations, overall mood including depression and anxiety improved significantly among staff. Of the 44 teachers who participated 64% were better, 30% were worse, and 6% did not change. Behavior of high school students did not improve but elementary/middle school students were more active in class; more responsive, more focused; had fewer health complaints; and had a better overall learning experience.

ConclusionsDirty electricity in schools may be adversely affecting wellbeing of teachers and behavior of their students, especially younger students in middle and elementary school. Power line filters improve power quality and may also protect those who are sensitive to this energy. Work on electric and magnetic field metrics with and without Stetzer filters urgently needs to be carried out to determine just what characteristics of the dirty electricity may be interacting with the people.

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1. Introduction

Poor power quality, commonly referred to as dirty electricity, is a growing concern for the electrical utility as it interferes with sensitive electronic equipment leading to malfunctions and costly repairs. Schools with fluorescent lights and electronic equipment in the form of computers; those near high voltage

transmission lines and near antennas for wireless communication are prime candidates for poor power quality (Havas 2006b; Vignati and Giuliani 1997).

Another, less well understood, consequence of dirty electricity is ill health for those who have become electrically hypersensitive (EHS). Diabetics with EHS have higher plasma glucose levels and require more medication, when exposed to

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

B. Blake Levitt and Henry Lai

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

Key words: radiofrequency radiation (RFR), antenna arrays, cellular phone base stations, microwave sickness, nonionizing electromagnetic fields, environmental pollution.

Résumé : La localisation des stations de base pour téléphones cellulaires et autres infrastructures cellulaires, comme les installations d'antennes sur les toitures, surtout dans les quartiers résidentiels, constitue un sujet litigieux d'utilisation du territoire. La résistance locale de la part des résidents et propriétaires fonciers limitrophes repose souvent sur les craintes d'effets adverses pour la santé, en dépit des réassurances venant des fournisseurs de services de télécommunication, à l'effet qu'ils appliquent les standards internationaux d'exposition. En plus de rapports anecdotiques, certaines études épidémiologiques font état de maux de tête, d'éruption cutanée, de perturbation du sommeil, de dépression, de diminution de libido, d'augmentations du taux de suicide, de problèmes de concentration, de vertiges, d'altération de la mémoire, d'augmentation du risque de cancers, de trémulations et autres effets neurophysiologiques, dans les populations vivant au voisinage des stations de base. Les auteurs révisent ici les études existantes portant sur les gens, vivant ou travaillant près d'infrastructures cellulaires ou autres études pertinentes qui pourraient s'appliquer aux expositions à long terme à la radiation de radiofréquence de faible intensité « RFR ». Bien que la recherche épidémiologique spécifique dans ce domaine soit rare et contradictoire, et que de telles expositions soient difficiles à quantifier compte tenu des degrés croissants du bruit de fond des RFR provenant de produits de myriades de consommateurs personnels, il existe certaines recherches qui justifient la prudence dans l'installation des infrastructures. Les futures études épidémiologiques sont nécessaires afin de prendre en compte la totalité des expositions à la RFR ambiante. Les symptômes rapportés jusqu'ici pourraient correspondre à la maladie classique des micro-ondes, décrite pour la première fois en 1978. Les champs électromagnétiques non-ionisants constituent les formes de pollution environnementale croissant le plus rapidement. On peut effectuer certaines extrapolations à partir de recherches autres qu'épidémiologiques concernant les effets biologiques d'expositions à des degrés bien au-dessous des directives internationales.

Mots-clés : radiofréquence de faible intensité « RFR », les installations d'antennes, des stations de base pour téléphones cellulaires, la maladie classique des micro-ondes, les champs électromagnétiques non-ionisants, pollution environnementale.

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Medical Hypotheses<http://intl.elsevierhealth.com/journals/mehy>**A Possible Association Between Fetal/neonatal Exposure to Radiofrequency Electromagnetic Radiation and the Increased Incidence of Autism Spectrum Disorders (ASD)****Robert C. Kane, Ph.D.***The Associated Bioelectromagnetics Technologists, P.O. Box 133, Blanchardville, Wisconsin 53516-0133 USA. FAX: 1 608 523-6500; E-mail: rkane@tds.net***Key words:** autism; radiofrequency; radiation; RF; microwave; fetus; embryo; neo-natal; blood-brain barrier; DNA; cognitive impairment.

Summary

Recently disclosed epidemiological data indicate a dramatic increase in the incidence of autism spectrum disorders. Previously, the incidence of autism has been reported as 4-5 per 10,000 children. The most recent evidence indicates an increased incidence of about 1 per 500 children. However, the etiology of autism is yet to be determined. The recently disclosed data suggest a possible correlation between autism incidence and a previously unconsidered environmental toxin. It is generally accepted in the scientific community that radiofrequency radiation is a biologically active substance. It is also readily acknowledged that human exposures to radiofrequency radiation have become pervasive during the past twenty years, whereas such exposures were uncommon prior to that time. It is suggested that fetal or neo-natal exposures to radiofrequency radiation may be associated with an increased incidence of autism.

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Introduction

Prior to the twentieth century the only sources of radiofrequency (RF) radiation were the hyper-low levels of RF energy originating from our sun and the even lower levels of extra-solar RF noise. It is in this environment of low-level RF radiation that life on earth developed and exists to this day.

During the 1940s, primarily as a result of research and development performed as a part of the war effort, industry and the military establishment were successful in bringing the state of RF energy generation to maturity. From that time onward we have witnessed a broad range of commercial RF energy product applications including, most notably, broadcast FM radio, radar, television, public-service mobile communication transceivers, residential microwave ovens, and the portable cellular telephone.

Initially, the contribution of each radiating device was imperceptible when weighed against the background of incoming solar radiation. However, over the span of decades the number of terrestrial RF radiation sources, now counted in the billions, has increased to the degree that, presently, the base radiation level is many thousands of times higher than from solar RF energy impinging on the earth.

A New Electromagnetic Exposure Metric: High Frequency Voltage Transients Associated With Increased Cancer Incidence in Teachers in a California School

Samuel Milham, MD, MPH^{*,†} and L. Lloyd Morgan, BS[‡]

Background In 2003 the teachers at La Quinta, California middle school complained that they had more cancers than would be expected. A consultant for the school district denied that there was a problem.

Objectives To investigate the cancer incidence in the teachers, and its cause.

Method We conducted a retrospective study of cancer incidence in the teachers' cohort in relationship to the school's electrical environment.

Results Sixteen school teachers in a cohort of 137 teachers hired in 1988 through 2005 were diagnosed with 18 cancers. The observed to expected (O/E) risk ratio for all cancers was 2.78 ($P = 0.000098$), while the O/E risk ratio for malignant melanoma was 9.8 ($P = 0.0008$). Thyroid cancer had a risk ratio of 13.3 ($P = 0.0098$), and uterine cancer had a risk ratio of 9.2 ($P = 0.019$). Sixty Hertz magnetic fields showed no association with cancer incidence. A new exposure metric, high frequency voltage transients, did show a positive correlation to cancer incidence. A cohort cancer incidence analysis of the teacher population showed a positive trend ($P = 7.1 \times 10^{-10}$) of increasing cancer risk with increasing cumulative exposure to high frequency voltage transients on the classroom's electrical wiring measured with a Graham/Stetzer (G/S) meter. The attributable risk of cancer associated with this exposure was 64%. A single year of employment at this school increased a teacher's cancer risk by 21%.

Conclusion The cancer incidence in the teachers at this school is unusually high and is strongly associated with high frequency voltage transients, which may be a universal carcinogen, similar to ionizing radiation. Am. J. Ind. Med. 2008. © 2008 Wiley-Liss, Inc.

KEY WORDS: high frequency voltage transients; electricity; dirty power; cancer; school teachers; carcinogen

Abbreviations: EMF, electromagnetic fields; O, observed cases; E, expected cases; O/E, risk ratio; p, probability; Hz, Hertz or cycles per second; OSHA, Occupational Safety and Health Administration; OCMAP, occupational mortality analysis program; AM, amplitude modulation; GS units, Graham/Stetzer units; G/S meter, Graham/Stetzer meter; MS II, Micro-surge II meter; mG, milligauss; EKG, electrocardiogram; LQMS, La Quinta Middle School.

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BACKGROUND

Since the 1979 Wertheimer–Leeper study [Wertheimer and Leeper, 1979] there has been concern that exposure to power frequency (50/60 Hz) EMFs, especially magnetic fields, may contribute to adverse health effects including cancer. Until now, the most commonly used exposure metric has been the time-weighted average of the power-frequency magnetic field. However, the low risk ratios in most studies suggest that magnetic fields might be a surrogate for a more important metric. In this paper we present evidence that a



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Historical evidence that electrification caused the 20th century epidemic of “diseases of civilization”[☆]

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SUMMARY

The slow spread of residential electrification in the US in the first half of the 20th century from urban to rural areas resulted by 1940 in two large populations; urban populations, with nearly complete electrification and rural populations exposed to varying levels of electrification depending on the progress of electrification in their state. It took until 1956 for US farms to reach urban and rural non-farm electrification levels. Both populations were covered by the US vital registration system. US vital statistics tabulations and census records for 1920–1960, and historical US vital statistics documents were examined. Residential electrification data was available in the US census of population for 1930, 1940 and 1950. Crude urban and rural death rates were calculated, and death rates by state were correlated with electrification rates by state for urban and rural areas for 1940 white resident deaths. Urban death rates were much higher than rural rates for cardiovascular diseases, malignant diseases, diabetes and suicide in 1940. Rural death rates were significantly correlated with level of residential electric service by state for most causes examined. I hypothesize that the 20th century epidemic of the so called diseases of civilization including cardiovascular disease, cancer and diabetes and suicide was caused by electrification not by lifestyle. A large proportion of these diseases may therefore be preventable.

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Background

In 2001, Ossiander and I [1] presented evidence that the childhood leukemia mortality peak at ages 2–4 which emerged in the US in the 1930s was correlated with the spread of residential electrification in the first half of the 20th century in the US. While doing the childhood leukemia study, I noticed a strong positive correlation between level of residential electrification and the death rate by state due to some adult cancers in 1930 and 1940 vital statistics. At the time, a plausible electrical exposure agent and a method for its delivery within residences was lacking. However, in 2008 I coauthored a study of a cancer cluster in school teachers at a California middle school [2] which indicated that high frequency voltage transients (also known as dirty electricity), were a potent universal carcinogen with cancer risks over 10.0 and significant dose–response for a number of cancers. They have frequencies between 2 and 100 kHz. These findings are supported by a large cancer incidence study in 200,000 California school employees which showed that the same cancers and others were in excess in California teachers statewide [3]. Power frequency

magnetic fields (60 Hz) measured at the school were low and not related to cancer incidence, while classroom levels of high frequency voltage transients measured at the electrical outlets in the classrooms accurately predicted a teacher's cancer risk. These fields are potentially present in all wires carrying electricity and are an important component of ground currents returning to substations especially in rural areas. This helped explain the fact that professional and office workers, like the school teachers, have high cancer incidence rates. It also explained why indoor workers had higher malignant melanoma rates, why melanoma occurred on part of the body which never are exposed to sunlight, and why melanoma rates are increasing while the amount of sunshine reaching earth is stable or decreasing due to air pollution. A number of very different types of cancer had elevated risk in the La Quinta school study, in the California school employees study, and in other teacher studies. The only other carcinogenic agent which acts like this is ionizing radiation.

Among the many devices which generate the dirty electricity are compact fluorescent light bulbs, halogen lamps, wireless routers, dimmer switches, and other devices using switching power supplies. Any device which interrupts current flow generates dirty electricity. Arcing, sparking and bad electrical connections can also generate the high frequency voltage transients. Except for the dimmer switches, most of these devices did not exist in the first half of the 20th century. However, early electric generating equipment

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Protecting the Health of Mothers-to-Be, Fetuses, Babies and Children

Precautionary Advice to Reduce Electromagnetic Radiation Exposures from Wireless Devices

For Perinatal Health Professionals, Parents and Educators

Do not use wireless baby monitors.

All monitors on the market are wireless and operate at either 900 MHz or 2.4 GHz (2400 MHz) within 200 to 900 feet and emit strong electromagnetic radiation signals. Wireless baby monitors operate on signals that are public frequencies and can be a security risk as burglars can hack into the monitor to access sounds and pictures of the baby.

Install and use only wired landline phones.

Remove all cordless phones, especially the DECT-type, from your home and workplace. Cordless phones emit radiation 24/7.

Use cable or fiber optic internet connections in your home or workplace.

Remove Wi-Fi and wireless internet routers. At the least turn off the wireless router at night while you sleep.

During pregnancy do not use a cell, smart or cordless phone. At the most limit use to one once-a-day short duration call.

Keep all wireless devices (phones, tablets, wireless book readers and wireless laptops, etc.) off your lap and away from your body.

Do not use any wireless devices – such as cell phones, wireless tablets, and book readers - near pregnant women, newborns, babies, and children. Do not subject them to “second-hand” radiation.

Support use of fiber optic (wireless free) Internet in your local schools or if WI-Fi has been installed, advocate for its removal.

Use LED (light emitting diodes) or incandescent light bulbs.

Do not use CFLs (compact fluorescent light bulbs) in your home as they emit both UV and RF radiation, which creates a “dirty electricity” environment, and contain mercury. CFL’s are not green or clean.

Avoid locations where wireless “hotspots” are present.

Stop your utility company (electric, gas and water) from installing “smart meters” on your home and business. Do not use wireless adapters for home appliances.

Wireless is NOT Healthy or Green!

HOW ELECTROMAGNETICALLY-INDUCED CELL LEAKAGE MAY CAUSE AUTISM

Andrew Goldsworthy May 2011

What is autism?

Autism is in fact a group of life-long disorders (autistic spectrum disorders or ASD) caused by brain malfunctions and is associated with subtle changes in brain anatomy (see Amaral *et al.* 2008 for a review). The core symptoms are an inability to communicate adequately with others and include abnormal social behaviour, poor verbal and non-verbal communication, unusual and restricted interests, and persistent repetitive behaviour. There are also non-core symptoms, such as an increased risk of epileptic seizures, anxiety and mood disorders. ASD has a strong genetic component, occurs predominantly in males and tends to run in families.

Genetic ASD may be caused by calcium entering neurons

It has been hypothesised that some genetic forms of ASD can be accounted for by known mutations in the genes for ion channels that result in an increased background concentration of calcium in neurons. This would be expected to lead to neuronal hyperactivity, the formation of sometimes unnecessary and inappropriate synapses, which in turn can lead to ASD (Krey and Dolmetsch 2007).

Electromagnetic fields let calcium into neurons, too

There has been a 60-fold increase in ASD in recent years, which cannot be accounted for by improvements in diagnostic methods and can only be explained by changes in the environment. This increase corresponds in time to the proliferation of mobile telecommunications, WiFi, and microwave ovens as well as extremely low frequency fields (ELF) from mains wiring and domestic appliances. We can now explain this in terms of electromagnetically-induced membrane leakage leading to brain hyperactivity and abnormal brain development.

Non-ionising radiation makes cell membranes leak

The first effect of non-ionising electromagnetic radiation is to generate small alternating voltages across the cell membranes, which destabilize them and make them leak. This can have all sorts of consequences as unwanted substances diffuse into and out of cells unhindered, and materials in different parts of the cell that are normally kept separate, become mixed.

Why weak fields are more damaging than strong ones

We have known since the work of Suzanne Bawin and her co-workers (Bawin *et al.* 1975) that modulated radio-frequency electromagnetic radiation that is far too weak to cause significant heating can nevertheless remove calcium ions (positively charged calcium atoms) from cell membranes in the brain. Later, Carl Blackman showed that this also occurs with extremely low frequency electromagnetic radiation (ELF) but only within one or more “*amplitude windows*”, above and below which there is little

or no effect (Blackman *et al.* 1982; Blackman 1990). A proposed molecular mechanism for this can be found in Goldsworthy (2010). In particular, it explains why weak electromagnetic fields can have a greater effect than strong ones and why prolonged exposure to weak fields (where cells are maintained in the unstable condition for longer) is potentially more damaging than relatively brief exposure to much stronger ones.

How calcium ions stabilize cell membranes

This loss of calcium is important because calcium ions bind to and stabilize the negatively charged membranes of living cells. They sit between the negatively charged components of the cell membrane and bind them together rather like mortar binds together the bricks in a wall. Loss of just some of these calcium ions destabilize the membrane and make it more inclined to leak, which can have serious metabolic consequences. Among these are the effects of membrane leakage on the neurons of the brain.

How membrane leakage affects neurons

Neurons transmit information between one another in the form of chemical neurotransmitters that pass across the synapses where they make contact. However, the release of these is normally triggered by a brief pulse of calcium entering the cell. If the membrane is leaky due to electromagnetic exposure, it will already have a high internal calcium concentration as calcium leaks in from the much higher concentration outside. The effect of this is to put the cells into hair-trigger mode so that they are more likely to release neurotransmitters and the brain as a whole may become hyperactive (Beason and Semm 2002; Krey and Dolmetsch 2007, Volkow *et al.* 2011). This may not be a good thing since the brain may become overloaded leading to a loss of concentration and what we now call attention deficit hyperactive disorder (ADHD).

How does this impact on autism?

Before and just after its birth, a child's brain is essentially a blank canvas, and it goes through an intense period of learning to become aware of the significance of all of its new sensory inputs, e.g. to recognise its mother's face, her expressions and eventually other people and their relationship to him/her (Hawley & Gunner 2000). During this process, the neurons in the brain make countless new connections, the patterns of which store what the child has learnt. However, after a matter of months, connections that are rarely used are pruned automatically (Huttenlocher & Dabholkar 1997) so that those that remain are hard-wired into the child's psyche. The production of too many and often spurious signals due to electromagnetic exposure during this period will generate frequent random connections, which will also not be pruned, even though they may not make sense. It may be significant that autistic children tend to have slightly larger heads, possibly to accommodate unpruned neurons (Hill & Frith 2003).

Because the pruning process in electromagnetically-exposed children may be more random, it could leave the child with a defective hard-wired mind-set for social interactions, which may then contribute to the various autistic spectrum disorders. These children are not necessarily unintelligent; they may even have more brain cells than the rest of us and some may actually be savants. They may just be held back

from having a normal life by a deficiency in the dedicated hard-wired neural networks needed for efficient communication with others.

A useful homology might be in the socialisation of dogs. If puppies do not meet and interact with other dogs within the first four months of their life (equivalent to about two human years), they too develop autistic behaviour. They become withdrawn, afraid of other dogs and strangers, and are incapable of normal “pack” behaviour. Once this four-month window has passed, the effect seems to be irreversible (just like autism). If this homology is correct, it suggests that experiments on dogs could hold the key to the investigation of autism and its possible links with electromagnetic exposure.

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How Much Wireless Radiation* Are Your Brain & Body Exposed to 24/7?

Yes	No	Survey by The EMR Policy Institute, Inc. (www.EMRpolicy.org)
___	___	Do you use a cellphone, blackberry, or PDA. Bluetooth? How many? ___
___	___	Do you use an iPhone or smart phone?
___	___	Have you used a wireless communication device more than 300 hours?
___	___	Do you hold your cell phone next to your head or less than one inch from your head?
___	___	Do you only use your cell phone on speaker mode or by texting?
___	___	Have you been using a cell phone more than ten years? How many? _____
___	___	Do you know what tumors** are associated with cell phone use?
___	___	Do you use a wired or hollow tube earpiece?
___	___	Do you ever use a wireless device in a car, elevator, train or airplane?
___	___	Do you use a cordless phone at home or work? At what RF frequency does it operate?
___	___	Is your cordless phone a DECT-type?
___	___	Is a cell phone the only phone you use at home? At work?
___	___	Do you use a wired landline phone at home or work?
___	___	Do you use an iPad or another type of wireless tablet?
___	___	Do you use a Kindle, Nook or another wireless book reader?
___	___	Have you used any wireless device while pregnant or near a pregnant woman?
___	___	Do you use any wireless devices near an infant, baby or toddler?
___	___	Do you use a baby monitor?
___	___	Is a cell tower located on or near your child's school?
___	___	Has Wi-Fi been installed at your child's school?
___	___	Does your child's school have fiberoptic Internet access?
___	___	Does your child use a wireless laptop computer?
___	___	Does your child use a laptop directly on his/her lap rather than on a hard surface?
___	___	Does your child use a cell phone, blackberry or other type of wireless communication device?

- ___ ___ Did your child begin using a cell phone before age 20?
- ___ ___ Does your child use a cordless phone?
- ___ ___ Has a smart meter been installed on your home, apartment or place of employment to track electric, gas or water usage? (Where and at what distance is the meter located in relation to where people live, work, or sleep?)
- ___ ___ Is Wi-Fi installed in your home?
- ___ ___ Do you turn off the wireless router at night while you sleep?
- ___ ___ Do you or any member of your family use wireless toys?
- ___ ___ Do you or a member of your family have a cardiac pacemaker, insulin pump, neurostimulator, cochlear implant or other implanted medical device?
- ___ ___ Do you wear metal eyeglasses or jewelry? Do you wear a metal underwire bra?
- ___ ___ Do you use CFL's (compact fluorescent light bulbs) that emit UV and RF radiation?
- ___ ___ Do you live or work within 1600 feet of a cell antenna or tower?
- ___ ___ Do you know where cell towers and antennas are located near your home?
- ___ ___ Are cell phone antennas camouflaged on any buildings near where you live or work?
- ---- Do you live or work where Wi-Fi has been installed?
- ___ ___ Do you live or work in an area where WiMax is operating?
- ___ ___ Are any DAS (mini) antennas installed on utility poles outside your home?
- ___ ___ Do you own a plasma flat screen TV?
- ___ ___ Is a wireless security system installed in your home?
- ___ ___ Do you utilize wireless Internet "hotspots"?
- ___ ___ Do you use a wireless device to monitor your health?
- ___ ___ Do you use any wireless devices not mentioned above?
- ___ ___ Do you live or work near high tension electric lines?
- ___ ___ Do you know how many wireless radiation sources you are exposed to in a typical day?

*Wireless technology and devices use radiofrequency radiation (RF). Scientific studies indicate that RF exposures are cumulative. ** The tumors are malignant gliomas, parotid gland tumors and acoustic neuromas.

Witness Statement

Witness Statement on Mobile Phone Radiation

- Andrew Goldsworthy



Andrew Goldsworthy was born in 1939. After a conventional Grammar School education he obtained a First Class Honors Degree in Botany followed by a PhD for research into plant physiology and biochemistry at the University of Wales. He went on to lecture at Imperial College London, where he spent the rest of his career. He has had many teaching and research interests, ranging from the biochemistry of photorespiration to the biology of space flight. He retired in 2004 but remains as an honorary lecturer. He was also a scientific advisor to the European Space Agency and is currently a scientific advisor to several European charities concerned with the environment and electromagnetic fields, including the Bio Electromagnetic Research Initiative, the Radiation Research Trust, and Electrosensitivity-UK. He has always had a strong interest in how living organisms use internally-generated electric currents to control their growth and metabolism, and in their disruption by externally-applied currents and fields. In his retirement, he pieced together nuggets of information from a wide range of scientific journals and created simple layperson's explanations of how weak electromagnetic fields affect us all. The first of these can be found at <http://tinyurl.com/2nfujj>. The present article was submitted at the request of the Canadian House of Commons Standing Committee on Health for a hearing on April 29th 2010 on the biological effects of microwave radiation".

Abstract

Many people suffer one or more of a wide variety of symptoms when exposed to weak non-ionising electromagnetic radiation, including that from cell phones and Wi-Fi. Those responsible for the radiation deny that these effects exist, saying that there is no plausible explanation. In this submission I explain just how these effects can arise, and how virtually all of them share one of two common mechanisms. The pieces of the jigsaw fit together remarkably well and leave little doubt that the majority of the reported effects are real and must be taken seriously. Knowledge of the mechanisms makes it possible to mitigate the worst of these effects and I have made a number of suggestions as to how this might be done. I have also explained how a simple test, taking just a day or two to perform, could be used to assess the biological safety of both new and existing wireless technologies. Until this has been done, it would be wise to halt the roll-out of new wireless technologies and withdraw from sale particularly hazardous items such as DECT baby monitors which radiate continuously next to a very young child.

Introduction

There are literally thousands of scientific papers written on the non-thermal effects of weak non-ionising radiation such as that from cell phones (www.bioinitiative.org). Well over half of them show some sort of biological effect, many with either direct or indirect implications for human health. However, the results lack consistency and the cell phone industry uses this to imply that there are really no ill effects and that it is all due to experimental error. This argument is, however, flawed because it does not take into account biological variability.

Biological variability

It is a common mistake made by physicists and engineers alike that living organisms behave like simple physical systems and must always respond in the same way to physical or chemical perturbations. Nothing could be further from the truth. Living cells are not just chemical factories run by a fixed computer program. They are the product of thousands of genes that interact in countless ways, both with each other and the environment. Their physiology changes continuously to cope with rapid alterations in the environment and there are also epigenetic changes to their DNA that can be semi-permanent over the lifetime of the whole organism. It is these characteristics that enable the genes from two different parents to adapt to one another and give a viable offspring rather than a genetic disaster. You could not take a random mix of components from an Apple Mac and a PC, throw them into a box and hope to get a machine that worked. However, living organisms do this sort of thing easily.

It follows that living cells and organisms cannot always be expected to respond in the same way to chemical insults or to electromagnetic radiation. For example, not every smoker dies of cancer and we do not all suffer the same (if any) side effects from taking a medicinal drug. We cannot therefore expect non-ionising radiation to affect everyone equally. Because not everyone is affected by the radiation does not mean that no one is. Although it is understandable why the Industry prefers to use this argument, it is deeply flawed and potentially dangerous to those who are susceptible to the radiation.

A new approach

A more realistic approach is to look at frequently reported effects of non-ionising electromagnetic fields to see if there are any underlying threads that may indicate a common mechanism and then to change the characteristics of the signal to minimise these effects.

I have tried to do this and have been moderately successful in that I have found two mechanisms, which together can explain most of the diverse health effects frequently reported as stemming from this sort of radiation. Both should be preventable or minimised by suitable modifications to the way in which the signal is modulated.

The first is due to effects on **cryptochrome**, which affect animal navigation, endogenous circadian rhythms and the immune system. The second is due to effects on **calcium efflux** from cell membranes. These include early dementia, multiple allergies, DNA fragmentation, loss of fertility, increased cancer risk and electromagnetic hypersensitivity.

Effects on cryptochrome

Cryptochrome is a ubiquitous pigment in animals and plants. Plants use it to sense light to optimise their ability to photosynthesise. Animals use it to sense the direction of the Earth's magnetic field. Both animals and plants also use it to regulate their body clocks, which anticipate dawn and dusk to switch metabolism between day and night modes. In animals, it regulates the sleep-wake cycle and also the immune system, which has peak activity during the night phase (Koukkari and Sothorn 2006).

Unfortunately, radio waves badly upset the cryptochrome molecule to affect all of these functions. The energy doesn't come from the radio wave itself but from a previously absorbed high energy photon of light that flips an electron between two parts of the molecule to drive it into a high energy "free radical state". This decays spontaneously as the electron returns to the restore the *status quo*. Light intensity at any one time is perceived from the proportion of cryptochrome in the free radical state.



The direction of the Earth's magnetic field is detected because free radicals are magnetic and the rate at which the electron returns is determined by the orientation of the magnetic field in relation to the molecule. This time, the proportion of the cryptochrome in the free radical form is a measure of the strength and direction of the magnetic field. Both processes appear to be disrupted by radio frequency magnetic fields and the magnetic component of radio waves. In plants, radio waves are perceived as if they were light and have profound effects on their physiology. Animals that use the Earth's magnetic field for navigation may partially or completely lose that ability, which can account for colony collapse disorder in bees. The role of cryptochrome in the body clock means that this too can be disrupted by radio waves. Since the activity of the immune systems of both animals and plants are closely linked to the body clock, if the clock fails, their immune systems will not at any time function at

full capacity. This will result in a reduced resistance to pathogens. It may also account for the increased incidence of cancer often reported around cell towers as the immune system becomes less able to deal with incipient cancer cells. I will not labour these points here since you should all have received an email from me giving a more detailed account of it together with a number of attachments containing the experimental evidence. Much of this evidence is very recent, the earliest being Ritz *et al* (2004) and most people are still unaware of it. Fortunately, the frequencies responsible (below about 10MHz) are outside the main cell phone frequencies, but occur as out-of-band frequencies arising from the transmission of harmonics of the main signal. They are therefore easy to filter out without loss of information carrying capacity. This has now been taken on board by the British Office of Communications (Ofcom), who are very much "on the ball" and asked for (and was given) my permission to pass it on to the UK operators.



Calcium efflux effects

Calcium efflux from the membranes of brain tissue in response to weak electromagnetic fields was first discovered by Bawin *et al.* (1975). It has since been repeated many times and also with other tissues such as frog heart muscle (Schwartz *et al.* 1990). The effects are strongest in the extremely low frequency range and in radio waves that have been amplitude modulated with extremely low frequencies). The phenomenon is curious in that it occurs only within “amplitude windows” with little or no effect at amplitudes above and below the window. However, the explanation is simple. Divalent positive ions such as calcium, because of their double charge, are more easily removed from the negatively charged membrane by weak alternating fields. If an alternating electrical field is applied across the membrane, the negatively charged membrane and the positively charged ions move in opposite directions so that the ions tend to bounce on and off the membrane. If the field is very weak, most of the ions remain stuck to the membrane. If it is very strong, they all bounce on and off more or less equally but, somewhere in between, ions such as calcium with a double charge will be preferentially removed and replaced by less affected ions with a single charge such as potassium (potassium is the most likely ion to replace the calcium since it is by far the most abundant positive ion in living cells). This explains the amplitude windows for calcium release. 16Hz is particularly effective because it is the ion cyclotron resonance frequency for the potassium ion in the Earth’s magnetic field. The potassium ion resonates at this frequency and acquires extra energy from the field, which makes it even more likely to replace the lost calcium. The whole process requires very little energy, since the ions are only moved by molecular dimensions. The effect is simply to change the chemical equilibrium between mono and divalent ions bound to the membrane and there is no theoretical mini-

mum below which there is no effect, but the biological effects can be devastating.

Demodulation

In theory, unmodulated radio waves should not release calcium from cell membranes because there is not enough time to replace the calcium with another ion before the field reverses. However, as shown by Bawin *et al.* (1975) calcium release does occur if the radio wave is modulated at a biologically-active low frequency, which suggests that living cells can demodulate it. The simplest way to demodulate a signal is to rectify it. Living cell membranes contain countless voltage-gated ion channels that open only when the voltage across the cell membrane reaches a pre-determined value. These can rectify low frequency signals but, because they require the mechanical opening and shutting of the channels, they cannot work at microwave frequencies. However, **any** ion channel, provided it is open, should be able to rectify, even at microwave frequencies, due to non-linearities imposed by the membrane potential. The membrane potential is a natural voltage of the order of 100mV across living cell membranes, which gives a voltage gradient of about 10 million volts per metre along each ion channel (which is about 10nm long). This voltage gradient gives the channel different electrical properties in either direction. In effect, the whole membrane behaves as an array of point contact Schottky diodes, which allows even microwave signals to be rectified and demodulated. The extracted low frequencies appear across the membrane, where they can do most damage. This principle has been nicely illustrated by the construction of a complete radio set from a single carbon nanotube having a similar diameter to an ion channel.

(See <http://tinyurl.com/m4u75o>.)

When a voltage gradient was applied along the tube, it could both amplify and demodulate a radio signal, even at microwave frequencies.

Calcium loss weakens cell membranes

Calcium plays a vital role in strengthening cell membranes. Cell membranes are only about 10nm thick and consist mainly of a double layer of negatively charged phospholipids containing islands of protein that have various metabolic functions. Because most of these components are negatively charged, they tend to repel one another, but the membrane is stabilised by positive ions that sit in between them and function rather like the cement holding together the bricks in a wall. Calcium, with its double charge, is much better at doing this than ions with a single charge. When electromagnetic radiation replaces calcium ions with potassium, the membrane is weakened and becomes more likely to tear and develop temporary holes under the stresses and strain imposed by the continually moving cell contents (Steck *et al.* 1970, Lew *et al.* 1998, Ha 2001).

Consequences of leaky cell membranes.

Effects on metabolism

The concentration of calcium in the cytosol (the main part of living cells) is extremely low, usually much lower than that outside. If the external membrane leaks, free calcium enters the cell, where it has many effects on metabolism. At relatively low concentrations it may stimulate growth and repair (which may account for the apparent short-term beneficial effects of some electromagnetic fields) but at higher concentrations, it initiates several stress responses and growth is inhibited.

Cardiac arrhythmia

The heart muscle contracts in response to a wave of electrical activity passing through it, which is what we see in an electrocardiogram. This is generated by an ordered exchange of ions across its cell membranes. When these membranes leak as a result of electromagnetic expo-

sure, this electrical wave becomes weakened and disordered, which can result in cardiac arrhythmia and a possible risk of a heart attack.

Effects on the skin

If cells leak some of their contents into the surrounding matrix, it will cause inflammation. This has frequently been associated with electromagnetic exposure.

Effects on the blood brain-barrier.

The brain is separated from the bloodstream by a barrier in which the gaps between the cells are normally sealed by "tight junctions", which prevent unwanted materials entering the brain. Exposure to mobile phone radiation can breach this barrier to allow toxic materials such as albumin in the blood to enter, which can kill neurons (Salford *et al.* 2003) There is little immediate effect on brain function because the brain has spare capacity, but prolonged exposure will cause progressive brain damage and may be partly responsible for the current increase in early dementia and Alzheimer's disease. This could be due to these materials leaking through perforated cell membranes or to an opening of the tight junctions themselves.

Effects on allergies

There are similar tight junction barriers protecting all of our body surfaces, including the skin (in the *stratum granulosum*) and the linings of the lungs, nose and gut. These normally stop foreign chemicals and allergens entering the body, but if electromagnetic radiation were to open these barriers too, it could explain the current increase in allergies, asthma and multiple chemical sensitivities. Calcium release is probably involved in these effects, since low external calcium or EGTA (a substance that removes calcium ions from surfaces) increase the permeability of respiratory epithelia to ions and particles as large as viruses (Chu *et al.* 2001).

Effects on nervous tissue.

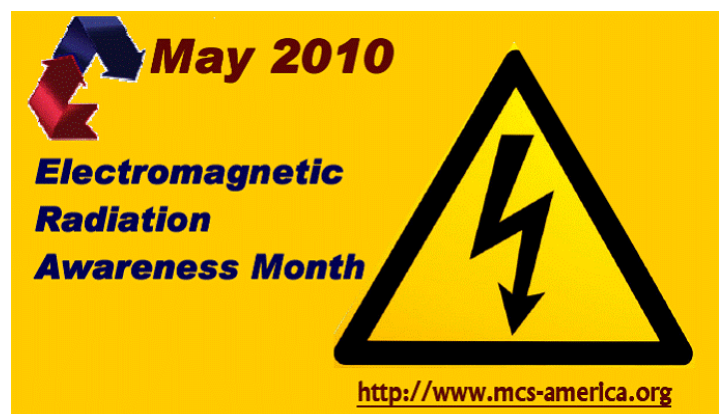
Calcium regulates the activity of the nervous system. Information is normally passed from one neuron to another as chemical neurotransmitters that flow across the synapses where they make contact. Calcium is needed for these neurotransmitters to be released. A pulse of calcium normally enters the cytosol of the neuron, either from internal stores or from the outside, before each batch of neurotransmitter can be released. If their membranes leak as a result of electromagnetic exposure, unscheduled calcium enters, which increases its background concentration inside. This has an effect similar to a hair trigger so that, when the time comes to send a signal to its neighbour, the response is faster. This explains why weak electromagnetic fields can often shorten our reaction time to simple stimuli. The downside is that they can also trigger a spurious release of neurotransmitters that have no right to be there, causing brain hyperactivity and a reduced ability to concentrate. Both of these effects are often reported by people living near cell towers. Neuron hyperactivity of this sort has also been detected by electrodes placed into the brains of animals (Beason and Semm, 2002). It can be argued that the increasing prevalence of attention deficit hyperactivity disorder (ADHD) is due to this effect resulting from our ever increasing exposure to electromagnetic radiation.

Electromagnetic hypersensitivity (EHS)

An estimated three percent of the population suffer from some form of electromagnetic hypersensitivity, probably due to their sensory cells sending spurious signals to the brain when they are exposed to electromagnetic fields. They include false sensations of heat, touch (e.g. crawling sensations), pins and needles, pain, tinnitus, dizziness and nausea. These too can be explained in terms of membrane leakage. Although we have a wide variety of sensory cells scattered over our body, most of them function in the same way. Whenever they sense what they are supposed to sense, their external membranes leak ions, which reduces the natural voltage between their insides and outsides.

This stimulates them to release neurotransmitters that trigger neighbouring nerve cells to send signals to the brain. When electromagnetic fields cause unscheduled leakage, false signals are sent, which can give a variety of false sensations, depending on which cells are most sensitive in the individual concerned. Many of these sensations are felt in the skin, but the hair cells of the inner ear can also be affected. Leakage in the hair cells of the cochlea give false sensations of sound (tinnitus) and those in the vestibular system (which sense rotation, linear acceleration and gravity) give false sensations of motion, which results in dizziness and symptoms of motion sickness, including nausea. The clincher is the effect on the eye. Unlike the rest of the sensory cells, the rods and cones of the retina actually **increase** their membrane potentials in response to light so that leakage here should **reduce** their response. This may be why electrosensitive people who have visual effects mostly report a partial loss of vision rather than seeing things that are not there.

What predisposes individual to electromagnetic hypersensitivity is unknown, but it could be because their cell membranes are already slightly leaky. This is supported by the findings of Eltiti *et al.* (2007) who found that the cells of individuals with EHS were more permeable to ions (as measured by skin conductance) than the control group ($p < 0.001$)



DNA fragmentation

Many experiments have shown both single and double stranded DNA breakage in cell cultures after several hours of cell phone radiation (Lai and Singh 1995, Diem *et al.* 2005). Although DNA molecules are too stable to be damaged directly by non-ionising radiation, they can still be damaged indirectly as a result of enzyme leakage from lysosomes. Lysosomes are membrane bound structures in the cells of most higher organisms that normally digest waste for recycling. They contain many digestive enzymes, including DNase, which destroys DNA. Were these to leak as a consequence of electromagnetic exposure, we would expect to see DNA fragmentation and possible collateral damage to other cellular components. Cells that have been affected in this way may lose some of their normal function and also have an increased risk of becoming cancerous. A possible example of function loss is the effect of power line frequencies on the thyroid glands of rodents. Short-term exposure up to about three months boosted thyroid activity but longer exposures resulted in loss of function and a reduced ability make its hormones (Rajkovic *et al.* 2003). Long-term exposure would be expected to cause hypothyroidism, the main symptoms of which are fatigue, loss of muscle tone and obesity. The thyroid gland is in the neck, close to where you hold your cell phone and a large and increasing proportion of the population is becoming clinically obese. There is also some evidence of an increase in brain and other head cancers associated with cell phone use, but because of the long latency time of many cancers, we may not know the full effect of a potential outbreak for some years to come.

Effects on fertility

There have been many reports of reduced male fertility associated with heavy cell phone use and these have been recently reviewed by Desai *et al.* (2009). Exposure to the radiation leads to the production of fewer sperm, often with abnormalities, of which the most consistent is a loss of mo-

tility. Most of the effects seem to be due to membrane damage and the production of reactive oxygen species. In some cases, DNA damage has also been reported, which could lead to abnormalities in future generations. Most of the studies have been based on epidemiology since it is unethical to do controlled experiments on humans. Fortunately, it has proved possible to get similar effects on healthy donated sperm, where there is no ethical problem. Just 60 minutes exposure to GSM phone radiation (in talk mode) caused a significant reduction in the viability and motility of donated sperm compared with the unirradiated controls. This was associated with an increase in reactive oxygen species and free radicals, which could cause DNA damage, but no DNA damage was seen after this relatively short exposure (Agarwal *et al.* 2009).

The real value of this experiment as I see it is that it provides an excellent and relevant test-bed for evaluating the safety (or otherwise) of virtually all existing and proposed forms of wireless communications. Each test takes little more than a day or so to perform, does not require much in the way of sophisticated apparatus and, unlike experiments on tissue cultures, the results cannot easily be dismissed as irrelevant to the whole organism. The spermatozoa are in the germ line and encapsulate the whole future of the human race. Given the widespread use of cell phones, any damage that they do to the sperm threatens the whole human race. The human genome, which has taken countless millions of years to evolve, is now under very serious threat.

What can be done about it?

It is clear that we are not dealing with heating effects, so the ICNIRP guidelines are irrelevant. The damaging effect is almost certainly due to the way the microwave signal is modulated. The effects of the radiation on cryptochrome can be eradicated by removing the part of the lower sideband of the transmissions that overlaps with the cryptochrome frequencies.

Most of the remainder can be attributed to the apparent ability of living cells to demodulate the signal so as to extract biologically-active low frequencies. The challenge to the Industry is to develop methods of modulation that do not generate these frequencies or to make them invisible to living cells. This should not be too difficult since we have at our disposal many highly sophisticated modulation techniques, but the living cell has little more than the equivalent of a simple untuned diode to detect it. By paying careful attention to the way in which the signal is encoded, it should be possible to avoid having biologically active low frequencies. Another possibility is to transmit two mirror image signals on slightly different carrier frequencies. If living cells do not have the ability to distinguish between the two carrier frequencies, they will cancel each other out and the signal will appear to them as if it is unmodulated. Neither of these are beyond the wit of man, but until these problems are solved, no new wireless technologies should be rolled out and any existing products that fail the sperm test should be withdrawn as soon as possible.

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On Second-Hand RF Radiation

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Radiofrequency radiation emissions from cellular towers and handsets hold the potential for increased incidence of long-term medical effects, but of equal importance are the immediate effects of exposure to the radiation.

Unlike second-hand cigarette or cigar smoke, exposure to which has been linked to life threatening and debilitating diseases, radiofrequency radiation exposure has, to date, successfully avoided the issue of passive personal exposure.

It is extraordinary that absorption of unwanted radiation is never cited as an objectionable byproduct of the wireless communication craze. The reason may be that radiofrequency radiation, being tasteless, odorless and invisible, just isn't considered. But, in fact, recent research has demonstrated that even short-term exposure to radiation power densities emanating from a nearby cellular telephone is sufficient to modify brainwave patterns, affect short-term memory, and modify an individual's ability to perform physical tasks such as driving an automobile. These effects are all well and good for those who are willing to accept the risk of modified brain functions and cancer but they are not well and good for the innocent victim of the insidious radiation - radiation that an innocent non-participant cannot even be aware is being deposited into his or her body.

Radiation emanating from a portable cellular telephone does not discriminate. It propagates through the entire environment surrounding the radiating antenna of the phone. Many people, perhaps most people, have the impression that the radiation goes only to the cellular tower receiving station. That's the cartoonish illusion passed on by the manufacturers and service providers, but the reality of the situation is that every time someone in an automobile next to you activates his cellular phone or whenever someone at a nearby table in a restaurant at which you are having lunch activates her phone your brain is being radiated. So, along with their own increased risk of memory deficits, automobile accidents, and brain cancer, the cellular phone users also include everyone nearby by bringing each into the high- risk pool.

Prior to the 1980s human exposure to radiofrequency radiating sources was pretty much restricted to the occasional passing police car, commercial mobile radio, or the ultra low-level RF energies emitted by the sun and a sparse array of remotely located television and radio broadcast antennae. However, today it is virtually impossible to venture into a public place without being battered by unwanted radiofrequency radiations from a variety of sources, the most objectionable of which must be the personal portable cellular telephone.

Without assuming any responsibility for their actions or assuming any liability for the effects, portable cellular telephone users are presently allowed to radiate nearby persons without fear of consequence, as there are no consequences, even while those unwillingly or unwittingly radiated have no recourse to remedy the unwanted exposures.

Such was the case with tobacco smoke until only recently. The issue of second-hand tobacco smoke might have been resolved many years ago if adequate research had been performed to support the complaints of objecting parties. In the instance of radiofrequency radiation the research has already been completed. The body of available research indicates that operation of a nearby portable cellular telephone will expose a non-user to radiation, some of which will be deposited into the brain of the non-user, at levels higher than necessary to elicit undesirable biological effects even though the phone may be more than ten feet away from the non-user.

To put the radiation exposure into perspective let's consider that a person standing ten feet away from a portable cellular phone user can be exposed to radiation levels of more than $1 \times 10^3 \text{ mW/cm}^2$ while the human body in the natural environment is exposed to about $1 \times 10^{-15} \text{ mW/cm}^2$ of radiofrequency radiation at the same frequency as the cellular phone. Expressed in everyday numbers this becomes: for the cellular phone radiation, 0.001 mW per square centimeter of the bystander's body, whereas for the bystander's normal environment the radiation level is only 0.000000000000001 mW per square centimeter.

In many instances a person may be legally exposed, contrary to one's own wishes, to radiofrequency radiation by a phone user standing or sitting immediately next to one's self - perhaps as little as one foot away. It's difficult enough to limit one's hazardous environmental exposures to avoid substances which can be detected, but to have no way of protecting one's self from a hazard that penetrates to the depths of the human brain violates the most fundamental principles of our social system.

Know, then, that whenever someone makes a cellular telephone call he or she doesn't just radiate their own brain, they radiate everyone's brain. Know, also, that after that cellular phone user leaves the scene he leaves behind, within the brain of each and every nearby person, the residual effects and damage. These are effects and damage known to the scientific community but not acknowledged by the industry placing their products into the commercial stream.

See also: Kane RC, A Possible Association Between Fetal/neonatal Exposure to Radiofrequency Electromagnetic Radiation and the Increased Incidence of Autism Spectrum Disorders (ASD). *Medical Hypotheses* (2004) 62, 195-197.

In 1992 Kane filed suit against Motorola claiming he developed a brain tumor as a result of testing a prototype antenna for a cellular telephone while employed by Motorola as an engineer. The case was ultimately settled as a confidential employer-employee resolution. See: <http://caselaw.lp.findlaw.com/scripts/getcase.pl?court=il&vol=app/2002/1002507&invol=3>
Kane passed away at the age of 56 in March, 2005.