



Current Problems in Pediatric and Adolescent Health Care

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Full Length Article

Wireless technologies, non-ionizing electromagnetic fields and children: Identifying and reducing health risks

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Children today are conceived and live in a sea of wireless radiation that did not exist when their parents were born. The launch of the digital age continues to transform the capacity to respond to emergencies and extend global communications. At the same time that this increasingly ubiquitous technology continues to alter the nature of commerce, medicine, transport and modern life overall, its varied and changing forms have not been evaluated for their biological or environmental impacts. Standards for evaluating radiation from numerous wireless devices were first set in 1996 to avoid heating tissue and remain unchanged since then in the U.S. and many other nations. A wide range of evidence indicates that there are numerous non-thermal effects from wireless radiation on reproduction, development, and chronic illness. Many widely used devices such as phones and tablets function as two-way microwave radios, sending and receiving various frequencies of information-carrying microwave radiation on multiple simultaneously operating antennas. Expert groups advising governments on this matter do not agree on the best approaches to be taken. The American Academy of Pediatrics recommends limited screen time for children under the age of two, but more than half of all toddlers regularly have contact with screens, often without parental engagement. Young children of parents who frequently use devices as a form of childcare can experience delays in speech acquisition and bonding, while older children report feelings of disappointment due to 'technoference'—parental distraction due to technology. Children who begin using devices early in life can become socially, psychologically and physically addicted to the technology and experience withdrawal upon cessation. We review relevant experimental, epidemiological and clinical evidence on biological and other impacts of currently used wireless technology, including advice to include key questions at pediatric wellness checkups from infancy to young adulthood. We conclude that consistent with advice in pediatric radiology, an approach that recommends that microwave radiation exposures be As Low As Reasonably Achievable (ALARA) seems sensible and prudent, and that an independently-funded training, research and monitoring program should be carried out on the long term physical and

psychological impacts of rapidly changing technological milieu, including ways to mitigate impacts through modifications in hardware and software. Current knowledge of electrohypersensitivity indicates the importance of reducing wireless exposures especially in schools and health care settings.

Abbreviations

EMF, Electro-magnetic field; EMR, Electromagnetic Radiation; FCC, Federal Communications Commission (U.S.A.); ICNIRP, International Commission on Non-Ionizing Radiation Protection; IEEE, Institute of Electrical and Electronics Engineers; MF, Magnetic field; GSM, Global System for Mobile Communications; RFR, Radiofrequency radiation; SAR, Specific Absorption Rate (a measurement of the rate at which energy is absorbed into particular tissues, when exposed to RFR); SAM, Specific Anthropomorphic Mannequin (a physical model used to estimate SAR, based on a 220 pound male with a 12 pound head); HPG, Hypothalamic-Pituitary-Gonadal axis; HSP, Heat Shock Proteins; ORSAA, Oceania Radio Frequency Scientific Advisory Association; DECT, Digital Enhanced Cordless Telecommunications; ICBE-EMF, International Commission on the Biological Effects of Electromagnetic Fields; ELF-EMF, Extremely Low Frequency Electromagnetic Fields (0 – 3 kHz); CDMA, Code Division Multiple Access; UMTS, Universal Mobile Telecommunications System; LTE, Long Term Evolution; ROS, Reactive Oxygen Species

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Introduction. Children's exposures to wireless radiation are increasing rapidly

We live in the age of technological wonder, where the ability to respond to

emergencies, engage in routine commerce, and even conduct warfare has been radically altered by wireless communications. At the same time, we are also in an age of technological imperatives; that is, the fact that something *can* technically be done has been misconstrued as an argument that this *should be done*, i.e., in favor of

implementing that technology. Parents understand that—just because you *can* go skateboarding ...

Electromagnetic radiation and biological effects

Radio communications lie at the heart of the cell phone and wireless radiation revolution via electromagnetic “radio waves” or RFR. ...

Children's unique vulnerability to wireless radiation

Children are more vulnerable to wireless radiation,^{78, 79, 80, 81} just as they are to other environmental pollutants⁹ and medicines. Present and future generations will have many more hours of cumulative lifetime exposure to RFR, because exposures begin prenatally and continue throughout early and later life.

Children have a unique physiology, that results in proportionately greater RFR absorption compared with adults.⁴ Children have smaller heads, resulting in shorter distances for RFR to ...

Reproductive capacity

Several, but not all reviews⁸⁹ of the effects of EMFs on male and female reproductive function have identified numerous serious effects that occur at levels of RFR that do not heat tissues. Gye and Park⁹⁰ and Jangid et al.⁹¹ present a number of *in vivo* and *in vitro* experimental studies demonstrating that non-ionizing nonthermal EMF exposure can alter cellular homeostasis, endocrine function, reproductive function, and fetal development. Impacts on both male and female reproductive parameters ...

Toxicological evidence of adverse impacts of RFR

Experimental studies form the foundation for evaluating pharmaceutical agents and other chemical and physical environmental exposures that can affect pediatric health. *In vitro* studies of well-established animal cell lines and human cell lines constitute one effective source of information that can be used to predict and prevent harm in humans. Employing validated rodent and other models, both short term and long-term *in vivo* studies on rodents and other animals are employed to clarify ...

Clinical practice guidance

Avoidable environmental exposures can profoundly affect and alter children's development and health. Along with the benefits of nutrition and regular physical and social activity, clinicians are aware of adverse effects of lead, pesticides, food additives, air pollution, ultraviolet radiation, and more broadly climate change, on children's health. Exposures that take place early life can have disproportionately large impacts on later life health and well-being.

As recommended by the AAP, ...

Inadequate regulatory limits

FCC and ICNIRP regulatory limits have been long criticized by experts and the court because they do not address children's unique vulnerability, the biological and health effects of long-term exposure nor the current ways that children are exposed to cell phone and wireless radiation. In 2012, the AAP wrote the FCC and other federal agencies calling for an update to the FCC's 1996 exposure limits stating, “it is essential

that any new standard for cell phones or other wireless devices be based ...

Conclusion: next steps for clinicians to better protect the young from impacts of RFR

Modern telecommunications have been embraced for their innumerable benefits to society, but we have been slower to acknowledge the need to avoid and reduce harms to youngsters or to the natural world on which our lives depend.²⁸⁶ Fortunately, alternatives to employing wireless devices can provide safer, faster and more efficient technical performance for many modern applications. There are many distinct physical, psychological and sociological grounds for moderating children's screen time to ...

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...Among them, Voltage Controlled Calcium Gates (VCCGs) have been considered as relevant since these channels are responsible for the calcium ions transport across the cellular membrane being key players of the cellular homeostasis regulation.33 Depending on RF-EMF exposure conditions and the model of study (cells, laboratory animals and human) the effects of EMF on health yet described can be therapeutic34,35 as well as potentially harmful.32,36,37 Scientific evidence on RF-EMF shows that everyday exposure to wireless devices can influence the physical, emotional and psychological health and well-being of children and adults.38...

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