

# The Adverse Health effects of Non Ionizing Radiation on Foetus and Child: is it a mythos or a scientifically evident Global Public Health Challenge

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## 1. Introduction

Exposure to EMF/RF radiation (electromagnetic/radiofrequency) of 30KHz-300GHz, is continuous, multiple, exponentially growing, affecting entire population actively and passively. Sources of exposure include all wireless devices, such as cellular telephones, their base stations, Wi-Fi, Wi-Fi toys, smart meters, baby monitors etc. Potential health impacts of non ionizing radiation from EMF/RF include carcinogenicity: *IARC (2011), Carlberg, M., 2017, Hardell L (2013, 2017) Miller A., (2017 & 2018)*, oxidative stress and effects on DNA, *Yakymenko I.(2016)*, effects on fertility *Houston, B.J(2016), Adams, J.,(2014)*, developmental neurotoxicity, cognitive impairments in learning and memory: *Deshmukh, P.(2015), Tang, J. (2015)*, and other serious effects well documented in peer reviewed studies. Eight non thermal biological effects, are well documented (each addressed in 12 up to 35 reviews, *Pall M.L. (2018)*, and , occurring at extremely lower levels than the thermally based limits (ICNIRP/Rec1999/519/EC). The main mechanism of action of EMFs is voltage-gated calcium channel (VGCC) activation, *Pall M.L (2018b)*. *Lai, H. (2017,2018)* also provides review of peer review studies. *Carlo V. et al* in Bionitiative 2012 sect 19 focuses in particular on fetal and neonatal effects of EMF.

## 2. Children and Fetuses Exposure and Vulnerability

Mobile phones, baby monitors, wireless tablets and toys, and Wi-Fi, are major sources of children's passive and active exposure at home and schools. Of great concern is the wide spread of Wi-Fi at schools (*Reykjavik Appeal 2017*). A review on Wi-Fi multiple effects is done by *Wilke I. (2018)*. *Pall, M.. (2018b)* concludes that Wi-Fi causes oxidative stress, sperm/testicular damage, neuropsychiatric effects including EEG changes, apoptosis, cellular DNA damage, endocrine changes, and calcium overload, and that these effects are established. Absorption from child's brain is greater and in deeper tissues compared to adults. Child's brain has different dielectric constants, greater conductivity, smaller size, thinner cranial bones and smaller distance from radiation source (*Keshvari, J et al 2006, Christ, A, 2010, Morgan L, 2014, .*). Apart from higher exposure, children's vulnerability to toxic factors is disproportionately higher

than adults, because of developmental windows of vulnerability. Children sensitivity to EMF/RF caused epigenetic changes in DNA is higher (*Kheifets, L 2005*). Embryonic stem cells are more sensitive to multiple radiation frequencies and cannot adapt to chronic EMF/RF exposures, *Lee(2014; Belyaev (2009)*. Because such stem cells occur at much higher cell densities in fetus and children impact on children are likely to be much higher than in adults *Belyaev (2009)* . The decreased DNA repair and increased DNA damage combined with faster cell division and more years of exposure to EMF/RF, strongly suggest that young children may be increasingly susceptible to cancer, *Pall M.L(2018b)*. EMF/RF action on stem cells may also cause young children to be particularly susceptible to disruption of brain development, *Xu (2016); Bhargav (2015)*. Epigenetic mechanisms can change fetal development especially the neurological one, *Sage, C. (2018)*. Damages can be irreversible, leading to neurological/neuropsychiatric effects, *Divan A.(2010), Schaeffers (2016), Pall M.. (2016)*.

## 3. Risk Evaluation- Precautionary Measures

Risk Assessment/management in the EMF/RF domain, remains quite complex and challenging, with gaps and uncertainties. Effects are multi factorial, depending e.g on vulnerability of the subject, frequency, modulation, strength and exposure duration (all being highly variable (*ANSES 2016*)). Dose-response curves are often non-linear/ non-monotonic, *Belyaev, 2005, 2015; Pall, 2015b*). Some long term effects have not yet been investigated or are beyond the timeframe of most of the studies. Disperse passive exposure, limits availability of unexposed /blank population. These could explain part of conflicting studies, and limit biological consistency, full establishment of certain effects and causality. Child oriented studies are still very limited (*ANSES 2016*) and extrapolation from adults studies is not scientifically adequate. Despite these constraints, the existing scientific evidence is strong enough, indicating damages that could be serious and in some cases irreversible. Application of the Precautionary Principle (Com 2000) is fully justified. Scientific groups, medical and other organizations and researchers, recommend actions to reduce EMF/RF

exposures, especially for children and pregnant women, to fully inform public about risks and good practices, to educate health professionals, to revise limits, to promote child oriented research and appropriate (REACH-like) control of new technologies prior marketing or deployment (*International Doctors' Freiburger Appeal 2012, Appeal on 5G 2018, American Academy of Paediatrics, EMF Scientist Appeal 2015, Reykjavik Appeal on Wireless Technology in Schools 2017, Environmental Health Trust (EHT), Nicosia Declaration 2017, Austrian Medical Association, Council of Europe, Resol. 1815, 2011, Appeal on holding 5G, 2018*).

Moral obligations for scientist, politicians and the society to protect children and future generation is undisputable. In taking actions and decisions for EMF, in particular when children's exposure is evaluated, health fundamental principles for prevention and ALARA principle must be applied and compliment the weighting of evidence.

**Keywords:** EMF/RF children exposure, vulnerability, effects, risk, precautionary approach.\*

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