Radiofrequency Electromagnetic Fields: Part 1 Radio Waves

David O. Carpenter, MD

Changes in exposure to RF fields over time:

The figure below (from Bandara and Carpenter, 2028) shows how human exposure to EMFs has changed over time at different frequencies, listed as power flux density. The most important point from this plot is the evidence that total exposure and especially exposure to higher frequencies has increased dramatically since 2010.

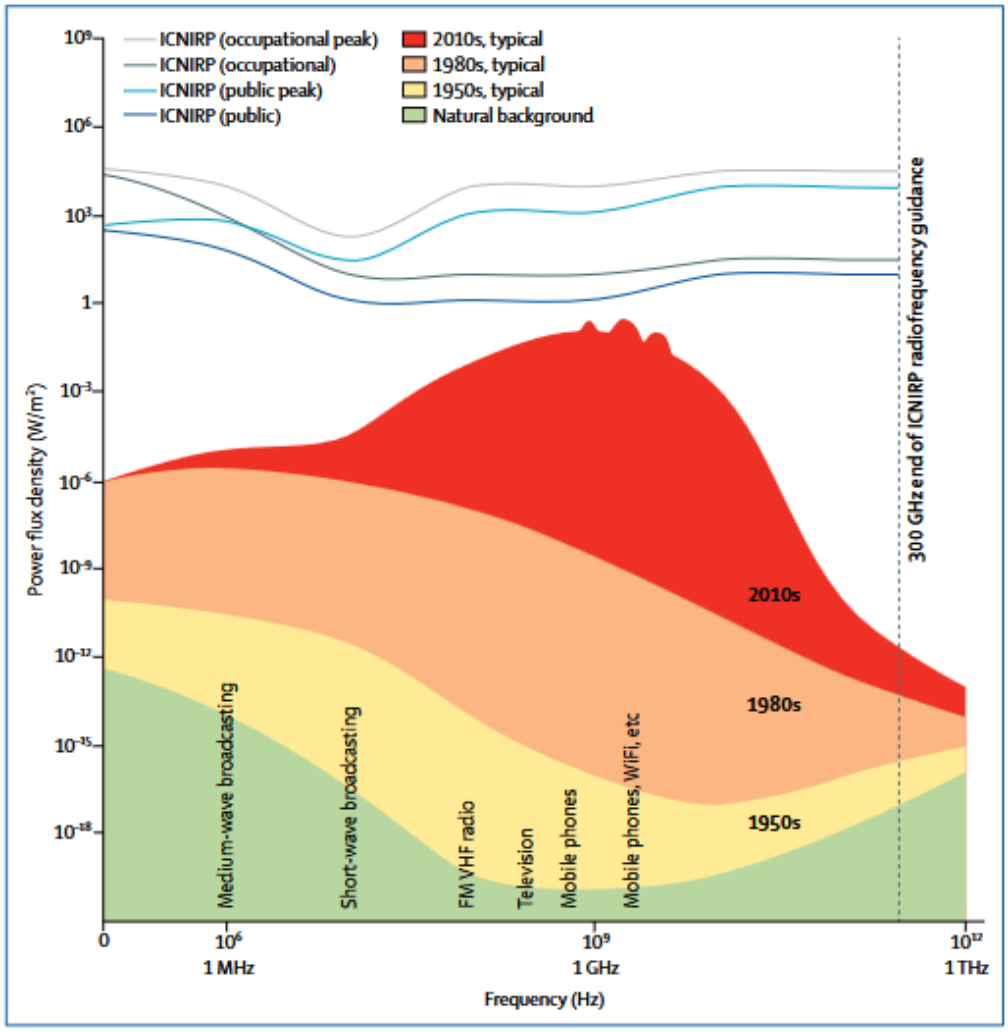


Figure: **Typical maximum daily exposure to radiofrequency electromagnetic radiation from man-made and natural power flux densities in comparison with International Commission on Non-Ionizing Radiation Protection safety guidelines[1]**

Anthropogenic radiofrequency electromagnetic radiation levels are illustrated for different periods in the evolution of wireless communication technologies. These exposure levels are frequently experienced daily by people using various wireless devices. The levels are instantaneous and not time-averaged over 6 minutes as specified by International Commission on Non-Ionizing Radiation Protection for thermal reasons. Figure modified from Philips and Lamburn[12] with permission. Natural levels of radiofrequency electromagnetic radiation were based on the NASA review report CR-166661.[13]

Radio waves:

There are many sources of RF in our everyday environment. Some are natural background but now the great percentage comes from human activity. Radio and television are the ones that have been around the longest. They operate at a higher frequency than those associated with the ELF-EMF but lower than microwave frequencies. They are usually called “radio waves”. AM radio in the US uses frequencies between 535 and 1,705 kHz

while FM radio uses frequencies between 88 to 108 MHz. Radio station towers typically emit RF signals in a 360-degree pattern.

Therefore, exposure is greater near to the transmitters than further away. If one can get reception on a radio or TV stations this means that your environment is continuously bathed in the radio waves at the specific frequency of each individual station. Therefore, everyone is continuously exposed whether or not the radio or TV is on and is exposed to each of the frequencies of individual stations. There are also other sources of exposure in this frequency range. Short-wave radio typically operates at frequencies between 3 and 30 MHz, citizen band radio operates between 26 to 28 MHz. Garage door openers use about 40 MHz. Baby monitors operate at 49 MHz. So in addition to the contributions to human exposure coming from radio and television, there is exposure from radio waves from a variety of low energy RF gadgets and household items.

Health effects of radio waves:

Since everyone except those in very remote areas is continually exposed to radio waves, it is difficult to determine whether they pose threats to human health, since there is no unexposed comparison population. While there remains some uncertainty around human health hazards coming from radio waves there are a number of reports that suggest that individuals living near to high powered radio transmission stations do show elevated rates of disease, especially childhood leukemia.

The first report of concern from broadcasting stations came from Australia where Hocking et al . (1996) reported elevated leukemia in children where they compared rates among children living in municipalities containing or not containing broadcasting towers. They report an elevated incidence [rate ratio (RR) = 1.58 (95% confidence interval = 1.09-2.34)] in children living near these TV stations but no difference for brain cancer. These results are of particular interest because of the evidence for elevated leukemia among children exposed to elevated magnetic fields discussed earlier.

Vatican radio has a very powerful radio transmission tower that transmits signals over the whole world. It utilizes several transmitters and different frequences for transmission throughout Europe and by shortwave internationally. Michelozzi et al. (2002) investigated rates of cancer of both children and adults who live within 10 km of the transmitter sites (n = 49,656). They found an elevated childhood leukemia of children <14 years of age living within 6 km of the transmitters with a standardized incidence rate (SIR) of 2.2 (95% confidence interval = 1.0-4.1). The risk decreased with distance from the station, where

the SIR within 0-2 km was 6.1, within 2-4 km was2.3 and within 4-6 km was 1.9. Leukemia rates among adults were not elevated except for men living within 0-2 km from the station.

Ha et al. (2007) investigated rates of childhood leukemia (n=1,928) and brain cancer (n=956) in Korean children under 15 years of age living near to 31 different AM radio transmitters. They found elevated rates of leukemia in children living within 2 km of the nearest AM transmitter (odds ratio = 2.15, 95% CI = 1.00-4.67) as compared to children living more than 20 km from the sites. They did not report any increase in brain cancer risk. However, Hauri et al., (2014) did not find elevated leukemia among Swiss children based on modelled exposure to radio waves from broadcast transmitters.

References:

Bandara P and Carpenter DO (2018) Planetary electromagnetic pollution: It istime to assess its impact. Lancet Planetary Health 2: e522-e523.

Ha M, Im H, Lee M, Kim HJ. Kim BC, Gimm YM and Pack JK (2007) Radio-frequency radiation exposure from AM radio transmitters and childhood leukemia and brain cancer. Am J Epidemiol 166: 270-279.

Haui DD, Spycher B, Huss A, Zimmerman F, Grotzer M, van der Weid N, et al., (2014) Exposure to radio-frequency electromagnetic fields from broadcast transmitters and risk of childhood cancer: a census-based cohort study. Am J Epidemiol 79:843-851.

Hocking B, Gordon IR, Grain HL and Hatfield GE (1996) Cancer incidence and mortality and proximity to TV towers. Med J Aust 165: 601-6-5.

Michelozzi P, Capon A, Kirchmayer U, Forastiere F, Biggari A, Barca A and Perucci CA (2002) Adult and childhood leukemia near a high-power station in Rome. Am J Epidemiol 155: 1096-1193.