HEALTH RESEARCH: The interaction between electromagnetic fields at megahertz, gigahertz and terahertz frequencies with cells, tissues and organisms: risks and potential

This paper systematically reviews the role and effects of static and pulsed radio frequencies (10^0–10^9 Hz), millimetre waves (MMWs) or gigahertz (10^9–10^{11} Hz), and terahertz (10^{11}–10^{13} Hz) on various biomolecules, cells and tissues. Electromagnetic fields have been shown to affect the activity in cell membranes (sodium versus potassium ion conductivities) and non-selective channels, transmembrane potentials and even the cell cycle. Particular attention is given to millimetre and terahertz radiation due to their increasing utilization and, hence, increasing human exposure. MMWs are known to alter active transport across cell membranes, and it has been reported that terahertz radiation may interfere with DNA and cause genomic instabilities. These and other phenomena are discussed along with the discrepancies and controversies from published studies.

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5746568/

HEALTH RESEARCH: Hearing of microwave pulses by humans and animals: effects, mechanism, and thresholds.

The hearing of microwave pulses is a unique exception to the airborne or bone-conducted sound energy normally encountered in human auditory perception. The hearing apparatus commonly responds to airborne or bone-conducted acoustic or sound pressure waves in the audible frequency range. But the hearing of microwave pulses involves electromagnetic waves whose frequency ranges from hundreds of MHz to tens of GHz. Since electromagnetic waves (e.g., light) are seen but not heard, the report of auditory perception of microwave pulses was at once astonishing and intriguing. Moreover, it stood in sharp contrast to the responses associated with continuous-wave microwave radiation. Experimental and theoretical studies have shown that the microwave auditory phenomenon does not arise from an interaction of microwave pulses directly with the auditory nerves or neurons along the auditory neurophysiological pathways of the central nervous system. Instead, the microwave pulse, upon absorption by soft tissues in the head, launches a thermoelastic wave of acoustic pressure that travels by bone conduction to the inner ear. There, it activates the cochlear

receptors via the same process involved for normal hearing. Aside from tissue heating, microwave auditory effect is the most widely accepted biological effect of microwave radiation with a known mechanism of interaction: the thermoelastic theory. The phenomenon, mechanism, power requirement, pressure amplitude, and auditory thresholds of microwave hearing are discussed in this paper. A specific emphasis is placed on human exposures to wireless communication fields and magnetic resonance imaging (MRI) coils.

https://www.ncbi.nlm.nih.gov/pubmed/17495664