

EFFECTS OF MOBILE PHONE RADIATION ON THE HUMAN HEALTH

Mobile or cellular phones are now an integral part of modern telecommunications. In many countries, over half the population use mobile phones and the market is growing rapidly. At the end of 2009, there were an estimated 4.6 billion subscriptions globally. In some parts of the world, mobile phones are the most reliable or the only phones available.

Mobile phones communicate by transmitting radio waves through a network of fixed antennas called base stations. Radiofrequency waves are electromagnetic fields, and unlike ionizing radiation such as X-rays or gamma rays, can neither break chemical bonds nor cause ionization in the human body ¹.

Radiation absorption form mobile phones:

Part of the radio waves emitted by a mobile telephone handset is absorbed by the human head. The radio waves emitted by a GSM handset can have a peak power of 2 watts, and a US analogue phone had a maximum transmit power of 3.6 watts. Other digital mobile technologies, such as CDMA2000 and D-AMPS, use lower output power, typically below 1 watt.

What is radiofrequency energy and how does it affect the body?

Radiofrequency energy is a form of electromagnetic radiation. Electromagnetic radiation can be categorized into two types: ionizing (e.g., x-rays, radon, and cosmic rays) and non-ionizing (e.g., radiofrequency and extremely low-frequency or power frequency) ².

Exposure to ionizing radiation, such as from radiation therapy, is known to increase the risk of cancer. However, although many studies have examined the potential health effects of non-ionizing radiation from radar, microwave ovens, and other sources, there is currently no consistent evidence that non-ionizing radiation increases cancer risk².

The only known biological effect of radiofrequency energy is heating. The ability of microwave ovens to heat food is one example of this effect of radiofrequency energy. Radiofrequency exposure from cell phone use does cause heating; however, it is not sufficient to measurably increase body temperature.

Effects of radiation energy of mobile phones on human health:

Thermal effects

One well-understood effect of microwave radiation is dielectric heating, in which any dielectric material (such as living tissue) is heated by rotations of polar molecules induced by the electromagnetic field. In the case of a person using a cell phone, most of the heating effect will occur at the surface of the head, causing its temperature to increase by a fraction of a degree. In

this case, the level of temperature increase is an order of magnitude less than that obtained during the exposure of the head to direct sunlight. The brain's blood circulation is capable of disposing of excess heat by increasing local blood flow. However, the cornea of the eye does not have this temperature regulation mechanism and exposure of 2–3 hours duration has been reported to produce cataracts in rabbits' eyes at SAR values from 100-140W/kg, which produced lenticular temperatures of 41°C. There were no cataracts detected in the eyes of monkeys exposed under similar conditions³. Premature cataracts have not been linked with cell phone use, possibly because of the lower power output of mobile phones.

Non-thermal effects

The communications protocols used by mobile phones often result in low-frequency pulsing of the carrier signal. Whether these modulations have biological significance has been subject to debate.⁴

Some researchers have argued that so-called "non-thermal effects" could be reinterpreted as a normal cellular response to an increase in temperature. The German biophysicist Roland Glaser, for example,⁵ has argued that there are several thermoreceptor molecules in cells, and that they activate a cascade of second and third messenger systems, gene expression mechanisms and production of heat shock proteins in order to defend the cell against metabolic cell stress caused by heat. The increases in temperature that cause these changes are too small to be detected by studies such as REFLEX, which base their whole argument on the apparent stability of thermal equilibrium in their cell cultures. Other researchers believe the stress proteins are unrelated to thermal effects, since they occur for both extremely low frequencies (ELF) and radio frequencies (RF), which have very different energy levels.⁶ Another preliminary study published in 2011 by *The Journal of the American Medical Association* conducted using fluorodeoxyglucose injections and positron emission tomography concluded that exposure to radiofrequency signal waves within parts of the brain closest to the cell phone antenna resulted in increased levels of glucose metabolism, but the clinical significance of this finding is unknown.^{7,8}

Blood-brain barrier effects

Swedish researchers from Lund University (Salford, Brun, Persson, Eberhardt, and Malmgren) have studied the effects of microwave radiation on the rat brain. They found a leakage of albumin into the brain via a permeated blood-brain barrier.^{9,10} This confirms earlier work on the blood-brain barrier by Allan Frey, Oscar and Hawkins, and Albert and Kerns.¹¹

Cancer

In 2006 a large Danish study about the connection between mobile phone use and cancer incidence was published. It followed over 420,000 Danish citizens for 20 years and showed no

increased risk of cancer.¹² The German Federal Office for Radiation Protection (Bundesamt für Strahlenschutz) considers this report inconclusive.¹³

The 13 nation INTERPHONE project – the largest study of its kind ever undertaken – has now been published and did not find a solid link between mobile phones and brain tumours.¹⁴

Exposure limit guidelines

Radiofrequency exposure limits for mobile phone users are given in terms of Specific Absorption Rate (SAR) – the rate of radiofrequency energy absorption per unit mass of the body. Currently, two international bodies^{15, 16} have developed exposure guidelines for workers and for the general public, except patients undergoing medical diagnosis or treatment. These guidelines are based on a detailed assessment of the available scientific evidence.

Precautionary measures:

In May 2011, the World Health Organisation's International Agency for Research on Cancer announced it was classifying electromagnetic fields from mobile phones and other sources as "possibly carcinogenic to humans" and advised the public to adopt safety measures to reduce exposure.

Few recommendations are:

- Use hands-free to decrease the radiation to the head.
- Keep the mobile phone away from the body.
- Do not use telephone in a car without an external antenna.

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