

Understanding Mobile Phone Radiation and Its Effects

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There is as yet no conclusive evidence of an adverse effect of mobile phone use on people's health. An inter-ministerial committee has, however, asked that mobile phone manufacturers prominently display certain health-related technical features. With telecom use exploding in India and with the haphazard growth of the telecom infrastructure (mobile towers) it helps to be careful in using mobile phones.

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The Department of Telecommunications (DOT) has said it is going to issue orders to the mobile handset manufacturers, to prominently display the Specific Absorption Ratio (SAR) levels on the packing, so that it is readily available to the consumer at the point of sale. The SAR is a measure of the amount of radio frequency energy absorbed by the body when a handset is in use. Lower number indicates a lower radiation exposure risk.

On 13 January 2010 an inter-ministerial committee submitted its report on electromagnetic frequency radiation to the DOT.¹ The committee has said that radiation can cause thermal effects by holding mobile phones close to the body. It can also cause non-thermal effects, which may result in burning and tingling sensations on the skin of the head, fatigue, sleep disturbance, dizziness, lack of concentration, ringing in the ears, reaction time, loss of memory, headache, disturbance in digestive system and heart palpitation, etc. Higher the SAR level of a handset, more are the chances of health hazards. The committee recommends buying a mobile phone with low SAR.

At present we follow the International Commission on Non-Ionising Radiation Protection (ICNIRP) guidelines for radiation, which allow a radiation rate of 4.5 watts/sq metre at 900 MHz and 9.2 watts/sq metre at 1,800 MHz to be emitted from cell phone towers (Inter-ministerial Report,

pp 31-32). India follows the latter reference level. The committee has now suggested that the radio frequency exposure limits in India may be lowered to 1/10th of the existing reference level. The existing standards are based on thermal limits and do not address non-thermal exposures.

The committee in its report says that the hot tropical climate of the country, low body mass index (BMI), low fat content of an average Indian as compared to European and high environmental concentration of radio frequency radiation may place Indians under greater risk of such radiation.

With this the government seems to accept that exposure to "unsafe" radiation levels might be harmful. Last year a study commissioned by *Teelka* magazine found that four-fifths of the capital's area was exposed to "unsafe" radiation levels.

Mobile Phone Radiation

Mobile phones emit signals via radio waves, which comprise radio frequency energy, a form of electromagnetic radiation. The radiation is transmitted by the antenna and the circuitry inside the mobile handset. This radiation is not directional, which means that it propagates in all directions more or less equally. Factors such as the type of digital signal coding in the network, the antenna design and its position relative to the head determine how much radiation is absorbed by the user of the mobile phone.

The SAR of a mobile phone is defined by the American National Standards Institute (ANSI) as "the time rate at which radio frequency electromagnetic energy is imparted to an element or mass of a biological body. It is expressed as energy flow (power) per unit of mass in units of w/kg." When referring to human tissue, this

means that SAR is the measurement of heat absorbed by the tissue.²

India has adopted ICNIRP guidelines as standard for safety limits of exposure to radiation by mobile handsets, whole-body average SAR at 0.08 w/kg, localised SAR head and trunk at 2 w/kg and localised SAR limbs at 4 w/kg (averaged over a six minute period using 10 gram average mass) (Inter-Ministerial Committee Report, p 35).

Every mobile phone model sold in the United States (us) has the SAR information in its manual. The Federal Communications Commission (FCC) has designated a SAR level of 1.6 w/kg as “safe”. The SAR data of a particular mobile phone is also available at the FCC website. Sometimes it is even coded on the mobile phone inside the battery pack or the phone manufacturer publishes the identification number for the specific level. In Europe, the level is capped at 2 w/kg, while Canada allows a maximum of 1.6 w/kg.

In India, the SAR number of a mobile phone is usually mentioned in the user guide. Consumers could also refer to the website of the company, where such information is available. The SAR numbers at the ear of a few mobile phones of one of the most popular mobile companies are anywhere between 0.61 and 1.07 w/kg. The SAR value of another popular low cost mobile handset in India is at 0.672 w/kg.

Many mobile phone companies known for their low cost qwerty pad mobile phones and for their stylish handsets, do not display the SAR information on their websites.

Radiation Research

There are two types of radiation: (1) ionising which knocks electrons from atoms producing ions, x-rays, and (2) non-ionising, which usually does not dislodge the electron and is considered not as hazardous as ionising radiation, for it only heats the surface layers of its target. The radiation from mobile phones and mobile phone towers is believed to be of the second, less harmful kind – non-ionising radiation.

The concern with non-ionising radiation is that it could have long-term effects. Although it may not immediately cause

damage to tissue, scientists are still not sure about what kind of problems might appear due to prolonged exposure to such radiation. The research findings vary and has not been able to conclusively determine the extent of mobile phone radiation danger to human health.

Let us look at some of the research studies.

One of the well-understood effects of mobile phone radiation is the thermal effect, where most of the heating effect occurs on the surface of the head. The thermal effect has the ability to heat human tissue, much like the way a microwave oven heats food. The level of temperature increase is of 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 two to three hours’ duration has been reported to produce cataracts in rabbits’ eyes at SAR values from 100-140 w/kg, which produced lenticular temperatures of 41°C. There were no cataracts detected in the eyes of monkeys exposed under similar conditions.

A 2009 study on the entire adult populations of Denmark, Finland, Norway and Sweden (a population base of 16 million people), tried to find out if there was high-quality cancer registration in these countries, including benign brain tumours. This study did not detect any clear change in the long-term time trends in the incidence of brain tumours from 1998 to 2003. It suggested that the induction period for brain tumours associated with mobile phone use exceeded 5-10 years, and because of the high prevalence of mobile phone exposure in this population and worldwide, longer follow-up of time trends in brain tumour incidence rates are warranted.³

A study in 2003 on eight rats exposed for two hours to the radiation of different strengths of the mobile phones having the Global Systems for Mobile (GSM) communications resulted in neuronal damage in the cortex, hippocampus and basal ganglia in the brains of exposed rats (Salford et al 2003; 881-83).

The findings from a study in 2004 do not indicate an increased risk of acoustic neuroma (a benign, slow growing tumour that can cause hearing loss, balance problems, and facial palsy),⁴ related to short-term mobile phone use after a short latency period. However, the data suggests an increased risk of acoustic neuroma associated with mobile phone use of at least 10 years duration (Lonn et al 2004; 653-59).

Later in 2009 an article in the *Journal of the National Cancer Institute* published findings based on a huge body of data from several national cancer registries in northern Europe. It found that there was no significant association between cell phone use and brain tumour incidence and concluded that there was no change in brain tumor incidence during a time when cell phone usage increased.

Olle Johansson, a scientist at the Department of Neuroscience, Karolinska Institute, Sweden, who is doing research on mobile phone radiation for more than three decades now, has found that the human brain is sensitive to electromagnetic radiation, i e, mobile phone radiation. His findings have been largely rejected by the industry. However, recently Sweden has recognised electrohypersensitivity (subjective and objective skin and mucosa related symptoms, such as itching, smarting, pain, heat sensation, redness, papules, pustles, etc, after the exposure to visual display terminals, mobile phones, as well as other electromagnetic devices) as functional impairment.⁵ His arguments about mobile phone radiation have been debated widely.

The international interphone case – control a study of brain tumours – showed no

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overall increase in glioma or meningioma risk (brain tumours), but leave open the possibility of a small to moderate increased risk for glioma among the heaviest users of mobile phones (Cardis et al 2007: 647-64). A Swedish – control study series, suggested substantially increased risks for glioma among both short- and long-term users of mobile phones (Hardell et al 2006: 4-74).

Recently, a study which tried to examine the minute effects of mobile phones on the brains of 47 healthy human subjects found that mobile phones have not been convincingly linked to brain cancer, but that does not mean that their associated radiation has no impact on our bodies. It says that these pervasive devices can alter the brain's glucose metabolism which is a marker of neuronal activity, "metabolism in the region closest to the antenna was significantly higher (about 7%) for ON than OFF conditions". "We have no idea what this means yet or how it works", said neuroscientist Nora Volkow of the

us-based National Institute of Health. "But this is the first reliable study showing that the brain is activated by exposure to mobile phone radio frequencies". The findings were published in the 23 February issue of *Journal of the American Medical Association (JAMA)*.⁶

Radiation and Cancer

A large part of the research on mobile phone radiation has been directed at finding a possible cancer link. In the past, tests on animals showed no evidence of cancer-induced by radiation from mobile phones (Heikkinen et al 2001: 775-85; Utteridge et al 2002: 357-64; Moulder et al 2005: 189-203). WHO established the International Electromagnetic Fields (EMF) Project in 1996 to assess the scientific evidence of possible adverse health effects from electromagnetic fields. In May 2006 it said "long-term animal studies have not established an increased risk of cancer from exposure to RF fields, even at levels that are much higher than

produced by base stations and wireless networks".⁷

In 2005, based upon the consensus view of the scientific and medical communities the WHO stated that there are too few peer reviewed studies assessing the health effects associated with long-term base station exposures to warrant scientific certainty. The general toxicological principle "the dose makes the poison" does not apply to non-ionising radiation. It further said the evidence of cancer from radio frequency is below the international level, unlikely to be carcinogenic to humans, and other health effects have not been established.⁸ It, however, suggested a list of precautionary measures. In the fact sheets issued in 2000,⁹ and later, in May 2010, WHO echoes that no consistent evidence of a causal relationship has been established.¹⁰ The European Commission in 2009 echoed that the exposure to radio frequency fields is unlikely to lead to an increase in cancer in humans.

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The Washington-based government watchdog group, Environmental Working Group in 2009 said that scientific evidence to date has not been able to make a hard link between cancer and mobile phones, but that recent studies were showing an increased risk for brain and mouth tumours for people who have used mobile phones for at least 10 years.

George Carlo, a public health scientist, epidemiologist and lawyer who headed the \$28.5 million research programme funded by the cell phone industry from 1993 to 1999 said

...with medical science indicating increased risks of tumors, cancer, genetic damage and other health problems from the use of cell-phones, the government and the cellphone industry have abandoned the public.¹¹

Michael Kundi, another scientist also concluded that the overall evidence speaks in favour of an increased risk, but its magnitude cannot be assessed at present because of insufficient information on long-term use (Kundi 2009: 316-24).

In India the sources of radio frequency according to the Inter-Ministerial Committee Report are 380 AM/FM towers with 1 kW to 300 kW of transmission power, 1,201 television towers with 10 to 500 watts of transmission power, 5.4 lakh of cell phone towers with transmission power of 20 watts, above 700 million of mobile phones with 1 to 2 watts of transmission power and WiFi in range of 10 to 100 milliwatt which is now almost widespread, specially in the metros (Report of Inter-Ministerial Committee, p 7).

What makes the matter of mobile phone radiation a great concern for India is the fact that it is the world's fastest growing telecommunications industry and the second largest telecommunication network in the world in terms of number of wireless connections. The number of mobile phone users is increasing every month and so is the bandwidth hunger of the ever smarter mobile phones and other communication devices. The Telecom Regulatory Authority of India (TRAI) projects the subscriber base by March 2014 at over 1,000 million subscribers.¹²

It is important to note that in India, there is no restriction on the location of towers, leading to a situation of jumble of towers/antennas throughout cities and

there is a mushroom growth of mobile tower infrastructure (Report of Inter-Ministerial Committee, p 9).

Precautions

- Buy a mobile phone with a low SAR number. A lower number indicates a lower radiation exposure risk. With a mobile phone, the highest SAR is going to be near the ear. The use of mobile phone accessories might result in different SAR values.
- Keep the mobile phone away from the body. Use a speaker phone or hands-free instrument to decrease the electromagnetic radiation to the head, ensure that a ferrite bead is clipped to the headset to absorb radiation.
- People with active medical implants should keep their cell phone at least 30 cm away from the implant.
- Use a phone with external antenna, preferring one where the antenna is further away from the skull.
- Do not use the telephone in a car without an external antenna.
- Use a landline for longer telephone calls.
- Avoid using a mobile phone in metallic enclosures such as lifts, where the radiation has nowhere to go but into the body.
- Use a mobile phone radiation shield. Many companies offer such shields.
- Use mobile phone radiation block applications which deactivate radiation emitting points in a mobile phone like the antenna, WiFi, GPS, Bluetooth for desired time periods.
- Some researchers also caution against using phone in areas with a weak signal since phones emit more radiation during those times. Children, who have smaller and thinner skulls should limit mobile phone use, and all users including children and adults, should not sleep with an active phone next to their bedside or under their pillow.

NOTES

- 1 "Inter-Ministerial Committee on EMF Radiations" available at the website of Department of Telecommunications, Ministry of Communications and Information Technology, Government of India, New Delhi (www.dot.gov.in/miscellaneous/IMC%20Report/IMC%20Report.pdf).
- 2 "Radiation Standards and Measures" (<http://ntrg.cs.tcd.ie/mobile/SAR.html>) Gandhi om P, Lazzi Gianluca "The Ansi/IEEE Rf Safety Standard and Its Rationale" (<http://www.ece.tamu.edu/~eml/APS/comar/ANSIstandard.pdf>), "Technical Information Statement On, Human Exposure to Microwaves and Other Radio Frequency

Electromagnetic Fields, 1995-98", Institute of Electrical and Electronics Engineers (IEEE) (http://ewh.ieee.org/soc/embs/comar/rf_mv.htm) (4) P 2, The Remote Sensing Applications Centre (RSAC) Paper 2/2002, Specific Absorption Rate.

- 3 http://www.oxfordjournals.org/our_journals/jnci/press_releases/deltour.final.djp415.pdf
- 4 <http://www.albertaradiosurgery.ca/faq/glossary/>
- 5 <http://www.bevolution.dk/pdf/MobilePhoneRadiationIsSafeOrNot.pdf>.
- 6 (1) "Cellphone Radiation Increases Brain Activity", 22 February 2011, wired, [http://www.wired.com/wiredscience/2011/02/cell-phone-brain/#\(2\)Study:CellPhoneUseChangesBrainActivity](http://www.wired.com/wiredscience/2011/02/cell-phone-brain/#(2)Study:CellPhoneUseChangesBrainActivity), News Feed Researcher, 28 February 2011, http://newsfeedresearcher.com/data/articles_m10/phone-brain-cell.html#hdngo (3) The article has been published in the 23 February issue of the *Journal of American Medical Association*, <http://jama.ama-assn.org/content/305/8/808.full>
- 7 <http://www.who.int/mediacentre/factsheets/fs304/en/>
- 8 Workshop Report, Workshop on Guiding Public Health Policy in Areas of Scientific Uncertainty, 11-13 July 2005. http://www.who.int/peh-emf/meetings/WHO_Final_workshop_report.pdf
- 9 Fact sheet no 193 on Mobile Phones and their Base Stations, http://www.who.int/peh-emf/meetings/ottawa_june05/en/index4.html
- 10 Fact sheet no 193, Electromagnetic fields and public health: mobile phones, <http://www.who.int/mediacentre/factsheets/fs193/en/>
- 11 (1) Mobile phone safety, <http://www.psrast.org/mobileng/mobilstarteng.htm> (2) "Will Your Cell Phone Kill You?", *PC World*, 3 April 2002, http://www.pcworld.com/article/92444/will_your_cell_phone_kill_you.html7
- 12 Final Recommendations on "Spectrum Management and Licensing Framework", 10 May 2010, Telecom Regulatory Authority of India, p 7.

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