



## Stress to Human Health Due to Electromagnetic Radiation Emitted from Mobile Phone

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### Abstract

Electromagnetic radiations are being used by mobile phones and it is being believed that these rays are harmful to both human and animal health. Studies on the hazardous effect of mobile phone are the subject of recent interest. This has also got a boost due to the enormous increase in mobile phone usage across the globe in recent past. Many other digital wireless systems like data communication networks produce similar kind of radiations. Users must be educated and awareness is needed to be created regarding the hazardous and ill effects of use of mobile phones and other wireless communications in human society.

### 1. Introduction

Large extent of research, both epidemiological and experimental, is currently being carried out in non-human animals and in humans for assessing the extent of harmful biological effect in human due to large extent exposure to mobile phones.

The World Health Organization (WHO) and International Agency for Research on Cancer (IARC) have proved mobile phones to be at par with the carcinogenic hazards category. Evidence regarding increase in glioma and acoustic neuroma brain cancer has been evidenced in regular mobile phone users (Salford et al., 2003). WHO have also stated that cancer is likely to be associated with this effect of electromagnetic radiations emitted from mobile phones as per research results of scientific and medical communities and it has been found convincing evidence for other health effects (WHO Reports, 2011).

### 2. Effect on Human Health

Many scientific studies are undergoing for investigating the possible hazardous effect of mobile phone radiations on human and animal health.

On 31<sup>st</sup> May 2011, the World Health Organization envisaged on the long term health risk due to continuous use of mobile phones confirmed that mobile phone use may represent a long-term health risk, stressing on the hazardous carcinogenic effect of use of mobile phones (WHO reports, 2011). The effect was declared after a long term scientific team study. Study in the past (Cardis, 2010) proved that there is a risk of 40% increased incidence of gliomas (brain cancer) in the users who use mobile phones very regularly and for long hours. Many countries like France have issued a ban against the use of mobile phones by minors due to potential health risk and serious long term complications.

The electromagnetic radiation emitted by mobile phones is the recent interest of study in the concerned field, as there is an enormous increase in the number of mobile phone users in the recent past (as of June, 2009, there were more than 4.3 billion users worldwide, as per Global System for Mobile Communications, originally Groupe Spécial Mobile (GSM) Association reports, 2009 (Table 1). The electromagnetic radiation emitted from mobile phones falls in the microwave category having the potential of hazards and stress on human



Table 1: Increasing trend of mobile phone users (approx.) over the years per 100 inhabitants across the globe

No.	Year	Country	
		Developed	Developing
1	2000	50-52	5-7
2.	2001	53-58	8-9
3.	2002	59-63	10-13
4.	2003	64-70	14-16
5.	2004	71-75	17-22
6.	2005	76-78	23-26
7.	2006	79-83	27-34
8.	2007	84-87	35-45
9.	2008	88-96	46-52
10.	2009	97-112	53-59
11.	2010	113-120	60-68

health. Both epidemiological and experimental research is going on in this area on non-human primates too to investigate the biological stresses on human health due to use of mobile phones. Majority of the experiments have failed to prove the relationship between the rate of use of mobile phones leading to its harmful biological effects. Similar kind of microwave range radiations are also produced by other wireless digital systems too.

Some recent studies have proved a definite relationship between use of mobile phones leading to occurrence of brain and salivary gland tumors. Lennart Hardell and other authors of a 2009 meta-analysis of 11 studies from peer-reviewed journals concluded that cell phone usage for at least ten years “approximately doubles the risk of being diagnosed with a brain tumor on the same (ipsilateral) side of the head as that preferred for cell phone use (Lai and Hardell, 2011; Khurana et al., 2009). Some study reports have revealed that excess use of mobile phones can spread infectious diseases as well as pathogenic bacteria, specially the mobile phones which are being borne by hospital duty staff. (Tekerekoglu et al., 2011).

### 3. Thermal Effects

In the case of a person using a cell phone, most of the heating effect occurs on the head surface, facial nerves and surrounding soft tissue causing increase in temperature 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 (Acar et al., 2009).

### 4. Non-thermal Effects

The German biophysicist Roland Glaser, for example, has argued

that there are several thermo-receptor 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. Other researchers believe the resultant stress is unrelated to thermal effects, as it occurs for both extremely low frequencies (ELF) and radio frequencies (RF), which have very different energy levels (Nakamura et al., 2003; Glaser, 2005).

### 5. Electromagnetic Radiation Absorption

Part of the radio waves emitted by a mobile telephone handset is absorbed by the human head. The maximum power output from a mobile phone is regulated by the mobile phone standard and by the regulatory agencies in each country. The rate at which radiation is absorbed by the human body is measured by the Specific Absorption Rate (SAR), and for modern handsets its maximum level has been standardized and governed by governmental regulating agencies in many countries (International Commission on Non-Ionizing Radiation Protection, 1998).

### 6. Electromagnetic Hypersensitivity

Some users of mobile handsets have reported feeling several unspecific symptoms during and after its use; ranging from burning and tingling sensations in the skin of the head and extremities, fatigue, sleep disturbances, dizziness, loss of mental attention, reaction times and memory retentiveness, headaches, malaise, tachycardia (heart palpitations), to disturbances of the digestive system. Reports have noted that all of these symptoms can also be attributed to stress (Roosli et al., 2008).

### 7. Blood-Brain Barrier Effects

Swedish researchers namely, Salford, Brun, Persson, Eberhardt, and Malmgren from Lund University and Gerard Hiland, Department of Biophysics, Warwick University have studied the effects of microwave radiation on the rat brain. They have detected leakage of albumin into the brain via a permeated blood-brain barrier (Salford et al., 2003; Salford et al., 2008).

### 8. Occupational Health Hazards

Telecommunication workers who spend time at a short distance from the active equipment, for the purposes of testing, maintenance, installation, etc. are being induced to be at risk of much greater exposure than the general population. Many times base stations are not turned off during maintenance, and the engineers do not have to work near live antennas.

A variety of studies over the past 50 years have been done on workers exposed to high RF radiation levels; studies includin

radar laboratory workers, military radar workers, electrical workers, and amateur radio operators. Most of these studies found no increase in cancer rates on the exposed population (Moulder et al., 1999).

### 9. Reports on Increase in Use of Mobile Phones

There has been a significant increase in the number of mobile phone users and subscribers. In 2010, according to the reports of the Cellular Telecommunications and Internet Association there were more than 303 million subscribers to cell phone service in the United States. As compared from 2000, there has been an increase from 110 million users. There is an estimated 5 billion mobile phone subscriptions. Currently, the wireless communication over mobile phone has increased prominently and mobile set is a daily companion for human society. The history of mobile phone use recalls its first beginning in Japan in 1979, in Nordic countries in Europe in 1981 and in the United States in 1983. Mobile phone use took a boost in the US in 1990s (National Cancer Institute at the National Institutes of Health, 2011).

### 10. Safety Standards

Radio base licensing procedures have been established in the majority of urban spaces regulated either at municipal/county, provincial/state or national level. Mobile telephone service providers are, in many regions, required to obtain construction licenses, provide certification of antenna emission levels and assure compliance to ICNIRP standards and/or to other environmental legislation (International Commission on Non-Ionizing Radiation Protection, 1998).

In order to protect the population living around base stations and users of mobile handsets, governments and regulatory bodies adopt safety standards, which translate to limits on exposure levels below a certain value. There are many proposed national and international standards, but that of the International Commission for Non-Ionizing Radiation Protection (ICNIRP) is the most respected one, and has been adopted by many countries. For radio stations, ICNIRP proposes safety levels for occupational exposure and another for the general population. Currently efforts are underway to establish correlation between the different existing standards (International Commission on Non-Ionizing Radiation Protection, 1998). Many governmental bodies also require that competing telecommunication companies try to achieve sharing of towers so as to decrease environmental and cosmetic impact. This issue is an influential factor of rejection of installation of new antennas and towers in communities (International Commission on Non-Ionizing Radiation Protection, 1998).

### 11. Conclusion

Excessive use of wireless network communication systems has led to the eruption of many health hazards among its users leading to long term health losses too. So, common public should be well educated and mass awareness campaigns should be initiated from medicos and health inspectors for alleviating the health issue based problems related to increasing and enormous use of mobile phones.

### 12. References

- Acar, G.O., Yener, H.M., Savrun, F.K., Kalkan, T., Bayrak, I., Enver, O., 2009. Thermal effects of mobile phones on facial nerves and surrounding soft tissue. *Laryngoscope* 119(3), 559-62.
- Cardis., 2010. Brain tumor risk in relation to mobile telephone use: results of the INTERPHONE international case-control study. *International Journal of Epidemiology*. International Epidemiological Association. April 2011. <http://ije.oxfordjournals.org/content/39/3/675.abstract>.
- Glaser, R., 2005. Are thermoreceptors responsible for non-thermal effects of RF fields? PDF Edition Wissenschaft. Forschungsgemeinschaft Funk e. V. G 14515. Issue No. 21. December 2005 ([http://www.fgf.de/publikationen/edition-wissenschaft/Edition\\_Wissenschaft\\_Nr21.pdf](http://www.fgf.de/publikationen/edition-wissenschaft/Edition_Wissenschaft_Nr21.pdf)).
- Lai, H., Hardell, L., 2011. Cell Phone Radiofrequency Radiation Exposure and Brain Glucose Metabolism. *The Journal of the American Medical Association (JAMA)* 305(8), 828-829. doi:10.1001/jama.2011.201.
- Nakamura, H., Matsuzaki, I., Hatta, K., Nobukuni, Y., Kambayashi, Y., Ogino, K., 2003. Nonthermal effects of mobile-phone frequency microwaves on uteroplacental functions in pregnant rats. *Reproductive Toxicology* 17(3), 321-326
- International Commission on Non-Ionizing Radiation Protection. 1998. Guidelines For Limiting Exposure To Time-Varying Electric, Magnetic, And Electromagnetic Fields (up to 300 GHz) (PDF). *Health Physics* 74(4), 494-505.
- Khurana, V.G., Teo, C., Kundi, M., Hardell, L., Carlberg, M., 2009. Cell phones and brain tumors: A review including the long term epidemiologic data. *Surgical Neurology* 72(3), 205-214.
- Moulder, J.E., Erdreich, L.S., Malyapa, R.S., Merritt, J., Pickard, W.F., Vijayalaxmi, 1999. Cell phones and cancer: what is the evidence for a connection? *Radiation Research* 151(5), 513-531.
- National Cancer Institute at the National Institutes of Health, 2011. Factsheet. <http://www.cancer.gov/cancertopics/factsheet/Risk/cellphone>. Accessed in August 2011.

- Roosli, M., 2008. Radiofrequency electromagnetic field exposure and non-specific symptoms of ill health: A systematic review. *Environmental Research* 107(2), 277-287.
- Salford, L.G., Brun, A.E., Eberhardt, J.L., Malmgren, L., Persson, B.R.R., 2003. Nerve Cell Damage in Mammalian Brain after Exposure to Microwaves from GSM Mobile Phones. *Environmental Health Perspectives* (United States: National Institute of Environmental Health Sciences) 111 (7), 881-883.
- Salford, L.G., Nittby, H., Brun, A., Grafstrom, G., Malmgren, L., Sommarin, M., Eberhardt, J., Widegren, B., Persson, B.R.R., 2008. The Mammalian Brain in the Electromagnetic Fields Designed by Man with Special Reference to Blood-Brain Barrier Function, Neuronal Damage and Possible Physical Mechanisms. *Progress of Theoretical Physics Supplement* (Japan: Physical Society of Japan) 173, 283-309.
- Soderqvist, F., Carlberg, M., Hardell, L., 2008. Use of wireless telephones and self-reported health symptoms: a population-based study among Swedish adolescents aged 15-19 years. *Environmental Health* 2008 7, 18.
- Tekerekoglu, M.S., Duman, Y., Serindag, A., Cuglan, S.S., Kaysadu, H., Tunc, E., Yakupogullari, Y., 2011. Do mobile phones of patients, companions and visitors carry multidrug-resistant hospital pathogens? *American Journal of Infection Control* 39(5), 379-381.
- WHO, 2011. Danielle Dellorto, Cell phone use can increase possible cancer risk. CNN Cable News Network. Turner Broadcasting System, Inc. <http://edition.cnn.com/2011/HEALTH/05/31/who.cell.phones/index.html>.