

THE EFFECT OF ELECTROMAGNETIC RADIATION EMITTED BY CELL PHONES ON POPULATION - A CURRENT ISSUE

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Abstract: The last time there was an explosive development of mobile communications, radar equipment used in aviation, medical devices using MRI and CT, using microwaves in the food or household purposes, various electronic devices used in industry, scientific research aimed at providing speed, security and convenience. But these technologies have triggered a series of questions on the health effects associated with their use body health: assessing the risk associated with using mobile portable, a long time living near power lines and use portable radar installations used by the police. This article aims to treat medical problems associated with the use of cell phones by population.

Keywords: mobile phones, electromagnetic radiations, SAR,

1. INTRODUCTION

Today, mobile phones are sources of electromagnetic field most commonly encountered in everyday life and a significant part of global telecommunications.

Currently in Romania there are no comprehensive studies on population irradiation with electromagnetic waves, and the hazard of using mobile phones can make it difficult to research.

In late 2009, according to figures published by the International Telecommunication Union, it was estimated that there were 4.5 billion mobile users worldwide.

In Europe there are a number of telephones greater than the number of inhabitants of 100% lead and detached from the rest of the world according to figure 1, 2 [2].

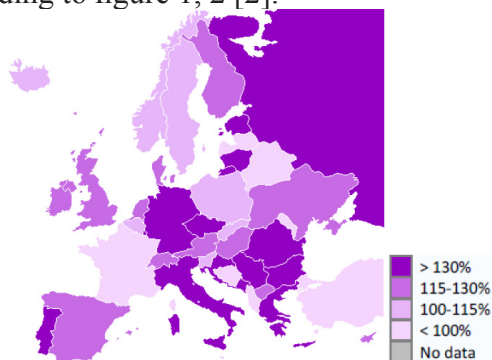


Fig. 1 Distribution of mobile users in Europe [according to data published by the International Telecommunication Union in 2009] [2]

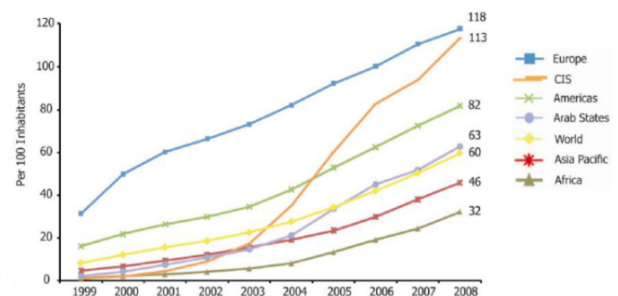


Fig. 2 Development of mobile telephony in the world per 100 inhabitants [according to data released by the International Telecommunication Union in 2009] [2]

According to figures presented previously observed intense use of cellular phones by population, with the possibility of adverse health effects, and according to the International Agency for Research on Cancer electromagnetic fields produced by mobile phones are classified as possibly carcinogenic to humans.

In Romania, according to figures released by the three major mobile phone companies, cellular phone users situation is shown in Fig. 3.

The situation presents both the number of subscribers and prepaid users. In recent years a number of studies have been conducted or are underway to better assess the long-term effects of electromagnetic fields produced by cell phones on the human body. WHO (World Health Organization) will conduct a formal risk assessment of all studied health outcomes for exposure to radio frequency fields by 2012.

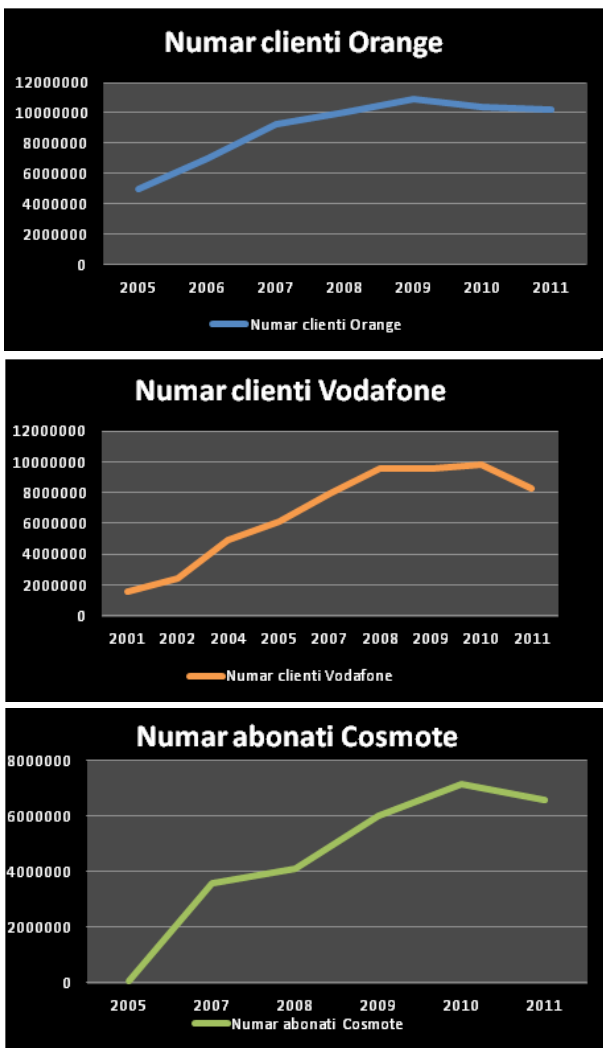


Fig. 3 The customer number of the three major cellular telephone companies in Romania

In this context steadily increasing number of users, the more long exposure time, the mobile phone becomes a "toy" increasingly used since childhood and new information on the effects of electromagnetic fields, investigate the characteristics of exposure levels, SAR, becomes an issue for public health research [10, 11].

2. STUDIES ON THE HEALTH EFFECTS OF MOBILE TELEPHONY

Due to the frequent use of cellphones by population in the last 10 years have been introduced radiation monitoring systems electromagnetic field emitted by cellular phones. On this line the European countries and some Scandinavian countries have participated in a number of epidemiological studies and clinical and experimental in order to determine the possible adverse effects of mobile phone use on the human body.

Between the years 2009-2010 were continued studies on the harmful effects of mobile phones on the human body. These studies were carried out by the SCENIHR (Scientific Committee on Emerging European and Newly Identified Health Risk), ICNIRP (International Commission for Non-Ionizing Radiation Protection), WHO (World Health Organisation), CCARS (Scientific Advisory Committee on Radio Frequencies and Health).

The Eubarometer study showed that Spanish population is one of the populations concerned the effects of mobile phone radiation emitted by the human body, although it is one of the populations less informed.

The Interphone study has been realized in 2010 attended by 13 countries. It was applied to a population aged 30-59 years who used a cell phone for 5-10 years.

The study started from the premise that there is a relationship between mobile phone use and the occurrence of brain tumors (gliomas and meningiomas) and salivary gland tumors.

The result was that there is a direct relationship between the cell phone and the occurrence of brain tumors [8, 9].

Studies have shown that the SAR distribution in the head depends on the type of phone and characteristics of communication systems; the more distance from the head and phone is higher with both decreases the amount of energy [9].

The other studies has been realized in four Nordic countries on the incidence of gliomas, meningiomas on a group of 60.000 patients with brain tumors diagnosed during 1994-2003.

The conclusions were that there were no significant changes in the incidence of these tumors in that period; information was obtained from the cancer registries of the four Scandinavian countries; also, the conclusion was the need for more advanced methods of study [8].

A study in 2009, funded by the European Commission for exposure to electromagnetic fields was studied the possible effects on the hearing aid by exposure of 73 volunteers in an electromagnetic field with a frequency of 1947 MHz for 20 minutes.

The result was that there was no immediate effect on hearing aid. (EMFN-EAR-Exposure at electromagnetic fields).

In May 2011 WHO in collaboration with the IARC (Agency for Research on Cancer) was classified use cell phone as possibly carcinogenic (could be at risk, therefore need attention on cell phone-cancer link) [6].

In 2009 SCENIHR conducted a study on the opinion in March 2007.

When it was concluded, using three epidemiological methods, in vitro and animal studies, that there is not relationship between mobile phone use and brain cancer incidence increased. The results were the same [4].

Studies in vivo and in vitro studies showed no genotoxic or mutagenic effects from use the mobile phone [8].

Have been published some register which showed evidence of cell phone effects on sleep and on the EEG (electroencephalogram), the mechanism is not known. Have been not reported effects on memory, cognitive disorders [8]. Studies on mice exposed to a frequency of **900 MHz**, for 5 days, at a SAR value between

0.3 – 3 W/kg, showed an improvement of memory.

The two studies were performed on neuronal cultures using a frequency of 900 MHz at a SAR value of 1 W / kg: in the first study there were no reported changes (Vecchio, 2009); in the second study has been a slightly higher level of neurons; noted that in the second study authors indicate an increase in temperature to 37-39 degrees. In 2002 were described a series of symptoms such as skin redness, burning as well as some general symptoms: difficulty concentrating, cough, palpitations, events that have been suggested as the possible effects of exposure to cell phone. But studies which were made in 2007, was show that these events are not fully determine to exposure to cell phone [4]. Recommendations of the European Council of 12 July 1999/519 on the general population exposure to sources of electromagnetic fields at frequencies between 0-300 GHz, fixed basic restrictions related to human exposure and references to sources of electromagnetic field. These restrictions are based on guidelines published by ICNIRP [4].

3. WHO (WORLD HEALTH ORGANIZATION) RESPONSE

In response to these problems, WHO established international program on Radio Frequency Electromagnetic Fields in 1996, aimed at assessing the scientific evidence of possible adverse health effects and by 2012, WHO will present these results.

In May 2011, a specialized agency from WHO, International Agency for Research on Cancer (IARC), was analyze the potential risk of cancer from exposure to radiofrequency fields for mobile users. WHO also aims to identify and promote research priorities in this direction.

To this purpose, WHO develops public information materials and promotes dialogue between companies producing cell phones, researchers, industries and people to improve their understanding of the possible health effects [5].

4. LEGISLATION

EU legislation on electromagnetic field is based on the recommendations of 12 July 1999 (1999/519 / EC) on the limitation of exposure of the general public to electromagnetic field "Council Recommendation (1999/519 / EC) of 12 July 1999 on the limitation of the exposure of the general public to electromagnetic fields (0 – 300GHz)" [1].

The main components of this recommendation are summarized briefly below: the current exposure limits are based on thermal effects of electromagnetic radiation and the frequencies of the radio frequency, microwave and millimeter wave they are specified in terms of specific absorption rate (SAR expressed in $\frac{W}{kg}$).

This parameter is the energy dissipated per unit time per unit mass of the body irradiated and consider the type of radiant source, operating frequency and duration of exposure. SAR limits may relate either to the average energy absorbed in the whole body or locally (legs, hand, head). Current internationally accepted limit for averaged SAR for whole body for occupational exposure is $0.4 \frac{W}{kg}$. This value is based on the finding that the absorption of a power level by $4 \frac{W}{kg}$ produces a temperature rise of $1^{\circ}C$ in a biological environment. So with a safety factor of 10 was adopted by the SAR limit by $0.4 \frac{W}{kg}$.

Population exposure has been limited to the level of $0.08 \frac{W}{kg}$ by the introduction of a safety factor of 50 compared to the value of $0.4 \frac{W}{kg}$ [1].

In Romania the exposure to electromagnetic radiation is regulated by the "Order no. 1193 of 29 September 2006 approving the Regulation on the limitation of exposure of the general public to electromagnetic fields from 0 Hz to 300 GHz Issuer: Ministry of Public Health, published in the Official Gazette no. 895 of 3 November 2006, in line with European legislation [7].

The main components of this order are briefly summarized below: Upon exposure according to frequency electromagnetic field is used commonly used eight quantities:

1. Contact current (Ic)
2. The current density (J)
3. The electric field strength (E)
4. The intensity of the magnetic field (H)
5. Magnetic induction (B)
6. The power density (S)
7. The Specific Absorption (SA)
8. Specific Absorption Rate (SAR) - is a measure of the rate at which energy is absorbed by the human body when exposed to a radio frequency (RF) electromagnetic field;

It is defined as the power absorbed per mass of tissue and has units of (W/kg) . SAR is usually averaged either over the whole body, or over a small sample volume (typically 1 g or 10 g of tissue). The value cited is then the maximum level measured in the body part studied over the stated volume or mass [7, 3] Basic restrictions, given in Table 1, are set so as to take into account the uncertainties related to individual susceptibility, environmental conditions, the age and health of the population, according to European legislation above [7].

Table 1. Basic restrictions on exposure the electromagnetic field under European law [7]

Frequency range	The magnetic flux density $(mT)(mT)$	Current density $(\frac{W}{m^2})(\frac{A}{m^2})$ (rms)	Full-body SAR Environment $(\frac{W}{kg})(\frac{W}{kg})$	Located SAR (head and body) $(\frac{W}{kg})(\frac{W}{kg})$	Located SAR (hands and legs) $(\frac{W}{kg})(\frac{W}{kg})$	Power density, S $(\frac{W}{m^2})(\frac{W}{m^2})$
0 Hz	40	-	-	-	-	-
>0 – 1 Hz	-	8	-	-	-	-
1 – 4 Hz	-	8	-	-	-	-
4 – 1000 Hz	-	2	-	-	-	-
1000 Hz – 100 kHz	-	$\frac{f}{500}$	-	-	-	-
100 kHz – 10 MHz	-	$\frac{f}{500}$	0,08	2	4	-
10 MHz – 10 GHz	-	-	0,08	2	4	-
10 – 300 GHz	-	-	-	-	-	10

4. CONCLUSIONS

From this study the following conclusions are deduced:

- the studies have not shown a direct relationship between mobile phone use and the occurrence of brain tumors or salivary gland.
- it is need for more than 10 years of study because some tumors have slower development time.
- it is necessary that the epidemiological studies are overlapping numerical methods for the determination of SAR values for different cell phone models and their validation with laboratory experiments

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