

Some negative effects of mobile phone's use

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Abstract

This paper is devoted to hypersensitive reactions in mobile phone users of two samples: a) school children, and b) workers applying magnetic resonance imaging (MRI) technology. Concerning hypersensitive reactions in children and professionals we obtain that sleep disturbance, headache, fatigue, vision problems, dizziness and some memory problems are the most frequent. In addition, we discuss the possible effects of mobile phones on mental states evaluated through EEG spectra. The sigmoid arousal-frequency correlation combined with the brain rate concept is used as a methodology. Mobile phones exposure leads to pronounced asymmetries and individualities in brain rate values, characterizing EEG spectral shifts towards over-arousal or under-arousal.

As a result, mental consequences of the use of mobile phones could be, in principal, detrimental or beneficial, depending on the individual initial EEG spectra and the different exposure frequencies from mobile phone technologies. Related to mobile phone use we propose some response measures.

Key words: mobile phones, hypersensitive reactions, mental effects, EEG spectra.

Introduction

During the 20th century, environmental exposure to man-made electromagnetic fields has been steadily increasing as growing electricity demand. Ever-advancing technologies and changes in social behavior have created more and more artificial sources. Everyone is exposed to a complex mix of weak electric and magnetic fields, both at home and at work, from the generation and transmission of electricity, domestic appliances and industrial equipment, to telecommunications and broadcasting.

Low-frequency magnetic fields induce circulating currents within the human body. The strength of these currents depends on the intensity of the outside magnetic field. If sufficiently large, these currents could cause stimulation of nerves and muscles or affect other biological processes (Andersen *et al*, 1995; Blettner *et al*, 2008, Gjoneska *et al*, 2007; Hocking, 1998).

Some scientists previously believed that the only way that EM radiation could produce damaging effects was if the radiation was sufficiently intense to cause a heating effect on the tissues. This theory has now been roundly discredited by many studies in which biological effects have been observed at intensities far too small to cause any measurable heating effect.

The mechanisms by which electromagnetic radiation may affect disease processes are not yet fully understood, but promising candidates include DNA damage (implicated in several disease processes, including various types of cancer); interference with melatonin production; interference with cellular communication etc.

In the area of biological effects and medical applications of non-ionizing radiation more than 30,000 articles have been published over the past 30 years. Scientific knowledge in this area is now more extensive than for most chemicals. Based on a recent in-depth review of the scientific literature, the WHO concluded that current evidence does not confirm the existence of any health consequences from exposure to low level electromagnetic fields. However, some gaps in knowledge about biological effects exist and need further research.

Generally, epidemiological studies oriented toward examination of EMF influence on health showed increased incidence of childhood leukemia in the vicinity of broadcast transmitters emitting radiofrequency RF-EMF; adverse pregnancy outcomes in RF exposure of physiotherapists from the use of diathermy; increased neuroblastoma incidence among children; some behavioral problems of children at age 7 and use of mobile phones of their mothers during pregnancy etc. (Bell, 1994; Ravazanni, 2005).

Some individuals report "hypersensitivity" to electric or magnetic fields. They ask whether aches and pains, headaches, depression, lethargy, sleeping disorders, and even convulsions and epileptic seizures could be associated with electromagnetic field exposure. There is little scientific evidence to support the idea of electromagnetic hypersensitivity (Frey, 1999; Chia *et al*, 2000; Oftedal, 2000).

It is confirmed that EMF health effects may depend on: EMF intensity; cumulative exposure; exposure duration; transience; frequency as well as on some superimposed signals.

In addition to dominant radio-frequency content, extremely low frequency (ELF) electromagnetic field (EMF) components are also produced from the devices for global mobile communication. Being in the same range as human EEG frequencies there is a potential for mutual interference (Heusser, 1997; Hung, 2007; Pop-Jordanova 2010, 2011; Verschueren *et al*, 2004).

The prevalence of MP users is already very high and is exponentially increasing in many countries, including R. Macedonia. The published results about possible mental effects of MP exposure are still inconsistent and inconclusive. Early animal studies reported effects on catecholamine and amino acid neurotransmitter levels in various areas of the brain.

Mobile phones exposure leads to pronounced asymmetries and individualities in brain rate values, characterizing EEG spectral shifts towards over-arousal or under-arousal (Pop-Jordanova N., *et al* 2010). As a result, mental consequences of the use of mobile phones could be, in principal, detrimental or beneficial, depending on the individual initial EEG spectra and the different exposure frequencies from mobile phone technologies. Thereby, brain rate can serve as a useful preliminary indicator.

This paper is devoted to the evaluation of prevalence of mobile phone's use in school population and health professionals working with MRI, as well as to detect hypersensitive reactions in mobile phone (MP) users, and to suggest some response measures.

Sample and method

We evaluated two groups of participants as users of mobile phone: a) school children and b) professionals (doctors and technicians) in MRI laboratories.

A survey using a self-reported questionnaire was conducted among randomly selected participants. The first examined group comprised 426 pupils from schools in Skopje, aged 12-18 years (mean age 14.4).

The second group comprised 56 workers in MRI laboratories in four centers in R.Macedonia (three in Skopje and one in Bitola).

The obtained results will be present and discussed in the following chapter.

Results and discussion

The first sample comprised 188 pupils in primary school and 239 pupils from secondary school (total N= 426). The age of children was 12-18 years (mean 14, 4); 207 were boys, and 219 girls.

The obtained data showed that 412 (96, 26%) are owners of MP, and only 16 (3, 74%) did not have own MP device and used the MP from their parents.

The most used MP devices in the sample of evaluated children are: "Sony Ericsson", "Nokia", "Samsung" and "Motorola". It is important to know that the electromagnetic pulse is different in different marks.

The answers about the duration of use of the MP show following result (Fig.1). On Fig. 2, 3 and 4 some specifics about the number of time, duration of calls, checking SMS of MP are presented.

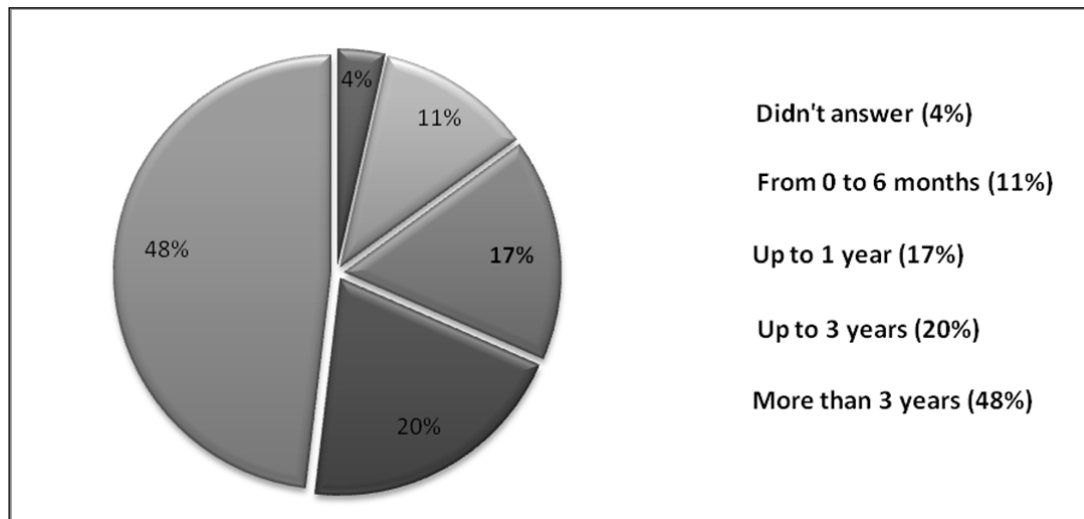


Fig. 1 The period of using MP device

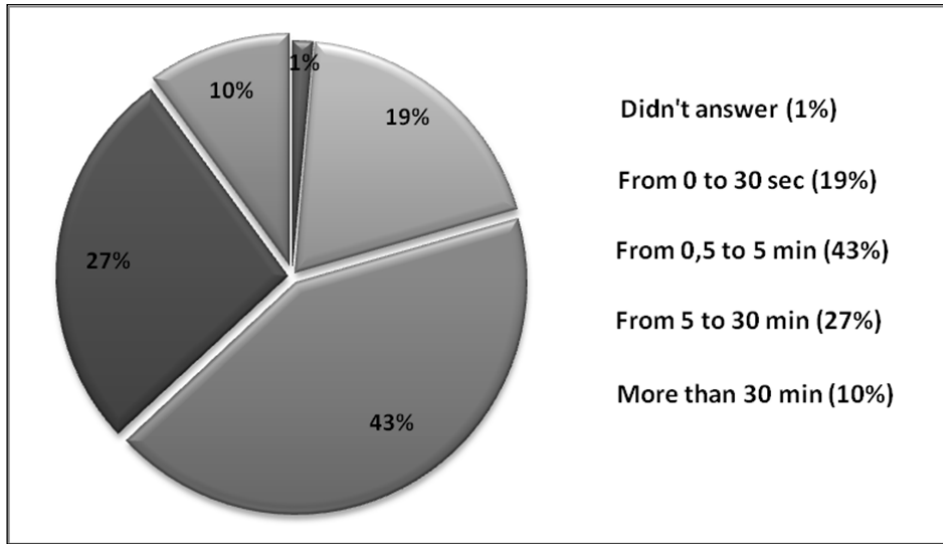


Fig. 2 Calling time when using MP

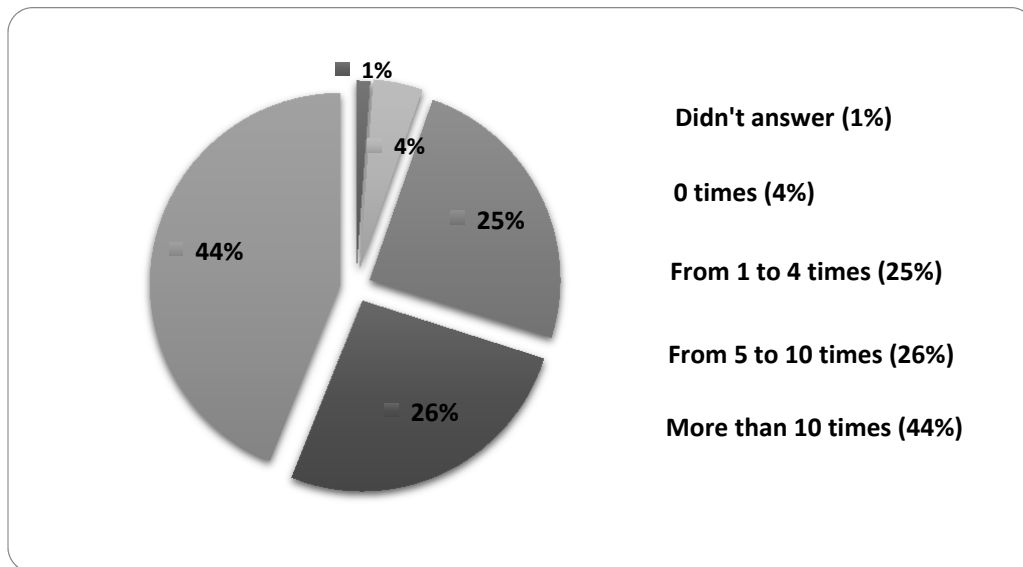


Fig. 3 Number of calls per day

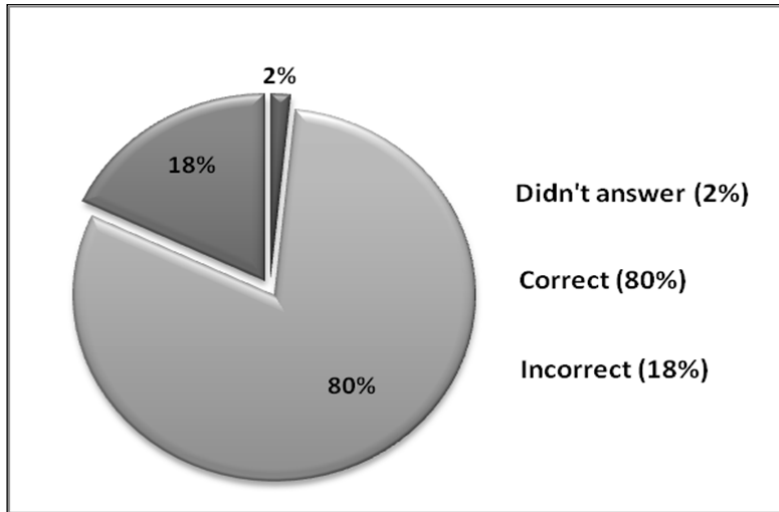


Fig. 4: "I checked MP for SMS every minute"

The possible hypersensitive reactions perceived by children are displayed on Fig. 5. It was interesting to see, do children correlate the symptoms with MP use (Fig. 6).

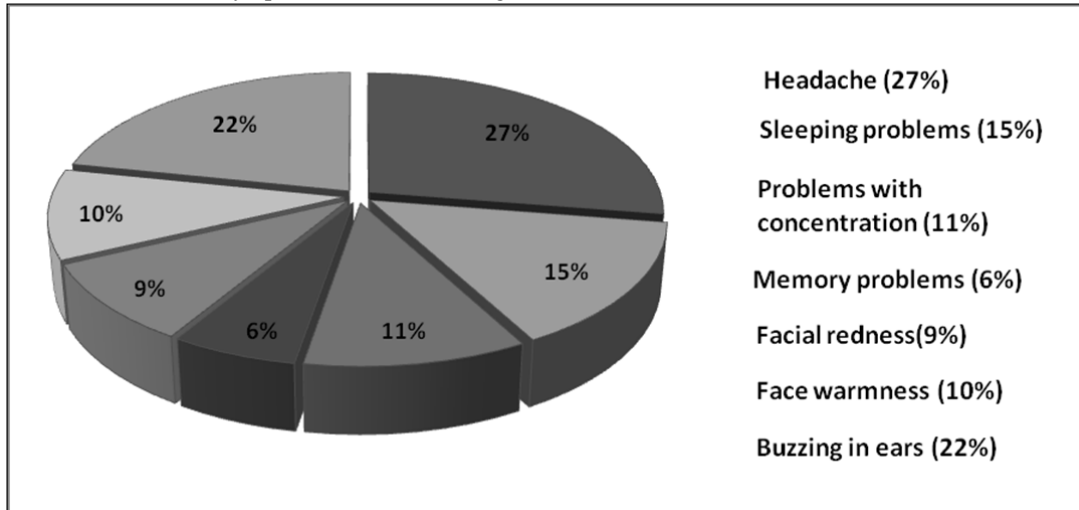


Fig. 5 Self- perceived reactions of MP use
 (Some of the respondents have more than one symptom)

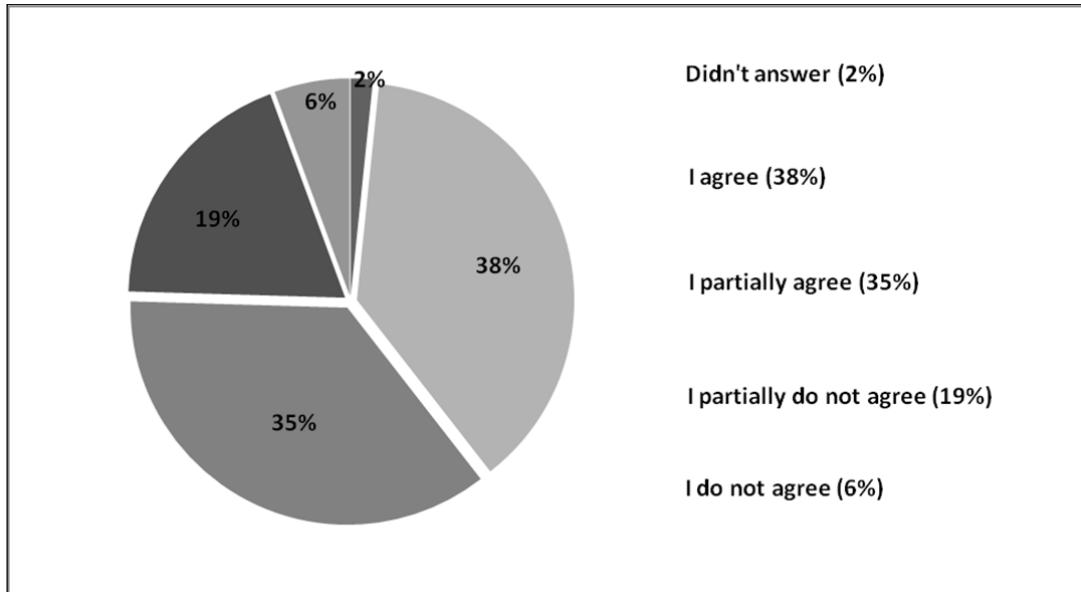


Fig. 6 Are these symptoms related to MP use?

It is obvious that MP use is very frequent in school population, calls are long, but also some hypersensitive reactions are perceived. Children are aware that these health effects could be related to MP use.

Having in mind that children’s head is growing, brain is immature, skull is tinny, health risk for this period of life is more serious than in adults. In this context some preventive measures must be implicated.

The sample of examined professionals comprised randomly selected 56 subjects from four MRI laboratories in R. Macedonia. These laboratories are selected because they used MRI technique for more than five years. This sample is selected for comparison of the results obtained for children.

Mean age of subjects was 39, 9 years; mean age of work with MRI was 6, 4 years. Technicians were 65%; doctors 35%. Males and females are equally included. All of examined subjects used MP in addition to work with MRI.

Practically all participants in the study used MP. Some characteristics of this use are presented on Table 1.

Table 1: Specifics of MP use in professionals

How many years they use MP	Over 10 years 50,3%	6-10 years 40%	Under 5 years 10,7%
Number of calls per day	Over 10 times 46%	6-10 times 29%	Under 5 times 25%

Calling time	Over 10 min. 35%	6-10 min. 33%	Under 5 min. 32%
The MP is placed in the pocket of pants	Yes 10%	Sometime 10%	Never 80%
Warmth in contact to MP	10%	5%	85%
Problems with sexuality	5%	5%	90%

Table 2: Some perceived hypersensitive reactions in professionals

symptom	present	Sometime	No
Headache	39%	20,6%	40,4%
Skin eruption	2%	1%	97%
Sleep problems	45%	10%	45%
Dizziness	10%	5%	85%
Vision problems	30%	15%	55%
Concentration problem	35%	15%	50%
Buzzing in ears	2%	1%	97%
Nausea	2%	1%	97%
Memory problems	10%	5%	85%
Fatigue	45%	15%	40%

As can be seen for Table 2, concerning hypersensitive reaction in professionals we obtain that sleep disturbance, headache, fatigue, vision problems, dizziness and some memory problems are the most frequent. However, adult people are more concerned about the possible relation between symptoms and MP use. Similarly to the finding for school population, professionals perceived also some hypersensitive reactions. They could be the consequence of both MRI and MP. Calculated t-test shows not significant differences in symptom percentages between groups (children and professionals) [$t= 0,053362$ $p= 0, 9574$].

For comparison, many people in Norway and Sweden reported headaches, fatigue, dizziness, discomfort, and memory loss, problems with concentration, warmth behind ear, warmth on ear, burning skin, and tingling /tightness experienced in connection with the use of a mobile phone. Therefore, a cross-sectional epidemiological study among 17,000 people, all using an MP in their job has been performed. Thirty-one percent of the respondents in Norway and 13% of those in Sweden had experienced at least one symptom in connection with MP use. Next to the sensations of warmth on the ear and behind/around the ear, burning sensations in the facial skin and headaches were most commonly reported. Most symptoms usually began during or within half an hour after the call and lasted for up to 2 hours. Relatively few had consulted a physician or been on sick leave because of the symptoms, but about 45% among those with an MP attributed symptom had taken steps to reduce the symptom. These results suggest an awareness of the symptoms, but not necessarily a serious health problem (Oftedal G. *et all* 2007, 2008).

Frey EH. (1999) discussed numerous recent reports of headaches occurring in association with the use of hand-held cellular telephones. Chia *et al.* (2000), evaluated the prevalence of headache among handheld cellular telephone users in Singapore. A total of 808 men and women between 12 and 70 years of age, who lived in one community, were selected using one-stage cluster random sampling and responses to a structured questionnaire. The prevalence of MP users was 44.8%. They found that headache is the most prevalent symptom among MP users compared to non-MP users, with an adjusted prevalence rate ratio of 1.31. There found also a significant increase in the prevalence of headache with increasing duration of usage (in minutes per day). Prevalence of headache was reduced by more than 20% among those who used hand-free equipment for their cellular telephones as compared to those who never use the equipment. In this study the use of MPs was not associated with a significant increase of CNS symptoms other than headache.

In another epidemiological study, where the prevalence of subjective symptoms among mobile phone users was studied, authors found that the prevalence of many of the subjective symptoms increased with increasing calling time and number of calls per day (Wilén *et al.* 2003). The information about the prevalence of symptoms, calling time per day, and number of calls per day and combined it with measurements of the Specific Absorption Rate (SAR) were used. It was defined three volumes in the head and measured the maximum SAR averaged over a cube of 1 g tissue (SAR (1g)) in each volume. Two new exposure parameters Specific Absorption per Day (SAD) and Specific Absorption per Call (SAC) have been devised and are obtained as combinations of SAR, calling time per day, and number of calls per day, respectively. The results of this study indicated that SAR values >0.5 W/kg may be an important factor for the prevalence of some of the symptoms, especially in combination with long calling times per day.

In a Poland's study (Szyjowska *et al.*, 2003) as the most prevalent symptom related to MP use was the thermal sensation within the auricle and behind/around the ear. This was reported by 28.2% of evaluated subjects. Only 6.8% of subjects who complained of headache related this symptom to mobile phone use. Very small number of subjects reported impaired concentration associated with the use of mobile phone. Similar results obtained Tornevik *et al.*, 1998)

Generally, epidemiological studies or human health studies are good source of information on long-term effects of exposure. These studies investigate the cause and distribution of diseases in real life situations, in communities and occupational groups. Researchers try to establish if there is a statistical association between exposure to electromagnetic fields and the incidence of a specific disease or adverse health effect. They involve measurements on very complex human populations and are difficult to control sufficiently well to detect small effects. For these reasons, scientists evaluate all relevant evidence when deciding about potential health hazards, including epidemiology, animal, and cellular studies.

If we summarize possible electromagnetic health effects reported in numerous studies they could differ from the very serious life-threatening diseases (Alzheimer's disease, brain cancer, breast cancer, depression (also leading to suicide), heart disease, leukemia, and miscarriage, to the some conditions such as: allergies, asthma, autism, raised blood pressure, electro sensitivity, headaches, hormone changes, immune system damage, nerve damage, sleep disturbance and sperm abnormalities are also cited as possible. It is the reason that many new studies concerned EMF influence on health are supported.

The most common step for diminishing hypersensitive reactions to MP use was reducing calling time, and using hands-free equipment, changing the side at which the MP is placed etc. Most of the people experienced that the reported steps led to a reduction of the symptoms. In addition it is proposed to use SMS instead of calls and the most important will be not to bear MP in pants pocket, closely to generative organs.

Our previous study on mental effects of mobile phones indicated that they could be either beneficial or detrimental, depending on the individual initial EEG spectra and the different exposure frequencies from mobile phone technologies. It corresponds to the findings referred by Cvetkovic *et al.*, 2006.

In this context, we proposed *brain rate* as a useful preliminary indicator of these effects (Pop-Jordanov J. and Pop-Jordanova N., 2005).

$$f_b = \sum_i f_i P_i = \sum_i f_i \frac{V_i}{V} \quad V = \sum_i V_i$$

where the index i denotes the frequency band (for delta $i = 1$, for theta $i = 2$, etc.) and V_i is the corresponding mean amplitude of the electric potential (or power). Following the standard five-band classification, one has $f_i = 2, 6, 10, 14$ and 18 , respectively. Brain rate as an indicator of mental arousal can be calculated using EEG parameters in any site of the scalp (Cz, Fz, etc). For preliminary diagnosing we propose the Cz as a central and more informative point. In medical practice, the brain rate can be used for checking mental arousal, similar to temperature, pulse, blood pressure etc. as indicators of bodily functions.

It appeared that MP exposure leads to pronounced asymmetries and individualities in brain rate values, characterizing EEG spectral shifts toward over arousal or under arousal (Pop-Jordanov J. and Pop-Jordanova N., 2010)

Conclusions

- At low frequencies, external electric and magnetic fields induce small circulating currents within the body. The levels of induced currents inside the body are too small to produce serious effects.
- Despite extensive research, there is no evidence to conclude that exposure to low level electromagnetic fields is seriously harmful to human health.
- Our study confirms that some health symptoms could be related to the exposure of EMF. The term "hypersensitivity" comprise headache, sleep disturbance, short term memory problems, nose bleeding, dizziness, eye problems, fatigue, discomfort, memory loss, problems with concentration, warmth behind ear, warmth on ear, burning skin, and tingling /tightness.
- In addition, mobile phones could induce changes on EEG depending on frequencies pull.
- Preventive steps are decrease of MP use especially for children, decrease of duration of calls, changes of the side, use of hand-sets, decreasing direct exposure to MRI for professionals, and health checking more frequently.
- Further investigations are needed for more clear conclusions.

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