

# The Cellular Phone-Induced Electromagnetic Radiation as the Risk Factor in Brain Cancer – a Survey of Recent Research

**Abstract.** This paper summarizes our current knowledge about the potential influence of exposition to electromagnetic field generated by cellular phone technology and other everyday-use appliances, on the risk of onset of brain tumors. The results of several large-scale international epidemiologic studies are compared and analyzed in detail. No results were found to clearly prove the significant effect of cellular phones, base stations, microwave ovens etc. in enhancing the risk of brain tumor incidence.

**Streszczenie.** W artykule podsumowano bieżącą wiedzę na temat możliwego wpływu pola elektromagnetycznego generowanego przez terminali telefonii mobilnej na powstawanie guzów mózgu. Wyniki międzynarodowych badań epidemiologicznych zostały szczegółowo porównane i przedszkutowane. Badania te wykazały, że nie ma istotnego wpływu telefonów komórkowych na podniesienie ryzyka powstawania guzów mózgu. (Promieniowanie elektromagnetyczne generowane terminalami telefonii mobilnej jako czynnik ryzyka nowotworów mózgu – przegląd współczesnych badań).

**Keywords:** telefonia komórkowa, pole elektromagnetyczne, analiza ryzyka, guzy mózgu.

**Słowa kluczowe:** cellular telephony, electromagnetic field, risk analysis, brain tumors.

## Aim of the study

The use of cellular phones has grown explosively during the last past two decades and there are over 5.6 billion subscribers in the world which is about 80% of world population.

Such a wide availability of this technology is accompanied by the growing interest in its safety. The special anxiety of electromagnetic field is evoked by the mass-media which from time to time excite the readers by news, like this presented in Fig. 1.



Fig.1. The article from the press (after [1])

In the late 1990s, several expert groups have voiced their critical concern about the impact on human health, caused by exposition to high-frequency electromagnetic field emitted by these devices. In consequence, the investigation of potential health threats brought by the cellular phone network has been initiated. The International Agency for Research on Cancer (IARC) performs the analysis of studies on the potential link between the usage of mobile phones and the risk of occurrence of brain cancer. These studies have mainly focused on two types of tumours in the tissues: glioma and meningioma. The first tumor is a cancer of the brain which begins in glial cells while the second one is a tumor which forms in the meninges. The aim of the studies was to determine, whether the exploitation of cellular phone can enhance the risk of occurrence of these tumours, especially in context of potential carcinogenic influence of energy emitted by such appliances in a form of radio waves. In the recent years, a vast number of studies have been performed to assess the biologic effect of exposition to high-frequency electromagnetic field. These studies can be *grosso modo* divided into two groups:

1. *in vivo research* on the biological phenomena in particular species,
2. *epidemiological evaluation* which is concentrated on the assessment of mass effect of mobile phones.

Both studies are necessary for the proper answer to the question: are the mobile phones hazardous for their users or not and if they are what the scale of this hazard is. Nevertheless the majorities of studies is concentrated on epidemiological evaluation for they give, the mentioned above, answer more spectacularly. What is more, the intensity of electromagnetic field generated by mobile phones usually exceed the values given in standards. It means that the hazard is somehow ambiguous.

Also few studies claiming such a carcinogenic effect of this type of radiation does exist. Therefore, the necessity to resolve this problem by means of interdisciplinary efforts including clinical trials is emphasized.

## Risk assessment

World Health Organization (WHO) defines the risk assessment as follows:

*The health risk assessments are the result of in-depth critical reviews conducted through independent, scientific peer-review groups. They are usually undertaken if new data are available that would substantially change the evaluation, if there is public concern for health or environmental effects of the agent because of greater exposure, or if an appreciable time period has elapsed since the last evaluation [1].*

Risk analysis should consider the following items:

- the probability that something can happen,
- the probability that something which happens influences something,
- the probability that there are some consequences coming from the influence.

If one of the above items is equal to zero, the risk is equal to zero too.

The sequence of items, constituting the risk analysis, can be easily expressed in terms of electromagnetic phenomena as follows:

Electromagnetic field by cellular phones exists,

- Electromagnetic field influences the human body,
- The influence is of negative nature.

Again, to prove that risk does not exist one has to prove that at least one of the three sentences is untrue. Therefore, to make the risk analysis one has to assume that electromagnetic field *must* exist, it *must* influence a human body, and the influence *must* be negative. The assessment of the risk is based on the analysis of the level of credibility of the above sentence. Since all the elements of the sentence cannot be refuted, the risk never disappears. The risk analysis is to show what level of risk is not to be overcome.

### **Area of international studies**

As it was written before to evaluate the risk created by the mobile phones the epidemiological evaluation seems to be to most proper. This is the reason to organize worldwide technical projects which after some years produce reports on how the problem looks like. The results differ from each other but recently the results somehow converge. There were a few projects in the recent years [2]. From all these projects two projects seem to be researched in more exhaustive way than the others, thus the press in this paper will be put on these two:

1. INTERPHONE project
2. SEER project

Below they will be presented these two projects and their result.

### **INTERPHONE project**

The project engaged 13 countries (Australia, Canada, Denmark, Finland, Greece, Germany, Israel, Italy, Japan, New Zealand, Norway, Sweden and UK). In order to make the number of participant (mobile phone users) big enough the study was focused on younger people (30-59 years of age) as they were expected to use mobile phones most intensive. For the same reason the research cohort were taken from large urban area.

The Interphone project was directed by the 21-member International Study Group. The total budget of the project was ca. 9.2 million Euros and was covered in amount of 5,5 million by industrial sources, 3,5 million by mobile phone companies and GSM Association. The big part of funding was provided by European Commission.

Between 2000 and 2004 all patient with brain tumors (gliomas and meningiomas) were examined. The confirmation of the presence of the tumor was based on the data coming from hospital registries, medical archives and hospital billing. All individuals were matched in the several centers the data file contained age (5 years tolerance), sex and region the examined subjects came from. Additionally, in Israel's case the people were asked on the ethnic origin.

The information about the mobile-phone use was available from face-to-face talks with the people examined, or proxies, if the subject used a mobile phone with the frequency one talk per week, at least for a period not shorter than 6 months. The proxies were used in the case. Later, the three groups of users were defined as to the period of mobile phone use and the frequency and time of calls: short term use, long term use and ever used.

Besides questions on mobile phone using the people were questioned about socio-demographic aspects. Occupational exposure on RF electromagnetic field and ionizing radiation, medical history and smoking as well.

During the study, 3115 meningioma and 4301 glioma cases and 14 354 control subjects were qualified to the project. Only some percent of them has been interviewed: meningioma cases – 78% and glioma cases - 64%. The detailed results are given in the project report. Here the conclusion of all the discussions is quoted and it sounds as follows:

*Overall, no increase in risk of either glioma or meningioma was observed in association with use of mobile phones [4].*

### **SEER programme**

The research was concentrated on the trends in time and frequency of incidence of brain cancers in the US. The data was collected by the Surveillance, Epidemiology, and End Results (SEER) Program within the time 1977-2006. This period covers both the pre-cellular (1977-1991) and cellular (1992-2006) times which gives the possibility of comparative study. Indeed, till the beginning of last decade of the last century the Americans were very skeptic as to the use of mobile phones, even it was bad seen to use a mobile phone in the public area. The jump in the number of mobile phones is well-seen in Fig.2A.

The total number of subjects were taken from 9 registries all over the United States which gave approximately 10% of the population.

Excepting the 20-29 year age group the trend is downward and flat. It shows that the mobile phone use does not bring the essential increase of tumor cases (see Fig. 2B).

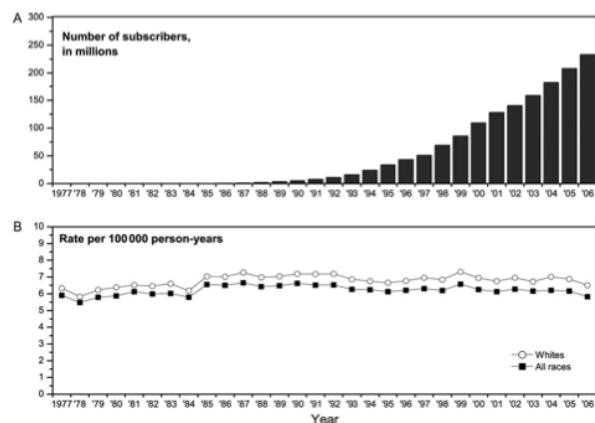


Fig. 2 (A) Number of mobile phone subscribers in the US within 1984-2006, (B) age-adjusted incidence of brain cancer in 1984-2006 [3]

The researchers are aware of the limitations of their research and pointed out all the doubts they have but concluding their project they state that *the data generated in this analysis do not support the thesis that cellular phones enhance the frequency of brain cancer occurrence [4]*.

### **Further research**

Although almost all projects show that there is no statistically valid relation between electromagnetic field from mobile phones and the induction of brain tumors, some doubts remain. Especially it is related to the EM hazard for children as well as for long term use for adults. Said Professor Elizabeth Cardis: *the INTERPHONE study will continue with additional analyses of mobile phone use and tumors of the acoustic nerve and parotid gland*. Because of concerns about the rapid increase in mobile phone use in young people – who were not covered by the Interphone – CREAL (Centre for Research in Environmental Epidemiology) is co-ordinating a new project, MobKids, funded by European Union.

MOBKIDS is an international multi-centre study involving 14 research groups, which will investigate radiofrequency radiation exposure from mobile phone use during childhood and adolescence and later onset of brain tumours. There is considerable community concern about possible health effects from mobile phone exposure, especially in young people, and this has been identified as

a high priority research need by the World Health Organisation. One problem in the study of environmental risk factors and brain cancer in young people is the limited number of children included in previous studies. Although the frequency of brain cancer may have increased in young people over recent decades, it is fortunately still a rare disease. Therefore, international studies are needed to answer such research questions. The study is partly supported by the European Union.

Over a period of two and a half to three years, starting in 2010, nearly 2000 young people between 10 to 24 years with brain tumours and a similar number of young people without a brain tumour will be invited to participate in the study.

COSMOS (COhort Study on MOBILE communicationS) is the world's largest study on the safety of mobile-phone users in five European countries (Denmark, Finland, Netherlands, Sweden, UK) eventually 250,000+ adults will be followed with repeat questionnaires for 20+ years. The project has been launched by researchers in London in April 2010. The project will recruit 250,000 phone users across five, mentioned above, countries.

It will last between 20 and 30 years and aims to provide definitive answers on the health impacts of mobile phones.

It is being funded in the UK by the Mobile Telecommunications and Health Research programme, an independent body, for an initial five year period. At this period the researchers will report their initial findings.

Besides mobile phones, the COSMOS researchers will monitor WIFI, cordless phones and the use of baby monitors, to obtain a complete picture of exposure to all types of electromagnetic radiation.

## Conclusions

To summarize, no increase of risk of brain neoplasm formation has been found in association with the use of cellular telephones. There were some suggestions concerning such an increased risk connected with the highest exposition levels, but due to the prejudice and methodology errors their evidential meaning remains limited. The majority of reports claiming the carcinogenic effect of high-frequency electromagnetic waves were based on too short exposition time, to be able to investigate the tumour growth dynamics, or the test groups were too scarce to allow the detailed reliable statistical analysis. The analysis of the aforementioned international studies

suggests that the use of cellular phone does not bring any increase in head neoplasm formation, or reveals the serious faults in the design of experimental protocols.

With regard to the epidemiologic data in the literature, no results were found to clearly prove the significant effect of cellular phones, base stations, microwave ovens or other every-day use appliances in enhancing the risk of brain tumour incidence. Nevertheless, the studies claiming such a carcinogenic effect of this type of radiation do also exist. Therefore, to unequivocally determine whether the exposition to high-frequency electromagnetic waves enhances the risk of onset of brain tumours, the results should be confirmed in clinical trials. This is a prerequisite to solve the problem, which has stayed unresolved for the last decade. Only after the full analysis of epidemiologic data and results of clinical trials has been completed, we will be free to verify the hypothesis forming an open question for the past ten years. It should be stressed at the end that nowadays dominating tendency is: the risk of mobile phone use is almost none and the warning opinions come mainly from the ecologists and sustain by politicians and media.

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