

## **Recent Research on Mobile Phones Effects**

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### **ABSTRACT**

The use of mobile phones always accompanied by the issue of health implications for human. Previous research studies show no evidence of the impacts of mobile phones to human health. New studies suggest that mobile radiation might double the risk of developing cancer on the side of the head used, increase brain activity, can cause damage to nerves around ears and, more importantly, damages the BBB. Also new research shows that biological effects are possible without any warming of tissues which impose of the current radiation exposure levels.

### **KEYWORDS**

Mobile Radiation, Health Effects

### **INTRODUCTION**

There are now about 1 Billion mobile phones in use worldwide, and it is expected to reach 1.6B lines by year 2005. In many countries, penetration rates of more than %50 has been reached. At present, there are approximately 4.5 million GSM subscribers in Saudi Arabia and STC has commissioned Ericsson and Nokia to expand its GSM network to 5.5 million lines (~ %20 penetration rate). This wide use of mobile technology have often raise the question about if there are health implications for human. In fact, there are conflicting reports relating to possible health effects from mobile phones and base stations.

In April 2000, an independent expert group in UK has issued a report on Mobile phone effects on health based on rigorous assessment of research in this area and show no evidence of the impact of mobile phones to human health. Since then a number of studies has been accomplished. This paper summarizes previous results. Then, the current efforts to assess health effects of mobile phones will be discussed and conclusions will be made.

### **MOBILE PHONE TECHNOLOGY AND RADIO FIELDS**

The maximum powers that GSM mobile phones are permitted to transmit by the present ICNIRP standards are 2 W and 1 W at 900 Hz and 1800 Hz, respectively. Radio frequency induce RF electric fields in tissue a part of the radiated energy will be absorbed in tissues. The power absorbed per unit mass is given by the following expression[1]:

$$\text{SAR} = (\mathbf{s} * E^2) / r$$

Where  $\mathbf{s}$  is electrical conductivity of tissue and  $r$  is the mass density. **SAR** is the specific energy absorption rate and is measured in watts per kilogram. It varies from point to point in the body both because the electric field changes with position and because the conductivity is different for different types of tissue. In most cases, SAR is directly proportional to  $1/d^p$  where  $d$  is the distance between the antenna and the head and  $p$  varies from 1.5-2.

## PREVIOUS RESEARCH RESULTS OF BIOLOGICAL EFFECTS

Results of earlier studies on rodents have shown that the threshold at which acute RF exposure disrupts learned operant behavior lies between 2.5 and 8 W/kg whole-body SARs, with an associated rectal temperature rise of about 1°C. Deficits in the performance of a previously learned behavior occur following long-term exposure to 2.45 GHz fields at SARs as low as 2.3 W/kg whole-body exposure.

Blood brain barrier, which prevents large molecules from crossing into the cerebrospinal fluid from the blood, might be susceptible to low level pulsed RF fields. Frey et al [2] reported increased penetration of the blood brain barrier of anaesthetized rats after acute low level exposure to pulsed or continuous-wave 1.2 GHz fields.

Previous studies show also little evidence that exposure to mobile phone radiation causes a stress response in mammalian cells, judged by elevated gene expression, the results on nematode worms are indicative of a non-thermal influence on gene expression[3]. Previous experiments on DNA synthesis also do not indicate changes in cell proliferation under conditions that mimic emissions from mobile phones or base stations.

Human laboratory studies of the acute effects of exposure to mobile phone signals suggest that exposure to mobile phone signals at exposure levels that fall within existing exposure guidelines have biological effects that are of sufficient magnitude to influence behavior. The causal mechanism is unclear, but could include a small, localized heating effect [4]. However, these studies do not provide evidence directly relevant to the question of the safety of mobile phones in the long term. Experimental designs employed focus on only the consequences of short-term exposure.

Braune et al. [5] have reported acute effects on blood pressure in human volunteers exposed to a conventional GSM digital mobile phone positioned close to the right side of the head. After 35 minutes of exposure, heart rate, blood pressure and capillary perfusion were measured with the subject either supine or standing for 60 seconds. They found that the heart rate during these tests was slightly lower after exposure to RF radiation than following non-exposed control sessions, and both systolic and diastolic blood pressure were elevated by 5 – 10 mm of mercury.

A few epidemiological studies have directly examined the relationship of mobile phones to morbidity or mortality. Rothman et al, has examined mortality among customers of a large

mobile phone operator in the USA [6]. It covered some 250,000 phone users, who were followed for one year. During this time, the overall death rate was similar in people using hand-held phones and in users of other mobile phones that did not have an antenna in the handset, and therefore gave lower exposures to RF radiation. For those customers who had been listed as continuous users for at least three years, overall mortality was slightly lower in the hand-held phone users than the other mobile phone users, but the difference was not statistically significant (relative risk = 0.86). Numbers of brain tumor and leukemia deaths were small and showed no substantial indication of increasing risk with number of minutes of hand-held phone use per day, or with years of hand-held phone use[7]. A case-control study of 270 cases with a histopathological diagnosis of brain tumor in two regions of Sweden with 233 actually participating. Each was age and sex matched to two controls from a population register. The use of mobile (cellular) telephones over preceding years, including type of system and pattern of use was established for each case and each control. The proportion of mobile phone uses was the same (38%) in each group, and no increased risk of brain tumor was found. Latency, type of tumor, position of tumor and amount of use of mobile phones were all examined for relation to tumor development. None was found [8]. These earlier epidemiological studies indicate that RF radiation is unlikely to induce or promote cancer in people.

A Larger-scale cross-sectional survey of some 11,000 mobile phone users was accomplished in Sweden and Norway [9]. This study has included information about various symptoms including fatigue, headache and warmth behind and on the ear. Of the participants, 13% in Sweden and 30% in Norway reported the occurrence of at least one symptom. For both analogue and digital phones, the prevalence of reported symptoms increased with minutes per day of phone use. The proportion of GSM phone users reporting a symptom was rather lower than in other groups.

### **THE PRECAUTIONARY PRICIPLE**

The ICNIRP guidelines were designed to prevent illness or injury through heating effects and were based on the behavioral changes that have been found when experimental animals were exposed to RF radiation at levels that produced a rise in whole-body temperature in excess of 1°C (An SAR of 1.4 W/kg or higher is needed to cause these changes). Since SARs cannot easily be measured in living people, the ICNIRP guidelines specify investigation levels for external electromagnetic field strengths, at or below which the basic restriction on whole-body SAR will not be exceeded.

### **RECENT RESEARCH RESULTS**

#### A. Recent Studies:

Previous research studies show no evidence of the impacts of mobile phones to human health. Wide research programs on the implications of mobile phones effects has been started in a number of countries.

A cohort study of 550,000 users was carried out in Denmark[10]. This is a retrospective cohort study of the incidence of cancer in all 420,095 users of cellular telephones during the period of 1982 to 1995. Overall, 3391 cancers were found, with 3825 expected, which yielded a significantly decreased standardized incidence ratio of 0.89. No increased incidence was seen for cancers of the brain or nervous system, of the salivary gland or for leukemia, cancers which were of a priori interest. The results do not support the hypothesis of an association between the use of these telephones and tumors of the brain or salivary gland, leukemia, or other cancers.

A large case control study of the risk of brain tumors in relation to the use of mobile phones in USA. This study does not show association between brain tumor risk and the use of mobile phones for the past a few years[11].

A study has contrasted the incidence rates of malignant melanoma of the eye rare cancer with the number of mobile phone subscribers in Denmark. It was observed that no increasing trend in the incidence rate of melanoma, which was in sharp contrast to the exponentially increasing number of mobile phone subscribers starting in the early 1980s. This study provides no support for an association between mobile phones and ocular melanoma[12].

A study is carried out to see if mobile phone radiation disturbs sleep patterns at the University of Zurich in year 2000. Electromagnetic fields from mobile phone use in bed significantly increases brain activity during early, non-rapid-eye-movement sleep. 16 people were subjected to electromagnetic radiation similar to mobile phone use for 30 minutes before they went to sleep. Increased brain activity lasted up to 50 minutes. This effectively means that people will soon have to accept that mobile phone do have a biological effect.

A new study in Sweden considered about 1600 people with brain tumor of whom had used mobile phones more than 10 years[13]. The RR was found to be highest for tumors in the temporal area of the brain. It was found that mobile phones doubles the risk of developing brain cancer on the side of head where phone is held. It is also found that the risk increased to more than three times for mobile users in case of tumors of the auditory nerve.

Mobile phones may also cause damage to nerves around ears according to a new study [14]. This study claims to have evidence of altered nerve function in the skin of a mobile phone user, around the ear area. Readings of nerves were taken 1cm in front of and 1cm behind the ear - both showed altered responses in a man complaining of strange feelings in his head after using a mobile phone. Researcher had many other cases but had investigated only one.

A new major study in Finland looked at the effects of mobile phone radiation on human cells rather than those of rats[15]. In this two year study researchers found that exposing human cells to mobile phone radiation damaged the blood brain barrier. This study has also demonstrated that mobile phones can affect cells without heating them.

In a recent study worms safety concerns over mobile phone radiation has been investigated. At Nottingham University, UK Feb. 2002, it was found that female nematode worms exposed to mobile phone radiation produced stress hormones, grew 10% larger, and produced more eggs. In a lab tests, British scientists have found that microwave emissions typical of mobile

phones make a type of worm more fertile. This study is important because it reveals, for the first time, that biological effects are possible without any warming of tissues.

A large epidemiological study is going in over 10 countries by IARC to identify if there are links between use of mobile phones and head and neck cancers. Results are expected in 2004.

A new French study begins to look at 6,000 mobile phone users in 14 countries, 50% of whom have brain cancer. Results are expected this year (Dr Elizabeth, the International Center for Cancer Research, Lyon).

## B. Discussion of the new results

Two of the new studies (1, 2) did not show an association between brain tumor and use of mobile phones. Also one of the new studies (3) did not indicate a link between mobile phones and ocular melanoma.

However, other studies suggest that mobile phones double the risk of increasing brain activity during early, non-rapid eye movement sleep (4), developing brain cancer on the side of head where phone is held (5), and causing damage to nerves around ears (6). More importantly is the new results presented by studies (7,8). Study by Dr. Leszczynski (7) showed that exposure to mobile phones radiation caused cultured human cells to shrink. In the UK study (8) mobile phones also found to make a type of worm more fertile. These two studies have thrown out the widely belief that heating is the only potential threat to brain cells from mobile phones.

Until now, regulations designed to protect people from microwave radiation - from mobile phones, microwave ovens and radar systems - have been based purely on avoiding heating from the microwave radiation.

## **CONCLUSIONS**

Some new research results show no association between brain tumor and mobile phone radiation. Others, however, suggest that mobile radiation double the risk of developing cancer on the side of the head used, increase brain activity, can cause damage to nerves around ears and, more importantly, damages the BBB.

Although research studies on the impact of Mobile phones radiation on health remains inconclusive, previous research results has taken the prevention of heating effects as a basis for exposure guidelines. But new research recent results demonstrate that mobile phones can affect cells without heating them.

The ICNIRP guidelines was set based on the behavioral changes when experimental animals are exposed to RF radiation at levels which produce temperature rise of more than 1C°. Therefore, new research results raise the question about the effectiveness of the ICNIRP exposure guidelines to prevent health implication to human. In fact some countries are

starting to impose new exposure measures. For example, China is planning a new strict standards that would cap handset radiation emissions at half the levels allowed elsewhere. The amount of radiation that can be passed from a handset to a user, the SAR, will be limited to 1 Watt/ Kgm instead of 2Watt/ Kgm

Even with those studies that show no relation between brain tumors and mobile phones radiation, such investigations do not measure risks for cancers such as brain tumors with longer latency periods of induction or for slow growing tumors. Mobile phones have not been in use for long enough to allow comprehensive epidemiological assessment of their impact on health

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