

**The U.S. National Toxicology Program of the U.S. National Institutes of Health  
Radiofrequency Carcinogenicity Research Study Findings on Heart and Brains of Rats**

The U.S. National Toxicology Program (NTP), released a final [report](#) of parts of the world's largest, most thorough and well-designed study of its type - at a cost of \$25 million - on the potential carcinogenicity of cell phone radiofrequency radiation in rats.

### **What did the study find?**

The study found adverse effects after long term exposure to cell phone radiation:

- Increased incidences of glioma, a rare, aggressive and highly malignant brain cancer.
- Increased incidence of schwannoma (a rare tumor of the nerve sheath) of the heart
- Increases of these cancers were found in both sexes of rats, but reached statistical significance only in males.
- Increased incidences of rare, proliferative changes in glial cells of the brain and in Schwann cells in the heart of both sexes of rats, while not a single unexposed control animal developed these precancerous changes.
- DNA damage was induced with both modulations of radiofrequency radiation (RFR) in both rats and mice (in the frontal lobe plus other tissues).

Results from this study clearly show that the no-effect hypothesis for RFR in biological systems at non-thermal exposure intensities has been disproved.

Note: Studies in mice are ongoing. The complete results from these rodent studies will be available in NTP Technical Reports for peer review and public comment by the end of 2017.

### **Why is this study considered a “landmark” study?**

1. The NTP findings of brain tumors (gliomas) and malignant Schwann cell tumors of the heart in the NTP study - as well as DNA damage in brain cells of exposed animals - present a major public health concern because these tumors occurred in the same types of cells that had been reported to develop into tumors (gliomas and acoustic neuromas) in epidemiological studies of long term cell phone users.
2. In 2011, the International Agency for Research on Cancer of the World Health Organization (IARC/WHO) classified radio frequency radiation as a Class 2B “possible carcinogen” largely based on the epidemiological studies linking long term cell phone use to increased glioma and acoustic neuroma. The NTP findings provide significant new animal evidence which supports the human epidemiological data and indicates that a higher carcinogenicity classification is appropriate for radiofrequency radiation.
3. The NTP results show adverse biological effects from RFR at non-thermal or minimally thermal (non-heating) exposure levels. Current international radio frequency exposure limits and mobile phone regulations are based on avoiding thermal (heating) effects and to protect the public from acute thermal effects. Therefore, the NTP findings indicate that current regulations do not adequately protect public health.

### **How were the animals exposed?**

NTP animals were carefully exposed to RFR in reverberation chambers. A reverberation chamber is a shielded room containing an excitation antennae and ventilation panels. In this chamber, field exposures emanate from all directions, while rotating paddles distribute the fields within the chamber to create a statistically homogeneous electromagnetic environment. An advantage of this approach is that animals are able to be

exposed in an unrestrained state for extended periods of time. During this time, RFR exposure was turned on and off at particular intervals. Prior to the start of the toxicity/carcinogenicity studies, specific exposure intensities were identified which would not cause measurable increases in body temperature. To maintain relatively uniform exposures to all body organs, rats were exposed to 900 MHz RFR and mice were exposed to 1900 MHz RFR.

### **Did the NTP study mimic human exposure?**

Rats and mice were exposed to frequencies and modulations currently used in cellular communications in the United States (GSM and CDMA) specifically to mimic humans long term low level exposures. The rodents were exposed for 10-minute on, 10-minute off increments, totaling just over 9 hours a day of exposure from before birth through 2 years of age. Based on the increased use of cell phones over the past 10 years and the extensive use of multiple wireless devices which emit RFR - these daily exposure durations are not unreasonable.

For the NTP studies of rats and mice, the full body exposure values were 1.5 W/kg, 3W/kg, and 6 W/kg. These exposures are similar to or only slightly above regulatory threshold levels for cell phones which range from 1.6 W/kg (head/torso) to 4W/kg (ears, hands, wrists).

### **Does the gender difference mean the findings of carcinogenicity can be dismissed?**

As the [American Cancer Society explains](#), "It's important to note that these sorts of gender differences often appear in carcinogenic studies, so the fact they show up here should not detract from the importance of the findings." In addition, gender differences in cancer rates also exist in humans. For example, brain cancer mortality rates are approximately 50% higher in men than in women, and for many human cancers (e.g., colorectal, liver, soft tissue including heart, kidney, non-Hodgkin lymphoma, etc.) the incidence and mortality rates are much higher in men than in women. Thus, the different response between male and female rats in the NTP study of RFR does not diminish the relevance of the cancer findings.

### **Were the results peer reviewed?**

The brain and heart tumors and the pre-cancerous lesions observed in the NTP study were reviewed by nearly 20 pathologists. In addition, because the results from this study provided evidence-based consistency and support for the IARC conclusions, the overall partial findings were subjected to an accelerated peer review by three individuals with expertise in evaluating experimental cancer data, plus six NIH scientists. Dr. John Bucher, Director of the National Toxicology Program Division, has stated that "the majority" of NIH reviewers to the data set agreed with the report's conclusions.

### **Is the statistical power strong?**

Typically, carcinogenicity studies use 50 animals per group. For this study 90 animals of each sex were included per exposure group. Though this study had more power than most other carcinogenicity studies, an increased incidence of about 5% compared to controls was necessary to achieve statistical significance for rare tumors.

### **Does the shorter lifespan of the controls mean they just did not live long enough to develop cancers?**

The answer to this question is no, for at least two reasons. First, there was no statistical difference in survival between control male rats and the exposure group with the highest rate of gliomas and heart schwannomas. Second, no glial cell hyperplasias (potential precancerous lesions) or heart schwannomas were observed in any control rat, even though glial cell hyperplasia was detected in exposed rats as early at week 58 of the

2-year study and heart schwannomas were detected as early as week 70 in exposed rats. Thus, survival was sufficient to detect tumors or pre-cancerous lesions in the brain and heart of control rats.

### **Have any other animal studies shown a link to cancer?**

Yes. With the results of the NTP, there are now three important animal studies within the past six years showing increased development of cancers after RF-EMF exposure. [A German study](#) published in 2015 replicated 2010 [research](#) which showed carcinogen-induced tumor rates were significantly higher in the lung and liver of animals exposed to RF-EMF along with a known carcinogen.

### **What are the limitations of the study?**

The study only followed the animals up to 2 years and not for a full lifetime. The study only tested one modulation at a time and yet humans are often exposed to multiple frequencies at various intensities. The effects to the reproductive system, hormones and to brain development were not addressed in the study design nor were cognitive and behavioral effects to the exposed animals.

### **What are the policy implications of these study results?**

This study adds significant evidence of cancer risk from cell phone RFR. It would be irresponsible for public health agencies to wait for absolute proof of human harm before implementing precautionary measures. Because of the large number of cell phone users in the US and worldwide, even a small increase in cancer risk at exposure intensities close to what humans experience could result in a large number of individuals developing an RFR-induced tumor with long term exposures. The current message to take precautionary measures "if you are concerned" is inadequate.

For children the cancer risks may be greater than that for adults due to increased penetration and absorption of cell phone radiation within the brains of children. Furthermore, the developing nervous system of children is more susceptible to tissue damaging agents. Based on this new information, it is time for regulatory agencies to make strong recommendations for consumers to take precautionary measures and avoid close contact with their cell phones, and especially limit or avoid use of cell phones by children.

### **NATIONAL TOXICOLOGY PROGRAM (NTP) LINKS**

[NTP Report of Partial findings from the NTP Carcinogenesis Studies of Cell Phone Radiofrequency](#)

[NTP Press Release: NTP Cell Phone Radiofrequency Radiation Study: Partial Release of Findings](#)

[NTP/NIEHS Webpage on Cell Phones](#)

[Video of Presentation by NTP at NIEHS June 2016 on the Study Findings](#)

[Powerpoint Slides by Dr. Birnbaum, Director of the National Toxicology Program](#)

### **NEWS MEDIA COVERAGE**

Wall Street Journal: [Debate Renews Over Health Risks from Cell Phone Use](#)

Wall Street Journal: [Cell Phone Study Fans Cancer Worries](#)

Consumer Reports: [Does Cell Phone Use Cause Brain Cancer? What the New Study Means For You](#)

Science Magazine: [Questions abound after study links tumors to cellphone radiation](#)

PBS: [How Might Cell Phone Signals Cause Cancer May 30, 2016](#)

Scientific American: [Major Cell Phone Radiation Study Reignites Cancer Questions: Exposure to radiofrequency radiation linked to tumor formation in rats](#)

### **SCIENTIFIC RESPONSE**

[American Cancer Society Press Release: New Study Linking Cell Phone Radiation to Cancer](#)

[American Academy of Pediatrics Responds to National Toxicology Program study](#)

[Barcelona Institute for Global Health, GROWING EVIDENCE FOR THE LINK BETWEEN MOBILE PHONES AND CANCER](#)

[BERENIS - Swiss expert group on electromagnetic fields and non-ionising radiation, September 2016 Newsletter Review of the NTP Study](#)

[Dr. Eitan Kerem, Chair of Pediatrics at Hadassah Hebrew University Hospital](#)