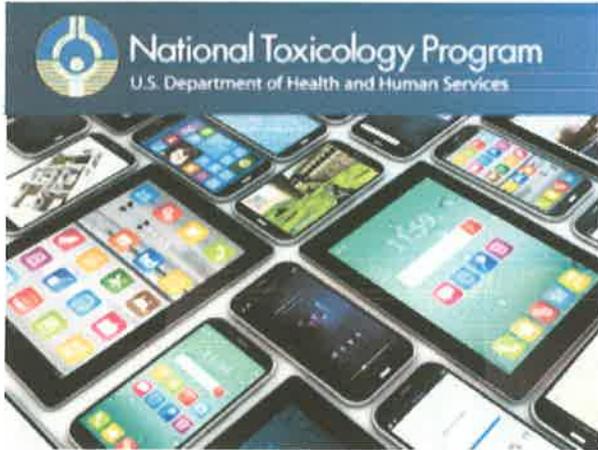


<http://ehtrust.org/science/facts-national-toxicology-program-cellphone-rat-cancer-study/>

Frequently Asked Questions About The U.S. National Toxicology Program Radiofrequency Rodent Carcinogenicity Research Study



The U.S. National Toxicology Program Radiofrequency Carcinogenicity Research Study



On May 27th, 2016, the U.S. National Toxicology Program, of the U.S. National Institutes of Health, released a [report](#) with partial results of their large study on the carcinogenicity of radiofrequency radiation (RFR, also known as microwave radiation) in male and female rats and mice.

The world's largest, most well-designed study of its type, at a cost of \$25 million, found increased occurrence of rare brain tumors called gliomas in male rats and increases in nerve tumors called Schwannoma of the heart, thymus and mediastinum in both male *and* female rats exposed to RFR. The released results are "partial" because more rat results and all of the mouse study results will be forthcoming, by 2017.

Study Design And Results

How Were The Animals Exposed?



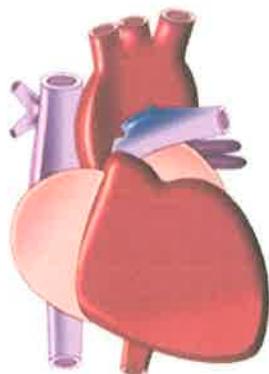
Animals were exposed daily during gestation and for two years after their birth to two commonly used types of RFR—Global System for Mobile (GSM) and Code Division Multiple Access (CDMA). For each type of RFR there were three exposure groups: 1.5 W/kg, 3W/kg, and 6 W/kg.

The rodents were housed in specially designed underground chambers for uniform RFR exposure.

RFR exposures were 10-minutes on, 10-minutes off for 18 hours a day, resulting in a total exposure of 9 hours daily.

Exposure intensity was at low *nonthermal or non-heating levels*. Heating from microwaves is the only adverse effect recognized by US regulators, who rely on standards set almost two decades ago. The NTP study set exposures at low levels determined *not* to heat the body in order to test if biological effects occur at non-thermal levels.

What Cancers And Tumors Were Found?



Increased incidence of gliomas, a rare and aggressive, highly malignant brain cancer, as well as schwannomas (a rare tumor of the nerve sheath) of the heart were found in both sexes but reached statistical significance only in males. Overall, there were more brain abnormalities and tumors in exposed male rats than in exposed female rats. In humans, gliomas are also more common in men than in women.

In addition to the gliomas, there were significantly more rare, pre-cancerous changes in the glial cells of the brain in both sexes, while not a single one of the unexposed control animals developed these same abnormal brain cells. Male rats exposed to all levels of CDMA developed exceptional numbers of damaged, pre-cancerous brain cells (glial hyperplasia). Both male and female rats, exposed to all levels of microwave radiation, developed increased incidence of rare malignant tumors of Schwann cells (nerve sheaths) of the heart. Females exposed to all levels of CDMA also developed precancerous hyperplastic Schwann cells, while none of the unexposed controls developed this rare abnormality.

It should be noted that this partial report focused only on these brain and heart tumors, and that additional results from the rats study will be released by 2017.

How Strong Are These Results?



“Game-changer” is increasingly being used to describe these results. For decades people believed that microwave radiation at low (non-heating) levels is safe and cannot cause harm. The NTP results clearly show that this assumption is false. Microwave radiation can cause harmful effects even at low non-heating- levels.

Although the results show “low” increases in tumors, these tumors are quite lethal. Moreover, even a small increase can have a great impact. As the NTP report stated, *“Given the extremely large number of people who use wireless communication devices, even a very small increase in the incidence of disease resulting from exposure to the RFR generated by those devices could have broad implications for public health.”*

Significantly more gliomas were seen in males exposed to CDMA (95% confidence level). Positive trends for a greater number of tumors at higher doses were observed for both gliomas and schwannomas of the heart in males. Both the trends and the replication make these very strong results.

Why Is This Study Considered A “Landmark” Study?



These results are very significant for three reasons:

1. In case-controlled studies, humans develop the same types of tumors from cell phone exposures.

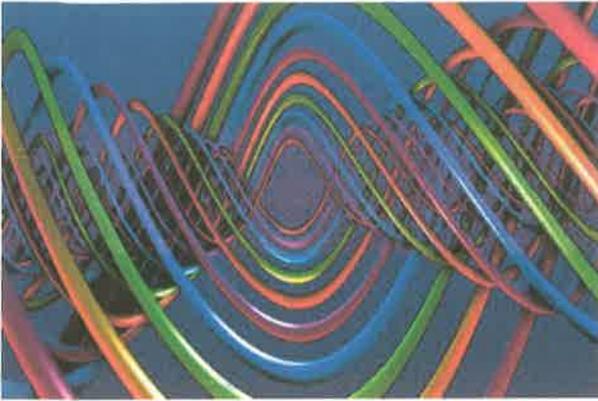
Epidemiological studies in humans show increased risks for gliomas and schwannomas after long-term use of cell phones – these are the same types of tumors that were found in the exposed rats.

2. The results show adverse biological effects at non-thermal levels meaning that current international regulations (based on avoiding heating) do not adequately protect public health.

The NTP study was designed to test if the basis for government safety standards is accurate. Current safety standards are based on the premise that only RFR levels that cause heating are harmful. The study was carefully designed to ensure that the body temperature of the exposed rats did not increase significantly. *Yet an effect was shown at non-thermal levels.* The NTP study provides well-documented, scientific evidence that current international regulations are based on a faulty assumption.

3. The results add significant weight to the scientific evidence that radio frequency radiation is carcinogenic.
 - o 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.” One of the reasons for the classification “possible” was because human epidemiological studies showed increased brain tumors after long term exposures, however, *more evidence* was needed from animal studies showing carcinogenicity and a mechanism of action. The recent NTP results provide new, well-designed research evidence in animal models that links RFR to cancer. As the NTP stated, “These findings appear to support the International Agency for Research on Cancer (IARC) conclusions regarding the possible carcinogenic potential of RFR.”

Is It True That The NTP Study Found DNA Damage In The Exposed Animals?



Yes – the NTP study found statistically significant evidence of DNA damage.

The preliminary data with comet assay showed a statistically significant trend in RF-induced DNA damage in both rat and mice brain tissues. These findings were shared by the National Toxicology Program during the [BIOEM 2016 Annual Meeting](#).

Associate Director of NTP John Bucher described some of the DNA findings in a Science Magazine interview stating that, “In a small side experiment of the NTP study, DNA from the tissues of 80 mice and rats that had spent 90 days in the reverberation rooms were examined for breaks in the DNA strands. There was more DNA damage in some of the rodents that received the highest radiation levels.”

Genotoxicity findings will be published in the forthcoming paper from the NTP rodent study entitled “Evaluation of the genotoxicity of cell phone radiofrequency radiation in male and female rats and mice following subchronic exposure” (as noted on [page 3 of the released NTP Report](#)).

Is This Study Well Designed?



This \$ 25 Million Study is, in fact, the world’s largest and most

comprehensive rodent study of radiofrequency electromagnetic fields. The design of this study was presented at an annual meeting of the Bioelectromagnetics Society prior to the start of these studies.

According to Ron Melnick PhD, *“the overwhelming opinion expressed by the meeting participants was that this would be the largest and most comprehensive study in animals exposed to cell phone radiation, and that the results from this study would trump all other animal carcinogenicity studies of this agent.”*

Seven thousand rodents were used for the entire study, which used a three-phased study design: (1) Pilot studies to establish field strengths that did not excessively raise body temperatures; (2) Subchronic toxicology studies in which the rodents were exposed to various low-level field strengths for up to two months; and (3) Chronic toxicology and carcinogenicity studies in which the rodents were exposed prenatally and for the majority of their lifetime (up to 24 months). The chronic exposure study employed seven groups of 90 rats: a sham control group that was not exposed to the radiation, and three groups for each of two common types of cell phone signal.

Why Was This Study Initiated?

Some Clarifications In Response To Concerns Raised In The Media

Does The Fact That Increased Numbers Of Tumors Were Statistically Significant In The Male Rats, But Not In The Female Rats, Mean The Findings Of Carcinogenicity Can Be Dismissed?



No. In *previous* NTP toxicology studies male rats were *more than ten times more likely* to develop malignant gliomas (brain tumors) than females. For malignant schwannoma of the heart, males were *more than twice as likely* to develop this type of cancer than the females. (These statistics called “historical control incidence” are documented in [the NTP report](#) at the bottom of the tables starting at page 9.)

[Microwave News](#) quoted Ron Melnick’s comments on the sex differences:

“It is not surprising that the exposed males had more tumors than the females given what we have seen in the historical controls. But we can go one step further, the fact that we saw any of these tumors in the exposed females but none in the concurrent controls adds support to the conclusion that cell phone radiation leads to cancer among rats.”

These gender-specific results are not uncommon in animal carcinogenicity research studies. As the [American Cancer Society explains in their statement about the NTP results](#), “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.”

[Analyses of NTP bioassays](#) show that “male rats are more sensitive to chemical carcinogens compared to female rats.” The fact that male rats are more likely to show carcinogenesis in NTP studies is well documented in “[Gender differences in chemical carcinogenesis in National Toxicology Program 2-year bioassays](#)”.

It is also important to note that in human studies, gender differences in cancer incidence and mortality is a regular finding.

Notably, in the NTP study, increased incidence of rare malignant tumors of Schwann cells (nerve sheaths) in the heart was found in both male *and* female rats, as were precancerous hyperplastic Schwann cells. The findings in the female rats were not statistically significant, but these tumors are known to occur more rarely in females.

The NTP findings cannot be dismissed because of the gender differences.

Were The Results Peer Reviewed?

The findings have undergone extensive reviews. The biological tissue analyses were reviewed by multiple pathologists and statisticians who were unaware of the test agent being evaluated, and looked solely at the obtained slides. The report has addressed several expert reviews with responses that are appended to the online document.

The National Toxicology Program states in the abstract, “The findings in this report were reviewed by expert peer reviewers selected by the NTP and National Institutes of Health (NIH). These reviews and responses to comments are included as appendices to this report, and revisions to the current document have incorporated and addressed these comments.”

Results have not yet been published in a journal but were released early by the NTP because of their importance for public health.

Is The Statistical Power Strong?



Typically, in this type of testing the NTP uses 50 animals per group. For this study they used 90 animals per group, as such, so it may be considered a large study relative to other similar animal studies. The expected background rate of the two tumors that have been found (glioma and Schwannoma of the heart) is also extremely low.

The chances of finding a true effect—or power of a study—depend on two principal things: (1) the size of the sample studied and (1) the size of the expected occurrence of the endpoints under study. With smaller numbers of animals, the chances of finding an effect—called the statistical power—would have been lower. Studies that are underpowered do not have enough data to present a full and clear picture. Had more animals been studied, there might have been further positive associations, possibly resulting in statistical significance in the female rats as well. The NTP finding of positive results in *multiple* tumor types means that these study results are even more important.

As Associate Director of the U.S. National Toxicology Program John Bucher stated in the [May 27, 2016 NTP Press conference](#), “The power to detect these tumors is probably in the range of between 10% and 20%, which also actually makes it more interesting that we have found statistically significant findings.”

Contrary to some claims about this study, false positives are not a significant concern. The reason that clinical trials (such as those Dr. Lauer conducts) use large numbers of people is to increase their chances of finding a true effect. The smaller the sample, the greater the chance of NOT finding an effect *when one is actually there*—also called a false negative.

Control Group Animals Did Not Develop Either Schwannomas In The Heart Or Gliomas. The Control Group Animals Also Did Not Live As Long As Those That Were Exposed. Does This Call Into Question The Validity Of The Study?



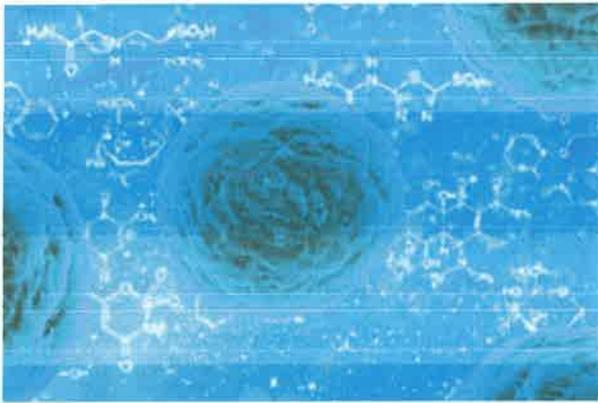
NTP scientists carefully considered this question. Control group lifespans were within historical ranges, and a statistical procedure was used so as not to over-estimate risks. In fact, it is not surprising to see that the stresses of RFR exposure might contribute to increased lifetime while also contributing to serious health damage. For example, calorie-restricted animals live longer on average. It is important to note that other statistically significant effects from

exposure were seen early on, as the pups exposed *in utero* had lower body weights at birth and remained at a lower weight throughout their lifetimes.

The mortality rates are not as important a fact as it seems when the data is analyzed. First, there was no statistical difference in survival between control male rats and those exposed to CDMA at 6 W/kg (the group with the highest rate of gliomas and heart schwannomas); at week 94, survival of rats in these two groups were the same. 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 a CDMA-exposed rat as early as week 58 and heart schwannomas were detected as early as week 70 in exposed rats. If the control rats were going to develop tumors, these precancerous lesions and tumors *would have already been present*. Yet not a single control had any evidence of an effect.

It is notable that a [US Air Force study from the 80's](#) which also found increased cancer also showed chronic RF exposure increased life span in rodents. The median survival time was 688 days for exposed animals and 663 days for the sham-exposed.

In This Study, The Exposed Group Developed Tumors At Rates Comparable To Historic Rates Of Tumors In Rats In Other Such Studies. How Is This Finding Considered Statistically Significant?



Most importantly, in every study, *the preferred control group is the present one*, as every detail of feed, housing, etc. is truly identical. If all groups of rats are treated the same in the same experiment and only the exposed group has a statistically significant effect, then an effect has been shown.

A crude analysis comparing all controls—historic and present—with all exposed animals in the present study still shows a consistently increased probability of developing cancer.

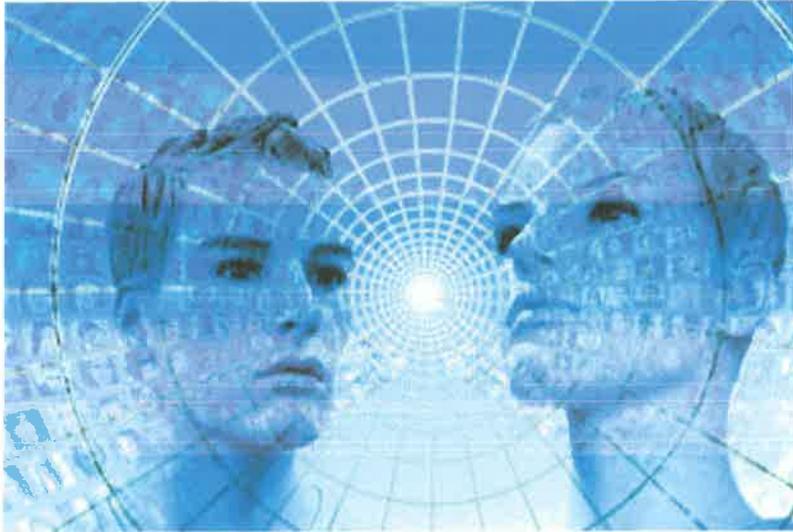
This chart shows the percentage of exposed rats that got tumors as compared with the percentage of the same tumor in all current and historical control rats. *In every case there were more tumors in the exposed group than in the control group.*

Probability of cancer compared with all controls, in rats in NTP wireless radiation study

>>	Ratio of % exposed cases / % cases in all controls including historic
Glioma	
Male	1.19
Female	3.50*
Schwannoma	
Male	3.08

*gliomas are extremely rare in these female rats; there were more gliomas in males, both in unexposed and exposed animals, so the ratio is lower.

The Rats Were Exposed For Nine Hours Per Day For Two Years, Over The Whole Body, With Some At Levels Higher Than Cell Phones. How Is This Study Relevant To People?



The study is relevant to humans because it tests the scientific basis for current cellular communication safety regulations, which are intended to protect humans from adverse health effects.

In case-control studies that compare persons with brain cancer to matched controls without the disease, increased gliomas have been seen with less than 1,000 hours of cell phone exposure. Animal studies typically last two years, or the lifetime of the rodent. The animals are specially bred in an attempt to induce tumors in an animal with a short lifetime. The overall exposure of the rats is set to approximate that of humans.

Government safety regulations for microwave radiation are based on the assumption that *“as it does not heat you, it will not hurt you.”* To test the “no-heating” cut-off for harm, animals were exposed up to almost the maximum dose they could tolerate with no increase in body temperature. The animals in this experiment never had an increase in body temperature over one degree Celsius. This study shows that adverse biological effects occur at non-thermal (non-heating) levels.

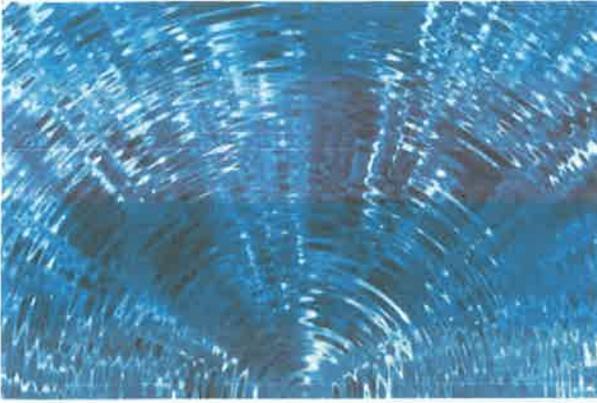
Dr. Moskowitz calculated the overall risk for the male rats in the group exposed to the lowest intensity of cell phone radiation (i.e., 1.5 watts/kilogram or W/kg). He found 12 of 180 (or 1 in 15) male rats in the exposed group developed cancer or a precancerous lesion. He concluded that, “This latter finding has policy implications as the FCC’s current cell phone regulations allow cell phones to emit up to 1.6 W/kg at the head or near the body (partial body SAR).”[Read his review here.](#)

Why Was Keeping The Rats From Overheating So Important?

Exposure to high levels of RFR energy, particularly at microwave frequencies, can rapidly heat biological tissue. This is known as a *thermal effect*. Thermal effects can cause harm by disrupting biological processes, and damaging tissue. Government safety regulations require mobile phones and wireless devices to operate at power levels well below the threshold for known thermal effects.

The study was carefully designed to ensure that the exposed rats did not have an increase in temperature beyond one degree, so the tumor development reflects a “non-thermal” mechanism of action. If adverse non-thermal effects are confirmed, then cell phone and wireless device emissions regulations will need to be re-evaluated *because they would not be protecting humans from non-thermal effects*. This is precisely why this NTP study is so significant.

Why Were Effects For CDMA-Modulated RFR Exposures Different From GSM?



Code Division Multiple Access (CDMA) and Global System for Mobile

(GSM) are two *different* communication technologies. CDMA is the primary type of technology used for cell phones in the United States with providers including Verizon, Sprint, and US Cellular. GSM is the primary type of technology used for cell phones in the rest of the world. In the United States, T-Mobile and AT&T use GSM. Europe adopted GSM technology in the 1980s, and users will not find access to CDMA networks in any European countries.

It is unclear why the more modern modulation (CDMA) proved to be more harmful, and there is no way to determine this from the NTP study. However, it makes sense that the body, at a cellular level, might have a different reaction to a different types of exposures and waveforms, *even if the power level is the same*.

Swedish cancer researchers have reported differences in gliomas associated with different modulations, with the more recent technologies appearing to have more of a biological effect. Modulations are evolving to transmit more data faster at a given frequency, and this results in higher peak to average power ratios. In the lab, it is notable that [experiments using real-life devices are much more likely to find significant effects](#).

This is an important finding, that hopefully will spur researchers to explore in future studies how different radio frequency radiation technology impacts the body. Until recently, regulators considered the power density of the radiation (linked to heating) important for human health and the issue of modulation was assumed to be less significant. *However, the reality is that cellular communication signals are very complex and all signal characteristics, such as modulation, waveform, and power density, must be considered.*

This is a topic of great concern as we prepare to move to newer technologies, driverless cars, and more and more wireless in schools with young children.

The Study Is Not Applicable To Modern Cell Phones And Wireless Devices. Cell Phones Are Now Using Even Newer Technology That Uses Even Lower Power.



In fact, the newer technology may have more adverse effects. These newer devices involve technology with greater variations in pulsed signaling the information content of signals that are being used. The pulse of the signals may well prove to be more important biologically than their power. The biological effects of the NTP study that produced an increase in cancer occurred *without heat*.