National Toxicology Program
U.S. Department of Health and Human Services

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Cell Phone Radio Frequency Radiation

Final reports from the rat and mouse studies, plus the press release and fact sheet, are now available.



Research Overview

Status: Completed
Substances: Cell Phone Radiation: GSM, Cell Phone Radiation: CDMA
Nominated: May 1999

BACKGROUND INFORMATION

Cell phones are currently used by 95% of American adults. The U.S. Food and Drug Administration (FDA) nominated radio frequency radiation (RFR) used by cell phones for an NTP study because of widespread public use of cell phones and limited knowledge about potential health effects from long-term exposure.

NTP STUDIES & FINDINGS

NTP conducted two-year toxicology studies in rats and mice to help clarify potential health hazards, including cancer risk, from exposure to RFR like that used in 2G and 3G cell phones which operate within a range of frequencies from about 700–2700 megahertz (MHz). These were published as Technical Reports in November 2018.

What did the studies find?

NTP uses a standard scale (graphic of NTP's Level of Evidence Rating System for Cancer Studies) to determine the strength of the evidence for an association between the exposure and findings in the tissues or organs studied. The scale ranges from the highest rating of "clear evidence," followed by "some evidence," then "equivocal evidence," and finally "no evidence." Different organs or tissues can have different conclusions.

The NTP studies found that high exposure to RFR (900 MHz) used by cell phones was associated with:

- **Clear evidence of an association with tumors in the hearts of male rats.** The tumors were malignant schwannomas.
- **Some evidence of an association with tumors in the brains of male rats.** The tumors were malignant gliomas.

- **Some evidence of an association with tumors in the adrenal glands of male rats.** The tumors were benign, malignant, or complex combined pheochromocytoma.

It was unclear if tumors observed in the studies were caused by exposure to RFR in female rats (900 MHz) and male and female mice (1900MHz).

As a follow-up, NTP published an article in October 2019 that evaluated DNA damage in three regions of the brain, the liver, and in blood cells in rats and mice that were removed at an earlier timepoint from the ongoing 2-year toxicology study. DNA damage, if not repaired, can potentially lead to tumors. This work was also included in NTP's published Technical Reports, but this study includes analyses of the data in the supporting information not included in the Technical Reports.

NTP scientists found that RFR exposure was associated with an increase in DNA damage. Specifically, they found RFR exposure was linked with significant increases in DNA damage in:

- the frontal cortex of the brain in male mice,
- the blood cells of female mice, and
- the hippocampus of male rats.

There are many factors that influence whether damaged DNA will lead to tumors. NTP plans to conduct additional studies to learn more about how RFR might cause DNA damage. Please see the FAQs below for more information about the specific studies and NTP's cell phone RFR program.

What are the future plans for studying cell phone RFR?

NIEHS scientists in the Division of Translational Toxicology, which supports the National Toxicology Program, are working to better understand some of the findings seen in the earlier Radio Frequency Radiation (RFR) rodent studies. These previous RFR results were reported in NTP Technical reports TR-595 and TR-596.

The goals of the current research efforts into the effects of RFR are to conduct rodent studies to:

- Determine the impact of RFR exposure on behavior and stress, including the real-time assessment of activity and response to system-generated noise and RFR signals.
- Conduct physiological monitoring including evaluation of heart rate.
- Investigate whether RFR induces heating.
- And further evaluate whether RFR exposure causes DNA damage.

To work toward accomplishing these goals:

- Researchers developed and designed a novel customized small-scale RFR exposure system, with flexible capabilities to address a broader range of RFR exposure scenarios than the original system used in the earlier studies. This included building and testing an exposure chamber prototype that could incorporate real-time physiological monitoring on animals during RFR

exposure. Facility modifications had to be made along the way to accommodate installation of the RFR exposure system and the exposures had to be independently evaluated to validate the RFR signals and exposure levels.

- A series of in vivo rodent studies were then designed to assess the suitability of the new exposure system. This included an evaluation of thermal changes in exposed animals with increasing exposure levels, a well-established RFR-mediated effect. These studies would serve to “replicate” short-term studies conducted as part of the published NTP bioassay studies and provide a comparison between the new exposure system and the old exposure system.
- After installation of the chambers and initial testing of the new small-scale exposure system, several technical issues were identified and resolved.

Addressing technical issues and moving forward

Once the issues with the new chambers were addressed, several short-term exposure studies were conducted. Studies were conducted to evaluate approaches to assess physiological changes using real-time monitoring of animals during RFR exposure and to evaluate whether RFR exposure causes DNA damage.

Data from these studies are being evaluated and interpreted and once complete, manuscripts will be written and submitted for peer review. Publications from these studies is expected to occur sometime in 2023-2024.

INFORMATIONAL RESOURCES

Fact Sheet and NIEHS Health Topic
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