

# **5G, CELL TOWERS AND SMALL CELLS**

**SCIENTIFIC RESEARCH**

# CHILDREN'S VULNERABILITY TO WIRELESS RADIOFREQUENCY (RF) RADIATION



## **The American Academy of Pediatrics states:**

"In recent years, concern has increased about exposure to radio frequency (RF) electromagnetic radiation emitted from cell phones and phone station antennas. An Egyptian study confirmed concerns that living nearby mobile phone base stations increased the risk for developing:

- Headaches
- Memory problems
- Dizziness
- Depression
- Sleep problems

Short-term exposure to these fields in experimental studies have not always shown negative effects, but this does not rule out cumulative damage from these fields, so larger studies over longer periods are needed to help understand who is at risk. In large studies, an association has been observed between symptoms and exposure to these fields in the everyday environment."

**-American Academy of Pediatrics  
HealthyChildren.org**

## **Cell towers, cell phones and Wi-Fi emit wireless radiofrequency (RF) radiation.**

Children are more vulnerable to RF radiation, just as they are to other environmental exposures. They have proportionately more exposure to RF compared to adults. More importantly, a child's brain is rapidly developing and more sensitive. Even very low exposures in childhood can have serious impacts later in life.

## **Children absorb higher levels of RF radiation deeper into their brains and bodies because they have:**

- Thinner skulls allow RF radiation to move easier into the brain.
- Higher water content in brain tissue which is more conductive to electricity.
- Smaller heads result in a shorter distance for the RF to travel from the skull to critical brain regions important for learning and memory.

## **Children are more sensitive to RF impacts because:**

- Their brains are still developing.
- Children have more active stem cells- a type of cell scientifically found to be uniquely impacted by RF.
- Children will have a longer lifetime of higher exposures, starting from before they are born.

# 5G IS RECKLESS

**5G Jumbo Pole  
at Hester and Eldridge  
New York City, New York**



**Children's Playground**

## SCIENTISTS ARE RINGING THE ALARM BELL

Hundreds of scientists are warning that safety is not assured with 5G and cell tower proliferation. They caution that FCC cell tower radiation limits do not protect against long term health effects nor do they consider children's unique vulnerability.

5G and the proliferation of cell towers and cell antennas in close proximity to where people live, work and play is increasing ambient radiofrequency radiation levels.

The Los Angeles California School District Office of Health and Safety developed a "cautionary level" for radiofrequency radiation 10,000 times lower than FCC regulations because, "it is believed that a more conservative level is necessary to protect children, who represent a potentially vulnerable and sensitive population."



INTERNATIONAL ASSOCIATION OF FIRE FIGHTERS

Since 2004, the International Association of Firefighters has officially opposed cell towers on their stations "until a study with the highest scientific merit and integrity on health effects of exposure to low-intensity RF/MW radiation is conducted and it is proven that such sitings are not hazardous to the health of our members."

In California, firefighter unions repeatedly and successfully lobbied state lawmakers to remove fire stations from the list of 5G cell tower fast track sites.

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# CELL TOWER RF RADIATION AND CANCER

## International Agency for Research on Cancer



World Health  
Organization

PRESS RELEASE  
N° 208

31 May 2011

### IARC CLASSIFIES RADIOFREQUENCY ELECTROMAGNETIC FIELDS AS POSSIBLY CARCINOGENIC TO HUMANS

Lyon, France, May 31, 2011 -- The WHO/International Agency for Research on Cancer (IARC) has classified radiofrequency electromagnetic fields as [possibly carcinogenic to humans \(Group 2B\)](#), based on an increased risk for [glioma](#), a malignant type of brain cancer<sup>1</sup>, associated with wireless phone use.

## The World Health Organization International Agency for Research on Cancer Classified Radiofrequency Radiation as a "Possible" Carcinogen in 2011

In 2011, radiofrequency electromagnetic fields (RF-EMF) were [classified](#) as a Group 2B possible carcinogen by the World Health Organization's International Agency for Research on Cancer (WHO/IARC).

The WHO/IARC scientists clarified that this determination was for RF-EMF from any source be it cell phones, wireless devices, cell towers or any other type of wireless equipment.

Since 2011, the published peer-reviewed scientific evidence associating RF-EMF (also known as RF-EMR and RFR) to cancer and other adverse effects has significantly increased.

A large-scale [animal study](#) published in Environmental Research found rats exposed to RF levels comparable to cell tower emissions had elevated cancers, the very same cancers also found in the US National Toxicology Program animal study of cell phone level RF [that found](#) "clear evidence" of cancer in carefully controlled conditions ([Falcioni 2018](#)).

In 2019 and 2024, the WHO/IARC advisory committee [recommended](#) that radiofrequency radiation be re-evaluated as a "high" priority in light of the new research. To date no meetings have been set.

Currently, several scientists conclude that the weight of currently available, peer-reviewed evidence supports the conclusion that radiofrequency radiation is a proven human carcinogen ([Hardell and Carlberg 2017](#), [Peleg et al. 2022](#), [Miller et al. 2018](#)).

# SCIENTIFIC RESEARCH STUDIES



European Parliament's requested 2021 report "[Health Impact of 5G](#)" and concluded that commonly used RFR frequencies (450 to 6000 MHz) are probably carcinogenic for humans and clearly affect male fertility with possible adverse effects on the development of embryos, fetuses and newborns.

A review entitled "[Evidence for a health risk by RF on humans living around mobile phone base stations: From radiofrequency sickness to cancer](#)" reviewed the existing scientific literature and found radiofrequency sickness, cancer and changes in biochemical parameters ([Balmori et.al., 2022](#)).

A [study](#) published in Electromagnetic Biology and Medicine found changes in blood considered biomarkers predictive of cancer in people living closer to cell antenna arrays ([Zothansiyama et al., 2017](#)). A 2024 study found higher chromosomal aberrations (non-repairable, permanent indicators of genotoxic effects) in the blood of people with higher RF exposures ([Gulati et al., 2024](#)).

A [study](#) published in the International Journal of Environmental Research and Public Health found higher exposure to cell network arrays linked to higher mortality from all cancer and specifically lung and breast cancer ([Rodrigues et. al., 2021](#)).

A 10-year [study](#) published in Science of the Total Environment by the local Municipal Health Department and universities in Brazil found a clearly elevated relative risk of cancer mortality at residential distances of 500 meters or less from towers ([Dode et. al., 2011](#)).

A [study](#) commissioned by the Government of Styria, Austria found a significant cancer incidence in the area around the RF transmitter as well as significant exposure-effect relationships between RF radiation exposure and the incidence of breast cancers and brain tumors ([Oberfeld 2008](#)).

A [review](#) published in Experimental Oncology found "alarming epidemiological and experimental data on possible carcinogenic effects of long term exposure to low intensity microwave (MW) radiation." A year of operation of a powerful base transmitting station for mobile communication reportedly resulted in a dramatic increase of cancer incidence among the population living nearby ([Yakymenko 2011](#)).

# PUBLISHED RESEARCH STUDIES

## OUTDOOR LEVELS OF RF ARE INCREASING DUE TO THE DENSIFICATION OF WIRELESS NETWORKS

An [article](#) published in *The Lancet Planetary Health* documents how RF exposures are increasing and so is the scientific research linking exposure to adverse biological effects. [“It is plausibly the most rapidly increasing anthropogenic environmental exposure since the mid-20th century...”](#)

A [2021 report](#) by the French government on 5G analyzed more than 3,000 measurements and found that while RF levels had *not yet* significantly increased, this was due to the lack of 5G traffic. Additional study specific to 5G in the 3500 MHz band with artificially generated traffic concluded that, “initial results suggest an eventual increase of about 20% in overall exposure.”

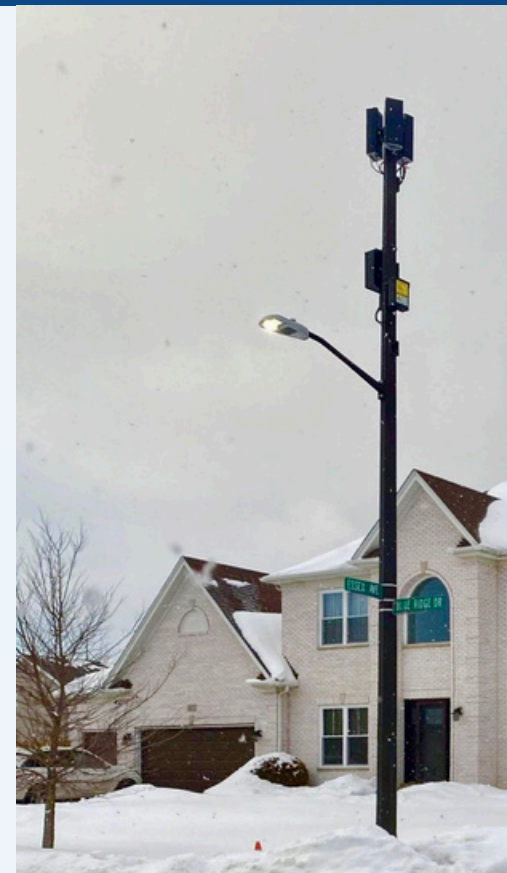
A [2018 multi-country study](#) published in *Environment International* measured RF in several countries and found cell tower/base station radiation to be the dominant contributor to RF exposure in most outdoor areas. Urban areas had higher RF.

A [study](#) measuring RF exposure in the European cities of Basel, Ghent and Brussels found the total RF exposure levels in outdoor locations had increased up to 57.1% in one year (April 2011 to March 2012) and most notably due to mobile phone base stations.

A [2018 study](#) published in *Oncology Letters* documented “unnecessarily high” RF levels in several locations in Sweden and concludes that “using high-power levels causes an excess health risk to many people.”

A [2017 Swedish](#) study of Royal Castle, Supreme Court, three major squares and the Swedish Parliament found that despite the architecturally camouflaged RF-emitting antennas, the passive exposure was higher than RF levels associated with non-thermal biological effects. The researchers noted that the heaviest RF load falls on people working or living near hotspots.

A [2016 study](#) at Stockholm Central Railway Station in Sweden documented higher RF levels in areas where base station antennas were located closest to people. Importantly, the RF from the downlink of UMTS, LTE, GSM base station antennas contributed to most of the radiation levels.

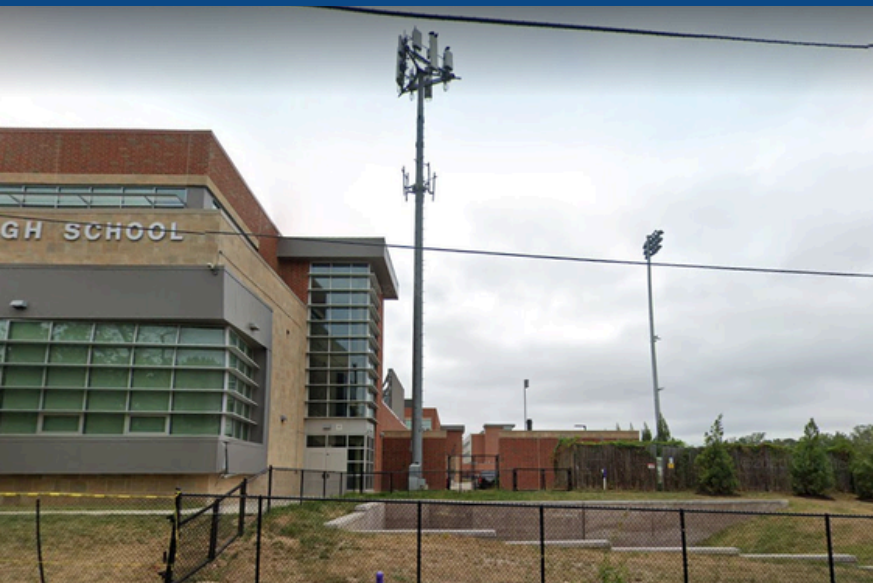


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# PUBLISHED RESEARCH STUDIES



## RESEARCHERS RECOMMEND CELL TOWERS BE DISTANCED AWAY FROM HOMES AND SCHOOLS

The review paper entitled “[Limiting liability with positioning to minimize negative health effects of cellular phone towers](#)” reviewed the “large and growing body of evidence that human exposure to RFR from cellular phone base stations causes negative health effects.” The authors recommend restricting antennas near homes, and restricting antennas within 500 meters of schools and hospitals to protect companies from future liability ([Pearce 2020](#)).

An [analysis](#) of 100 studies published in *Environmental Reviews* found approximately 80% showed biological effects near towers. “As a general guideline, cell base stations should not be located less than 1500 ft from the population, and at a height of about 150 ft” ([Levitt 2010](#)).

A [review](#) published in the *International Journal of Occupational and Environmental Health* found people living less than 500 meters from base station antennas had increased adverse neuro-behavioral symptoms and cancer in eight of the ten epidemiological studies ([Khurana 2010](#)).

A [paper](#) by human rights experts published in *Environment Science and Policy* documented the accumulating science indicating safety is not assured, and considered the issue within a human rights framework to protect vulnerable populations from environmental pollution. “We conclude that, because scientific knowledge is incomplete, a precautionary approach is better suited to State obligations under international human rights law” ([Roda and Perry 2014, PDF](#)).

# APARTMENTS & CONDO BUILDINGS

## INCREASED RF RADIATION FROM CELL ANTENNAS



The study "[Radiofrequency radiation from nearby mobile phone base stations-a case comparison of one low and one high exposure apartment](#)" published in *Oncology Letters* by [Koppel et al. \(2019\)](#) measured 2 apartments and found that the apartment with high RF levels had outdoor areas as close as 6 meters (about 19.6 feet) from transmitting base station cell antennas. In contrast, the apartment with low RF exposure had cell antennas at 40 meters (about 131 feet) away from the balcony.

Furthermore, the researchers also found that both high- and low-RF apartments had good mobile phone reception, and they concluded, "therefore, installation of base stations to risky places cannot be justified using the good reception requirement argument."

A measurement study by [Baltrėnas et al. \(2012\)](#) published in *Journal of Environmental Engineering and Landscape Management* investigated RF power density levels from cell phone antennas located 35 meters away from a 10-story apartment building. The transmitting antennas were approximately at the same height as the 6th floor of the building. The researchers found the highest RF levels at floors 5, 6 and 7. The RF at the 6th floor balcony was three times higher than the 3rd floor balcony. The RF power density at the 6th floor was about 15 times the RF measured at the first floor.

A [case report by Hardell et al. \(2017\)](#) of RF levels in an apartment in close proximity to rooftop cellular network antennas used an exposimeter to measure levels of different types of RF in the apartment and balconies including TV, FM, TETRA emergency services, 2G GSM, 3G UMTS, 4G LTE, DECT cordless, Wi-Fi 2.4 GHz and 5 GHz and WiMAX. The closest transmitting antennas were 6 meters away from the balcony. The researchers found 97.9% of the mean RF radiation was caused by downlink from the 2G, 3G and 4G base stations. (Downlink means frequencies emitted "down" from the base station cellular antennas.) The researchers found that if the base station RF emissions were excluded, the RF radiation in the children's bedrooms was reduced approximately 99%.

The researchers conclude, "due to the current high RF radiation, the apartment is not suitable for long-term living, particularly for children who may be more sensitive than adults."



# INCREASED EXPOSURE FROM 5G/4G "SMALL" CELL ANTENNAS LOCATED CLOSE TO PEOPLE

A study entitled "[Very high radiofrequency radiation at Skeppsbron in Stockholm, Sweden from mobile phone base station antennas positioned close to pedestrians' heads](#)" published in *Environmental Research* by Koppel et al. (2022) created an RF heat map of RF measurements, finding that the highest RF measurements were in areas of close proximity to the base station antennas. The researchers concluded with recommendations to reduce close proximity placements such as positioning antennas "as far as possible from the general public" like in high-elevation locations or more remote areas.

A study entitled "[Measurements of radiofrequency electromagnetic fields, including 5G, in the city of Columbia, South Carolina, USA](#)" published in the *World Academy of Sciences Journal* found the highest RF levels in areas where the cell phone base station antennas were placed on top of utility poles, street lamps, traffic lights or other posts near to the street. The scientists compared their [2022 findings](#) to an earlier [2019 published review](#) on the mean outdoor exposure level of European cities and they found the South Carolina measurements to be higher.

The researchers concluded that the highest exposure areas were due to two reasons: cell phone base antennas on top of high-rise buildings provide "good cell coverage reaching far away, but creating elevated exposure to the radiofrequency electromagnetic fields at the immediate vicinity; and cell phone base station antennas installed on top of utility poles have placed the radiation source closer to humans walking on street level."



Figure 7. Gervais Street: Cell phone base station antenna placed close to street level and causing high exposure to pedestrians and nearby café visitors (exposure scenario illustration). The antenna appears camouflaged and seemingly part of a utility pole. The measurer only discovered the antenna due to the high radiofrequency levels in the vicinity.

# HEALTH SYMPTOMS REPORTED BY PEOPLE LIVING CLOSE TO CELL ANTENNAS

Image: Figure 1: Top floor apartment adjacent to base stations. Nilsson M, Hardell L. (2023) Development of the Microwave Syndrome in Two Men Shortly after Installation of 5G on the Roof above their Office. Ann Clin Case Rep



## RESEARCH ON ANTENNAS CLOSE TO HOMES, SCHOOL AND WORK

Surveys of people living near cell tower antennas in [France](#), [Spain](#), [India](#), [Germany](#), [Egypt](#), [Poland](#) have found significantly higher reports of health issues including sleep issues, fatigue and headaches.

A [study](#) published in *American Journal of Men's Health* linked higher cell tower RFR exposures to delayed fine and gross motor skills and to deficits in spatial working memory and attention in school adolescents.

A [study](#) published in *Environmental Research and Public Health* found higher exposures linked to higher risk of type 2 diabetes.

A [study](#) following people for 6 years linked increased cell phone and cell phone tower antenna exposure to altered levels of hormones including cortisol, thyroid, prolactin and testosterone.

A [study](#) that followed people in a German town after a cell tower was erected found stress hormones adrenaline and noradrenaline significantly increased over the first 6 months after the antenna activation and decreased dopamine and PEA levels after 18 months ([Buchner 2011](#)).

Three published case reports document illness that developed after 5G antennas were installed. A 52-Year healthy woman developed severe microwave syndrome shortly [after installation of a 5G base station](#) close to her apartment.

In another case report, a couple developed [microwave syndrome symptoms](#) (e.g., neurological symptoms, tinnitus, fatigue, insomnia, emotional distress, skin disorders, and blood pressure variability) after a 5G base station was installed on the roof above their apartment.

Similarly, in [“Development of the Microwave Syndrome in Two Men Shortly after Installation of 5G on the Roof above their Office”](#) two men developed symptoms after 5G antennas were activated on the roof of their workplace. The symptoms disappeared in both men within a couple of weeks (case 1) or immediately (case 2) after leaving the office.

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# PUBLISHED RESEARCH ON 5G



New York City Jumbo 5G poles with 5 tiers to house transmitting antennas from numerous carriers.



Cell antennas in front of New York City living room window.

## Scientists state that 5G's higher frequencies cannot be assumed safe.

5G systems are using low band frequencies well associated with harmful effects ([ICBE-EMF 2022](#), [European Parliament 2021](#), [Panagopoulos et al. 2021](#)). However 5G networks are also using higher frequencies such as 3.5 GHz and into the mmWave range with 24 GHz and higher.

Contrary to claims that the 5G's higher frequencies simply "bounce" off the skin, researchers have documented that the coiled portion of the skin's sweat duct can be regarded as a helical antenna in the sub-THz band and the skin, our largest organ, can intensely absorb the higher 5G frequencies ([Feldman and Ben Ishai 2017](#)).

Reviews of 5G health effects caution that the expected real-world impact would be far more serious due to the complex waveforms and other combinations with other toxic stimuli in the environment ([Kostoff et al 2020](#), [Russell, 2018](#), [Belyaev 2019](#), [McCredde et al 2023](#)).

Researchers will often experiment with zebrafish, rodents and fruit flies to gain data on potential health effects to humans. An Oregon State University study on zebrafish exposed to 3.5 GHz ([Dasgupta et al. 2022](#)) found "significant abnormal responses in RFR-exposed fish" which "suggest potential long-term behavioral effects. Yang et al 2022 found 3.5 GHz induced oxidative stress in guinea pigs.

A study on 3.5 GHz exposure to both diabetic and healthy rats ([Bektas et al 2022](#)) found an increase in degenerated neurons in the hippocampus of the brains, changes in oxidative stress parameters and changes in the energy metabolism and appetite of both healthy and diabetic rats. The researchers conclude that, "5G may not be innocent in terms of its biological effects, especially in the presence of diabetes."

# PUBLISHED RESEARCH ON 5G



5G's higher frequencies will be combined with the lower frequencies from current networks already present in the environment.

Studies on rats have found exposure to both 1.5 and 4.3 GHz microwaves induced: cognitive impairment and hippocampal tissue damage ([Zhu et al 2021](#)); impairments in spatial learning and memory, *with the combined simultaneous exposures* resulting in the most most severe effects ([Wang et al 2022](#)); and immune suppressive responses ([Zhao 2022](#)).

Long-term exposure to 2.856 and 9.375 GHz microwaves impaired learning and memory abilities as well as EEG disturbance, structural damage to the hippocampus, and differential expression of hippocampal tissue and serum exosomes ([Wang et al. 2023](#)).

Studies on fruit flies exposed to 3.5 GHz have found the exposure led to increases in oxidative stress, changes in the microbial community ([Wang et al 2022](#)) and alterations of the expression of several types of genes (Wang et al 2021).

A review by [Russell 2018](#) found evidence for millimeter wave effects to the skin, eyes, immune system, gene expression, and bacterial antibiotic resistance.

Recent experimental research on high-band 5G impacts to animal fertility found that 27 GHz damages sperm quality in mussels ([Pecoraro et al 2023](#)).

Yet the US government is not funding any research on biological effects of frequencies at 3.5 GHz or above 6 GHz to humans.

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