

**Cell phones and brain tumors:
A review including the long-term epidemiologic data**

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This article has 68 references. An editorial comment ascribed to this study indicates that it is "the most comprehensive study and analysis to date of this topic."

FROM ABSTRACT

Background: The debate regarding the health effects of low-intensity electromagnetic radiation from sources such as power lines, base stations, and cell phones has recently been reignited.

In the present review, the authors attempt to address the following question: is there epidemiologic evidence for an association between long-term cell phone usage and the risk of developing a brain tumor? Included with this meta-analysis of the long-term epidemiologic data is a brief overview of cell phone technology and discussion of laboratory data, biological mechanisms, and brain tumor incidence.

Methods: In order to be included in the present meta-analysis, studies were required to have met all of the following criteria:

- 1) Publication in a peer-reviewed journal.
- 2) Inclusion of participants using cell phones for ≥ 10 years.
- 3) Incorporation of a "laterality" analysis of long-term users (ie, analysis of the side of the brain tumor relative to the side of the head preferred for cell phone usage).

This is a meta-analysis incorporating all 11 long-term epidemiologic studies in this field.

Results: The results indicate that using a cell phone for ≥ 10 years approximately doubles the risk of being diagnosed with a brain tumor on the same ("ipsilateral") side of the head as that preferred for cell phone use. The data achieve statistical significance for glioma and acoustic neuroma but not for meningioma.

Conclusion: The authors conclude that there is adequate epidemiologic evidence to suggest a link between prolonged cell phone usage and the development of an ipsilateral brain tumor.

THESE AUTHORS ALSO NOTE:

First generation (1G) cell phones began in Sweden in 1981. They used analogue technology at 450 MHz.

Second generation (2G) cell phones started in 1991, and used digital technology termed "global system for mobile communication (GSM). Radio waves emitted by these GSM handsets have a peak power of 1 to 2 watts (W).

The third generation (3G) cell phones will use code division multiple access (CDMA) and time division multiple access (TDMA) technology, using 800 and 1900 MHz. These 3G use less than 0.25 W of peak power.

The power generated by a cell phone will vary according to the amount of interference with the signal. Higher power is required when using a cell phone in a moving vehicle, within a building, or in an elevator.

“The output power of the phone is generally set to the highest level during ‘handovers’ between networked base stations as a user moves from one geographic area to another or when signal interference is greatest.”

“It should be noted that cordless phones operate as transmitters and receivers like GSM cell phones despite shorter signal distances to the home desktop base station. Although such phones have lower peak power than cell phones, user call times tend to be longer. Furthermore, because of adaptive power control of cell phones, the average power output of cordless phones is comparable to cell phones at least in urban areas.”

Cell phone base stations emit electromagnetic radiation (EMR) continuously at far greater power than cell phones.

Cell phones emit electromagnetic radiation (EMR) only during calls.

Within the electromagnetic field, gamma rays, cosmic rays, and x-rays are all dangerous to humans and other organisms because they carry short-wavelengths which cause ionizing radiation with an ability to break intermolecular bonds.

Cell phone systems act in a range close to that of a microwave oven but with much less power output.

Cell phone systems are supposedly safe because of the lower-energy they carry, associated with the long-wavelength they use, which are nonionizing. They lack sufficient energy to break intermolecular bonds.

The intensity of electromagnetic radiation exposure from cell phones varies with the antenna type and position, head morphology, the distance between the phone and the head, and the power output of the phone that can vary.

“Irrespective of the type of phone, exposure is highest on the side of the head against which the cell phone is held and appears to be even higher in children owing to thinner scalps and skulls, increased water content of their brain, and lower brain volume.”

In this study, the authors comprehensively searched the PubMed database up to December 1, 2008. They found 11 studies meeting their inclusion criteria.

This analysis “shows that long-term cell phone usage can approximately double the risk of developing a glioma or acoustic neuroma in the more exposed (ipsilateral) brain hemisphere and does not protect the less-exposed (contralateral) brain hemisphere against developing a tumor.”

“There appears to be a statistically significant effect of cell phone usage in terms of tumor type and laterality, latency, and cumulative use of the phone in hours.”

“Science Magazine has recently acknowledged that there are several peer-reviewed studies from laboratories in at least 7 countries including the United States, showing that cell phone or similar low-intensity EMF can (contrary to expectations of non-ionizing sources) break DNA or modulate it structurally.”

“Many independent laboratory investigations have suggested adverse biologic effects of cell phone radiation.” (12 references)

The authors present evidence that cell phones can be DNA-damaging as a consequence of “nonthermal interaction between incoming microwaves and exquisitely sensitive oscillatory electrical processes found in living tissues.” “This is akin to the reception of a clock radio being susceptible to interference from a nearby cell phone.” This “oscillatory similitude may lead to genetic or epigenetic damage through increased local production of reactive oxygen species or free radicals.” **[Wow!]**

“There are several hundred studies that support the existence of low-intensity, non-thermal effects of cell phone radiation on biological systems. The consequences are mostly adverse: DNA single- and double-strand damage, changes in gene transcription, changes in protein folding, heat shock protein generation, production of free radicals, and effects on the immune system.”

CLINICAL IMPLICATIONS

“Taken together, the long-term epidemiologic data suggest an increased risk of being diagnosed with an ipsilateral brain tumor related to cell phone usage of 10 years or more.”

There is also “significantly elevated odds for the development of ipsilateral parotid gland tumors among heavy cell phone users.”

The Central Brain Tumor Registry of the United States maintains comprehensive tumor incidence rates in the USA, and their data shows an increase in incidence of brain tumors of about 36% in less than a decade. This increase is not explained by an ageing population (because these figures were age-adjusted) or by better detection.

CONCLUSIONS

"The authors believe that the aforementioned epidemiologic and laboratory findings underscore the need for reassessment by governments worldwide of cell phone and also most radiation exposure standards and the usage and deployment of this technology. If the epidemiologic data continue to be confirmed, then in the absence of appropriate and timely intervention and given the increasing global dependence on cell phone technology especially among the young generation, it is likely that neurosurgeons will see increasing numbers of primary brain tumors, both benign and malignant."

KEY POINTS FROM DAN MURPHY

- 1) This article has 68 references. An editorial comment ascribed to this study indicates that it is "the most comprehensive study and analysis to date of this topic."
- 2) These authors found 11 long-term studies in the PubMed database of participants using cell phones for ≥ 10 years.
- 3) "The results indicate that using a cell phone for ≥ 10 years approximately doubles the risk of being diagnosed with a brain tumor on the same ("ipsilateral") side of the head as that preferred for cell phone use."
- 4) "The authors conclude that there is adequate epidemiologic evidence to suggest a link between prolonged cell phone usage and the development of an ipsilateral brain tumor."
- 5) The power [and danger] generated by a cell phone will vary according to the amount of interference with the signal. Higher power is required when using a cell phone in a moving vehicle, within a building, or in an elevator.
- 6) "The output power [and danger] of the phone is generally set to the highest level during 'handovers' between networked base stations as a user moves from one geographic area to another or when signal interference is greatest."
- 7) Evidence presented suggests that cordless phones are also not safe.
- 8) Cell phones emit electromagnetic radiation only during calls.
- 9) Cell phone systems have been presumed to be safe because their longer wavelengths are nonionizing, lacking sufficient energy to break intermolecular bonds. Therefore, their increased cancer risk is not as a consequence of ionization.
- 10) "Science Magazine has recently acknowledged that there are several peer-reviewed studies from laboratories in at least 7 countries including the United States, showing that cell phone or similar low-intensity electromagnetic fields can (contrary to expectations of non-ionizing sources) break DNA or modulate it structurally."

- 11) "Irrespective of the type of phone, exposure is highest on the side of the head against which the cell phone is held and appears to be even higher in children owing to thinner scalps and skulls, increased water content of their brain, and lower brain volume."
- 12) "Many independent laboratory investigations have suggested adverse biologic effects of cell phone radiation." (12 references)
- 13) The authors present evidence that cell phones can be DNA-damaging as a consequence of "nonthermal interaction between incoming microwaves and exquisitely sensitive oscillatory electrical processes found in living tissues." "This is akin to the reception of a clock radio being susceptible to interference from a nearby cell phone." This "oscillatory similitude may lead to genetic or epigenetic damage through increased local production of reactive oxygen species or free radicals." **[Wow!]**
- 14) "There are several hundred studies that support the existence of low-intensity, non-thermal effects of cell phone radiation on biological systems. The consequences are mostly adverse: DNA single- and double-strand damage, changes in gene transcription, changes in protein folding, heat shock protein generation, production of free radicals, and effects on the immune system."
- 15) "Taken together, the long-term epidemiologic data suggest an increased risk of being diagnosed with an ipsilateral brain tumor related to cell phone usage of 10 years or more."
- 16) There is also "significantly elevated odds for the development of ipsilateral parotid gland tumors among heavy cell phone users."
- 17) The Central Brain Tumor Registry of the United States maintains comprehensive tumor incidence rates in the USA, and their data shows an increase in incidence of brain tumors of about 36% in less than a decade. This increase is not explained by an ageing population (because these figures were age-adjusted) or by better detection.
- 18) "The authors believe that the aforementioned epidemiologic and laboratory findings underscore the need for reassessment by governments worldwide of cell phone and also most radiation exposure standards and the usage and deployment of this technology. If the epidemiologic data continue to be confirmed, then in the absence of appropriate and timely intervention and given the increasing global dependence on cell phone technology especially among the young generation, it is likely that neurosurgeons will see increasing numbers of primary brain tumors, both benign and malignant."