



Prevention and Early Detection

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Cellular Phones

Cellular (cell) phones are a relatively new technology that became widely used in the United States only in the 1990s. Although they have been studied extensively, we don't yet have information on the potential health effects of very long-term use or usage by children. Cell phones wouldn't be expected to cause cancer because they don't emit ionizing radiation.

Periodic reports exist that have observed an association between cell phone use and the risk of brain cancer, but these reports are primarily based on small studies in Sweden. But the weight of the evidence, which is based on larger studies, has shown no association between cell phone use and brain cancer. Studies currently in progress such as the European Interphone Study will provide more information on this subject. For now, the Food and Drug Administration Center for Devices and Radiological Health and the Federal Communications Commission offers the following advice to people concerned about cell phone use and risk:

If there is a risk from these products -- and at this point we do not know that there is -- it is probably very small. But if you are concerned about avoiding even potential risks, you can take a few simple steps to minimize your exposure to radiofrequency energy (RF). Since time is a key factor in how much exposure a person receives, reducing the amount of time spent using a wireless phone will reduce RF exposure. If you must conduct extended conversations by wireless phone every day, you could place more distance between your body and the source of the RF, since the exposure level drops off dramatically with distance. For example, you could use a headset and carry the wireless phone away from your body or use a wireless phone connected to a remote antenna.

Background

Recent media attention has focused on a possible link between cell phone use and brain cancer, originally because of a lawsuit that alleged such a link. Network news programs ran their own tests of cell phones, reporting to the public that some of them exceed the maximum level of emitted radiofrequency (RF) energy allowed by the US Federal Communications Commission (FCC).

The Cellular Telecommunications & Internet Association estimated that there were 219 million US cell phone subscribers in mid-2006. Based on the large and still rapidly growing number of cell phone users, and the seriousness of brain tumors, this is clearly a topic of wide concern. This document summarizes what we now know about the carcinogenicity (cancer-causing potential) of using cell phones.

How do cell phones work?

Cell phones operate with radio frequencies (RF), a form of energy located on the electromagnetic spectrum between FM radio waves and the waves used in microwave ovens, radar, and satellite stations. Cell phones do not emit ionizing radiation, the type that damages DNA and is known to have the ability to cause cancer.

Cell phone technology works on a system of geographically separated zones called "cells." Each cell has its own "base station" that both receives and emits radio waves. When a call is placed from a cell phone, a signal is sent from the cell phone antenna to that cell's base station antenna. The base station responds to the cell phone signal by assigning the phone an available RF channel. When the RF channel is assigned, radio signals are simultaneously received and transmitted, allowing voice information to be carried between the cell phone and the base. The base station transfers the call to a switching center, where the call can be transferred to a local telephone carrier or another cell phone.

There are 2 types of wireless phones:

- cordless
- mobile

Cordless phones, commonly used in homes, have base units that are plugged into telephone jacks and wired to a local telephone service; these are not considered "cell" phones. The question of health risks associated with cordless phones, which operate at 1/600 the power of cell phones, has not been raised.

Mobile phones are also known as "cell phones." The antennas of these phones are integrated into the body of the phone. Because the antenna of a mobile phone is close to the phone user's head, mobile phones pose greater RF exposure than the other types of cordless phones.

How are people exposed?

Many factors affect the amount of RF to which a person is exposed. The number of "cells" in a geographical area depends on the cell phone traffic in that area. For example, large cities may have many cells per square mile, whereas a less-populated, rural area may have a single large cell stretching over several square miles. The farther away a cell phone antenna is from its base station, the higher the power level needed to maintain the connection. Smaller cells are therefore associated with much lower exposures.

Each geographical cell has a different number of available channels. Cell phones operate ideally with the least amount of interference from neighboring channels. To help achieve the best operation, cell phones automatically step down to the lowest power level available that still maintains a connection with the base station. On the other hand, any physical obstacle, such as buildings or trees, interfering with the connection forces the base station to increase the power sent to the phone. Therefore, the amount of power sent from a base station to a particular cell phone can vary, even within a single call. For additional information on base stations, please see the American Cancer Society document, [Cellular Phone Towers](#).

Cell phone makers are required to report the specific absorption rate (SAR) of their product to the FCC. The SAR is the amount of RF energy

absorbed from the phone into the user's local tissues. The upper limit of SAR allowed is 1.6 watts per kilogram (W/kg) of body weight. Exposure to RF also depends on the duration and frequency of cell phone use, with more use implying more exposure. Finally, older cell phones (analog models) involve higher exposure than newer, digital equipment.

Do cell phones cause brain cancer?

What studies in humans suggest

Because widespread cell phone use is little more than a decade old, there has been limited opportunity to examine its long-term health effects. However, large case-control studies and cohort studies have compared cell phone use among brain cancer patients and people without brain cancer. In each of the case-control studies, patients with brain cancer were compared to people free of brain cancer, in terms of their past use of cell phones. If the patients reported more cell phone use than those in the study who did not have brain cancer, and if no other differences between the 2 groups could account for the brain cancers, these observations would provide evidence of a possible link between cell phones and brain cancer. The majority of case-control studies have yielded similar results:

- First, the patients with brain cancer did not report more cell phone use overall than the controls. This finding was true when all brain cancers were considered as a group, when individual types of brain cancer were considered, and when specific locations within the brain were considered. In fact, most of the studies showed a tendency toward a lower risk of brain cancer among cell phone users, for unclear reasons.
- Second, none of the studies showed a "dose-response relationship" -- a tendency for the risk of brain cancer to increase with increasing cell phone use, which would be expected if cell phone use caused brain cancer.
- Third, the studies did not show a clear link between the side of the head on which the brain cancer occurred and the side on which the cell phone was used (with the possible exception of the Swedish study).

Recent results from the Swedish Interphone study of long-term cell phone use, using a population-based case control design indicate the same conclusions. There was no association with risk of any of the brain tumor types studied (glioma or meningioma), or with duration of use, side of use, or amount of use.

Results of the long-term cohort study, which linked data on all of the 420,095 cell phone users in Denmark between 1982 and 2002 to the Danish Cancer Registry, agree with the findings of the case-control studies. Cell phone use, even for more than 10 years, was not associated with an increased risk of developing brain tumors or cancer overall, nor was there an association with any brain tumor subtypes or with tumors in any location within the brain. As in the case-control studies, no link was found between brain tumor risk and RF dose, as assessed by length of cell phone use, date since first subscription, age at first subscription, or type of cell phone used.

However, these published studies have only limited ability to examine the

association between cell phone use and specific subtypes of brain cancer. One subtype that has been studied is acoustic neuroma, a relatively rare, slow-growing tumor of the acoustic nerve (which transmits the sensation of hearing from the ear to the brain) that occurs in less than one adult per 100,000 people per year. At least 9 epidemiological studies have looked for an association between the use of cell phones and acoustic neuroma. Results of these studies have been inconsistent, due largely to variations in study design and statistical challenges posed by the rarity of these tumors. One of the largest and most recent studies analyzed data from the 5 northern European countries, and found no relation of acoustic neuroma risk with cell phone use, duration of use, or number of calls made. According to the researchers, "The study suggested there is no substantial risk of acoustic neuroma in the first decade after starting mobile phone use. However, an increase in risk after longer term use or after a longer lag period could not be ruled out."

In summary, there is now considerable epidemiologic evidence that shows no consistent association between cell phone use and overall risk of brain cancer. Some uncertainty remains regarding a possible association with acoustic neuromas. Several large studies now in progress will add markedly to the evidence within a few years.

What the animal and laboratory evidence suggests

Most but not all laboratory studies have reported a lack of RF-induced DNA damage. No increase in spontaneous brain tumors was observed in 2 studies of rats exposed to RF. The risk of lymphoma after radiation in rodents genetically altered to be especially sensitive to cancer-causing influences was increased following whole-body RF exposure.

What do expert agencies say?

Based on animal and human evidence like the examples above, expert agencies have evaluated the cancer-causing potential of cell phone use.

In October 1999, the Center for Devices and Radiological Health (CDRH), part of the U.S. Food and Drug Administration (FDA), responded to increased media focus on cell phones and brain cancer by issuing a Consumer Update on Mobile Phones (including cell phones). In its statement, the CDRH stated, "The available science does not allow us to conclude that mobile phones are absolutely safe, or that they are unsafe. However, the available scientific evidence does not demonstrate any adverse health effects associated with the use of mobile phones."

The FCC issued a statement in October 1999 in response to media assertions that some mobile phones exceed the maximum level of emitted radiation permitted. Claiming support from the Food and Drug Administration, the Environmental Protection Agency, the National Institute for Occupational Safety and Health, and the Occupational Safety and Health Administration, the FCC stated that its guidelines "already incorporate a large margin of safety between allowed levels of exposure and exposure thresholds that have been identified with known adverse health effects." The excess levels of exposure reported by the media were "well within that safety margin, and, therefore, there is no indication of any immediate threat to human health from these phones." The FCC is currently undertaking new research to verify the safety of RF levels emitted from mobile phones.

A recent consumer information document issued jointly by the FDA and FCC reaches the same conclusions:

The available scientific evidence does not show that any health problems are associated with using wireless phones. There is no proof, however, that wireless phones are absolutely safe. Wireless phones emit low levels of radiofrequency energy (RF) in the microwave range while being used. They also emit very low levels of RF when in the stand-by mode. Whereas high levels of RF can produce health effects (by heating tissue), exposure to low-level RF that does not produce heating effects causes no known adverse health effects. Many studies of low level RF exposures have not found any biological effects. Some studies have suggested that some biological effects may occur, but such findings have not been confirmed by additional research. In some cases, other researchers have had difficulty in reproducing those studies, or in determining the reasons for inconsistent results.

The United States Environmental Protection Agency (EPA), National Toxicology Program (NTP), and the International Agency for Research on Cancer (IARC), 3 of the main exposure classifying agencies, have not evaluated the carcinogenicity (cancer-causing potential) of cell phone use.

Do cell phones cause any other health problems?

To date, no claims have been made that cell phones are responsible for any other health problems. A small epidemiologic study from Germany found an association between uveal melanoma (a rare form of eye cancer) and exposure to mobile phones and other RF-transmitting devices, but this has not yet been examined in other studies. However, evidence has shown that the use of cell phones while driving increases the risk of automobile crashes. Another concern, without much evidence one way or the other, is that cell phones may interfere with medical electronic devices such as pacemakers and insulin pumps.

Can I do anything to lower my exposure to RF from cell phones?

Cell phone users who wish to lower exposure to RF emissions from cell phones may choose to use a corded or cordless earpiece when using their phone. Using an earpiece moves the device away from the user's head, which decreases the amount of radiation that reaches the body. Corded earpieces emit virtually 0 RF emissions, and Bluetooth® earpieces have an SAR value of around 0.001 watts/kg (less than one thousandth the SAR limit for cell phones as set by the FDA and FCC).

Cell phone users can also choose a phone with a low SAR value. According to the FDA,

Information on SAR for a specific phone model can be obtained for many recently manufactured phones using the FCC identification (ID) number for that model. The FCC ID number is usually printed somewhere on the case of the phone. Sometimes it may be necessary to remove the battery pack to find the number. Once you have the ID number, go to the following Web address: www.fcc.gov/oet/fccid. On this page, you will see instructions for entering the FCC ID number.

The FDA also provides information regarding hands-free kits and accessories that claim to shield the head from RF exposure:

Since there are no known risks from exposure to RF emissions from wireless phones, there is no reason to believe that hands-free kits reduce risks. Hands-free kits can be used with wireless phones for convenience and comfort. These systems reduce the absorption of RF energy in the head because the phone, which is the source of the RF emissions, will not be placed against the head. On the other hand, if the phone is mounted against the waist or other part of the body during use, then that part of the body will absorb more RF energy.

Some products that claim to shield the user from RF absorption use special phone cases, while others involve nothing more than a metallic accessory attached to the phone. Studies have shown that these products generally do not work as advertised. Unlike 'hands-free' kits, these so-called 'shields' may interfere with proper operation of the phone. The phone may be forced to boost its power to compensate, leading to an increase in RF absorption.

Additional resources

National organizations and Web sites*

In addition to the American Cancer Society, other sources of patient information and support include:

Federal Communications Commission
RF Safety Program, Office of Engineering and Technology
Web site: www.fcc.gov/oet/rfsafety/

Food and Drug Administration
Cell Phone Facts: Consumer Information on Wireless Phones
Web site: www.fda.gov/cellphones/

National Institute of Environmental Health Sciences
Web site: www.niehs.nih.gov

World Health Organization
International Commission on Non-Ionizing Radiation Protection (select Qs & As)
Web site: www.who.int/emf

** Inclusion on this list does not imply endorsement by the American Cancer Society.*

No matter who you are, we can help. Contact us anytime, day or night, for cancer-related information and support. Call us at **1-800-ACS-2345** or visit www.cancer.org.

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