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# CANCER FACTS

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National Cancer Institute • National Institutes of Health  
Department of Health and Human Services

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## Cellular Telephone Use and Cancer

Recently, there has been concern that the use of hand-held cellular telephones may be linked with an increased risk of cancer. In response to this concern, and the rapidly rising number of cellular telephone users worldwide, studies have been conducted to determine whether there is an association between cellular telephone use and an increased risk of certain types of cancer. Although the majority of these studies have not supported any such association, scientists caution that more research needs to be done before conclusions can be drawn about the risk of cancer from cellular telephones.

### Concerns About Cellular Telephone Use and Human Health

The number of people using cellular telephones has risen dramatically during the past decade, and is expected to continue increasing. According to the Cellular Telecommunications Industry Association (CTIA), there are currently over 110 million wireless telephone users in the United States. This number is increasing at a rate of about 46,000 new subscribers per day. Experts estimate that by 2005 there will be over 1.26 billion wireless telephone users worldwide.

The concern about an increased risk of cancer with cellular telephone use is related to the radiation that the device produces. Like televisions, alarm systems, computers, and all other



electrical devices, cellular telephones emit electromagnetic radiation. In the United States, cellular telephones operate in a frequency ranging from about 800 to 2100 megahertz (MHz). In that range, the radiation produced is in the form of non-ionizing radiofrequency (RF) radiation. AM/FM radios, VHF/UHF televisions, and cordless telephones operate at lower radio frequencies than cellular phones; microwave ovens, radar, and satellite-stations operate at higher radio frequencies. RF radiation is different from ionizing radiation, which can present a health risk at certain doses. Ionizing radiation is produced by devices such as x-ray machines. It is not yet known whether the non-ionizing radiation emitted by cellular telephones poses a cancer risk. Because so many people use cellular telephones, it is important to learn whether RF radiation affects human health, and to provide reassurance if it does not.

A cellular telephone user's level of exposure to RF radiation depends on several factors. These factors include the amount of cellular telephone traffic, the quality of the transmission, how far the antenna is extended, and the size of the handset. A cellular telephone's main source of RF energy is its antenna. Therefore, the closer the antenna is to the head, the greater a person's expected exposure to RF radiation. The amount of RF radiation absorbed decreases rapidly with increasing distance between the antenna and the user. The antenna of hand-held cellular telephones is in the handset, which is typically held against the side of the head while the phone is in use. The antenna of a car cellular telephone is mounted on the outside of the car, some distance from the user. Transportable cellular telephones or "bag phones" have an antenna in a portable unit separate from the handset. Most of the studies conducted on cellular telephone use and cancer risk have focused on hand-held models, since they deliver the most RF radiation to the user.

The intensity of RF radiation emitted by cellular telephones also depends on the power level of the signal sent to and from the nearest base station. A given geographical region is divided into zones or cells, each of which is equipped with a base station. When a call is placed from a cellular telephone, a signal is sent from the antenna of the phone to the nearest base station antenna. The base station routes the call through a switching center, where the call can be transferred to another cellular telephone, another base station, or to the local land-line telephone system. The farther a cellular telephone is from the base station antenna, the higher the power level needed to maintain the connection. This distance, in part, determines the amount of RF radiation exposure to the user.

RF radiation can be harmful at high levels because it produces heat. Some people have speculated that the heat produced by RF radiation from hand-held cellular telephones may be associated with brain tumors, because the antenna is held close to the user's head. However, the heat generated by a cellular telephone is small in comparison with the large amount of heat generated by RF radiation in a microwave oven. It is generally agreed that the amount of heat produced by a cellular telephone is too small to cause cancer.

### **Studies of Cellular Telephone Use and Cancer Risk**

Public concern and limited scientific evidence have prompted several studies of cellular telephone use and cancer risk. Because hand-held models are used close to the head, most of these studies have examined the risk of brain cancer. Researchers have focused on whether the RF radiation emitted by cellular telephones increases the risk of tumors, and, if so, how this type of radiation causes cancer.

Results of a study from Sweden were published in the July 1999 issue of the *International Journal of Oncology*. This study compared cellular telephone use in a group of 209 individuals who had brain tumors (the case group) with a group of 425 people without brain cancer (the control group). The study reported a statistically non-significant increased risk for brain tumors on the side of the head on which the cellular telephone was used. However, researchers found no overall increase in the risk for brain tumors with cellular telephone use.

A study of 195,775 wireless communications workers was published in the March 2000 issue of the journal *Epidemiology*. These workers were exposed to RF radiation during the manufacturing and testing of cellular telephones. The results of this study found no association between occupational RF radiation exposure and cancers of the brain and nervous system, or between RF radiation exposure and all types of lymphoma and leukemia.

A study funded by Wireless Technology Research LLC and the National Cancer Institute (NCI) was conducted in five academic medical centers in the United States. The study analyzed the possible link between brain cancer and cellular telephone use between 1994 and 1998. Results of this study were published in the December 20, 2000, issue of the *Journal of the American Medical Association*. The study compared a group of 469 men and women with brain cancer to a control group of 422 men and women.

Researchers asked the participants how often they used a hand-held cellular telephone, for how many years they had used one, and what hand they generally used to hold the phone. The study found that the use of handheld cellular telephones was unrelated to the risk of brain cancer. However, like the Swedish study (described above), the researchers found a statistically non-significant increased risk for brain tumors on the side of the head on which the cellular telephone was held.

The results of another large NCI-funded study of cellular telephones and brain tumors were published in the January 11, 2001, issue of the *New England Journal of Medicine*. The study focused on 782 patients with one of three types of brain tumors (glioma, meningioma, or acoustic neuroma) at three medical centers between 1994 and 1998. The control group consisted of 799 patients at the same hospitals who did not have brain cancer.

Researchers interviewed the participants about their hand-held cellular telephone use, including how long they had used a cellular telephone, the usual frequency of use, and which hand they normally used to hold the handset. The researchers did not find an increased risk of brain cancer among cellular telephone users. The results showed no evidence of increasing risk with increasing years of use, or average minutes of use per day. The study also found that brain tumors did not occur more often than expected on the side of the head on which participants reported using their phone.

Because very little is known about the causes of brain tumors, the NCI is studying a wide range of possible environmental and genetic causes, in addition to cellular telephone use. Topics under study include a family history of cancer or other diseases, a personal medical history of certain diseases, dietary factors, workplace exposure to certain chemicals and electromagnetic fields, selected home appliances, hair dyes, reproductive history and hormonal exposures, viruses, exposure to ionizing radiation, and genetic factors. Results of these studies will be reported in future publications.

A small study of mobile telephones and the risk of uveal melanoma, a rare type of eye cancer, was conducted in Germany. The results of this study were published in the January 2001 issue of the journal *Epidemiology*. A total of 118 individuals with uveal melanoma were compared with a control group of 475 people without this condition. Participants were asked

about their exposure to several sources of electromagnetic radiation, including cellular telephones. Researchers found that an elevated risk of uveal melanoma was associated with exposure to electromagnetic radiation. This small study was the first to examine the risk of uveal melanoma in relation to RF radiation exposure, and it did not measure the amount of RF radiation exposure in each participant. Future studies may clarify this hypothesized association.

The results of a large study of all cellular telephone users in Denmark from 1982 through 1995 were published in the February 7, 2001, issue of the *Journal of the National Cancer Institute*. Subscriber lists from the two Danish cellular telephone operating companies identified 420,095 non-corporate cellular telephone users during that time period. Researchers determined cancer incidence by linking subscriber data with the Danish Cancer Registry, which is considered to be a valid and virtually complete record of all cancer cases in Denmark. Results indicated no increased risk among cellular telephone users of cancers of the brain or nervous system, leukemia, cancer of the salivary gland, or all cancers combined. Moreover, there was no evidence for an increasing risk of cancer with increasing years as a cellular telephone subscriber.

## **Conclusions**

Overall, most of these studies do not support a link between cellular telephone use and an increased risk of cancer. However, all of the studies have limitations, and it would be premature to conclude that the use of hand-held cellular telephones is not associated with cancer. One limitation is the relatively short amount of time that cellular telephones have been widely available. Cancers that take a long time to develop would not have been detected by these studies.

Researchers suggest that future studies need to address the effects of long-term, heavy use of cellular telephones, and the differences between analogue and digital technologies. Analogue and digital telephones operate at different frequencies and power levels. Although many of the cellular telephones tested in recent studies used analogue technology, most cellular telephones today are based on digital technology.

Additional studies of cellular telephone use and cancer risk are under way in the United States and internationally to address these remaining issues. For example, the U.S. Food and Drug Administration (FDA), a Federal Government agency that monitors the safety of wireless phones, and the Cellular Telecommunications Industry Association (CTIA) are working jointly to evaluate the health effects of cellular telephone use. They will plan studies to determine the possible health effects of repeated or long-term exposure to cellular telephones, and select topics for future research.

### **What Consumers Can Do If They Are Concerned About the Health Effects of Cellular Telephones**

The FDA has suggested some steps that cellular telephone users can take if they are concerned about potential health risks, but do not want to give up their mobile phones:

- Reserve the use of cellular telephones for shorter conversations, or for when a conventional phone is not available;
- Switch to a type of mobile phone with a headset to place more distance between the antenna and the phone user;
- For use in the car, switch to a mobile phone with the antenna mounted outside the vehicle.

The Federal Communications Commission (FCC) is a Federal Government agency that regulates interstate and international communications by radio, television, wire, satellite, and

cable. The FCC provides consumers with information on human exposure to RF radiation from wireless phones and other devices. The Commission's Web site, which is located at <http://www.fcc.gov/oet/rfsafety> on the Internet, allows consumers to find information about the specific absorption rate (SAR) of cellular telephones produced and marketed within the last 1 to 2 years. The SAR corresponds to the relative amount of RF energy absorbed into the head of a cellular telephone user. Consumers can access this information using the phone's FCC ID number, which is usually located on the case of the phone. Instructions for obtaining information about the SAR are available on the FCC's Web site.

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### **Sources of National Cancer Institute Information**

#### **Cancer Information Service**

Toll-free: 1–800–4–CANCER (1–800–422–6237)

TTY (for deaf and hard of hearing callers): 1–800–332–8615

#### **NCI Online**

##### ***Internet***

Use <http://cancer.gov> to reach the NCI's Web site.

##### ***LiveHelp***

Cancer Information Specialists offer online assistance through the *LiveHelp* link on the NCI's Web site.

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