

NIOSH FACTS

Cellular Telephones: What do we know about the radiation they emit?

What has caused the recent alarm over the safety of cellular telephones?

In 1992, a law suit was filed against the manufacturer of a hand-held cellular phone. A cellular phone user claimed that the *radiofrequency electromagnetic radiation (RF)* emitted by her phone caused or promoted the development of her brain tumor. The location of her tumor, in the area of the brain proximate to the telephone antenna during use, has contributed to the credibility of this claim among the public. As a result of initial media coverage, a few other cellular phone users with brain cancer also made their concerns public. These concerns, combined with rapidly expanding cellular phone use (there are presently 10 million users), have stimulated extensive public interest.

Do cellular phones cause cancer?

At this point in time, much remains unknown about the health effects of non-ionizing radiation, including the type (RF) emitted by cellular phones. Currently, there is not a conclusive answer to this question. Only a small number of studies done on the effects of these frequencies of radiation have investigated cancer as an endpoint. These studies are not conclusive in substantiating or rejecting the validity of this health concern.

What is a cellular telephone?

A cellular phone is a portable phone which, utilizing a vast network of "base station" fixed antennas, allows the user to make phone calls from virtually any location. The phones send and receive RF signals to and from the base station antennas.

Although there has been some past concern about the emissions from the base station antennas, the recent concerns are related to the radiation emitted by the portable phones themselves.

What types of cellular phones are there?

There are three types of cellular phones in use today—the hand-held, the transportable, and the car phone. Of these, the *hand-held* phone has generated the most concern for personal radiation exposure. The receiver on these phones has a small antenna projecting from the end in which the earphone is located. Therefore, the antenna, which transmits throughout a call, is close to the head when the phone is in use. Hand-held phones normally have an emitted power of 0.6 watts. *Transportable phones* are those that can be carried around, and have a small case like a lap-top computer. For these, the antenna is normally on the case, not on the receiver, and has an emitted power of 3.5 watts. The third type,

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the *car phone*, is hard-wired to an antenna mounted on the roof or trunk of the car. The emitted power of these is also 3.5 watts, but the exposure of the individual is much less because the antenna is usually outside the passenger compartment, not close to the user's head.

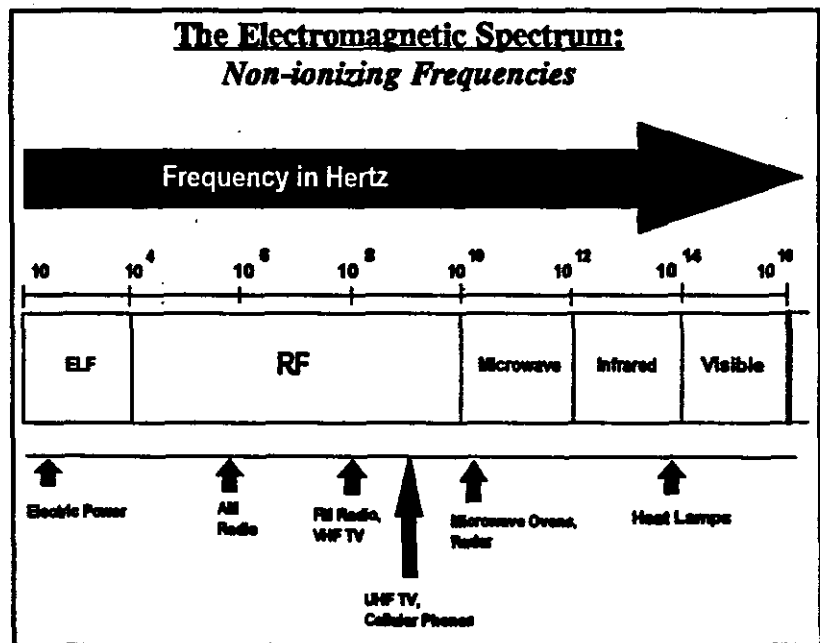
What about cordless telephones?

Cordless telephones in the home work on a similar principle, but, because the base transmitter is so near the phone (usually the range is only about 50 feet) the power emitted is very, very weak compared to that of a cellular phone.

What is RF ?

To understand RF, one must first understand non-ionizing radiation. Non-ionizing radiation covers a wide range of frequencies of the electromagnetic spectrum. The various frequency ranges have unique characteristics and therefore may have unique health effects. Non-ionizing radiation includes visible light, infrared, microwave, RF, and extremely low frequency (ELF) radiation.

RF is the frequency range falling between microwave and ELF radiation.



How does the RF radiation from cellular phones relate to that from electric power lines?

As illustrated in the chart above, electric power falls in the ELF frequency range, which is quite different from the RF radiation emitted by a cellular phone, because of the vast difference in frequency. Electric power in North America is 60 hertz, or 60 cycles per second, compared to the thousands or millions of cycles per second of the RF radiation sources. Cellular phones transmit in the frequency range of 825-890 megahertz (megahertz=million cycles per second.) The two frequency ranges (ELF and RF) have very different energy characteristics and may have different biological effects on the human body. At this time, health effects reported in the ELF range cannot be generalized to apply to the RF range and vice versa.

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What is known about the health effects of non-ionizing radiation?

Non-ionizing radiation covers a wide range of frequencies. These different frequency ranges have unique properties, and health effects reported in one range cannot be generalized to apply to all ranges.

The known biological effects associated with these fields vary with the frequency and intensity of exposure. Frequency is the number of cycles per second that the energy wave oscillates. Intensity varies both with the amount of power emitted (measured in watts) by the energy source and the distance of the individual from that source. Different regions of the electromagnetic spectrum may affect biological systems differently. However, for much of the non-ionizing radiation spectrum, including RF, we currently have insufficient scientific information to evaluate the full range of potential health risks of human exposure.

What is NIOSH presently doing relevant to this public concern?

NIOSH is conducting research on the effects of both RF and ELF electromagnetic fields. In response to concerns about the safety of traffic radar gun use, NIOSH is evaluating the effect of microwave radiation on the health of police officers. The first step in this study is to assess police officer exposures to non-ionizing radiation and to determine the availability of health and exposure records needed. This study, now being planned, may also be relevant to assessing the cancer risk of cellular telephone use.

What research is needed to assess the risks of RF exposure?

One of the primary scientific concerns with RF exposure from hand-held cellular telephones arises from the very close proximity of the antenna to the body, normally within a few centimeters. However, the health implications of local energy exposure to the head have not been determined, nor has research

investigated chronic human health effects of RF emitted from cellular phones.

We need to conduct *in vivo* (in whole animals) and *in vitro* (on tissues and cells in a test tube environment) laboratory studies to determine whether RF and microwave radiation are involved in cancer promotion. We also need comprehensive assessments of exposures to human populations such as cellular telephone users and traffic police, and epidemiologic studies of cancer incidence among these populations. Unfortunately, the process of conducting and interpreting such studies is a prolonged one, lasting several years, and a resolution of these health concerns is unlikely in the near future.

What studies have been done on RF ?

Note: Because of the closeness in frequency ranges, RF and microwave radiation are often studied in conjunction. In describing the health effects, the following paragraphs refer to both types of radiation.

A few studies suggest that RF and microwave radiation may promote the development of tumors arising from other causes. These include two studies conducted in the 1980s: a life-span study of rats exposed to microwave radiation which found a small increase in cancer tumor development in microwave-exposed rats and a study which found that microwave exposure accelerated tumor development in mice with existing tumors. Some *in vitro* studies of cells have also reported changes during RF and microwave exposure which suggest effects on cells that could be related to promoting tumor development. Conversely, there are also reports in the literature of cell studies in which the RF or microwave radiation did not cause any change that would suggest tumor promotion.

Only a small number of studies done on the effects of these frequencies of radiation have investigated cancer as an endpoint. These studies are not conclusive in substantiating or rejecting the validity of this health concern.