

2003

# Health Risks Caused by Wireless Technologies

DurreeShahwar ZafarAhmed  
*Minnesota State University, Mankato*

Qurrat-ul-Ain ZafarAhmed  
*Minnesota State University, Mankato*

Follow this and additional works at: <http://cornerstone.lib.mnsu.edu/jur>

 Part of the [Electromagnetics and photonics Commons](#), [Electronic Devices and Semiconductor Manufacturing Commons](#), and the [Environmental Health Commons](#)

## Recommended Citation

ZafarAhmed, DurreeShahwar and ZafarAhmed, Qurrat-ul-Ain (2003) "Health Risks Caused by Wireless Technologies," *Journal of Undergraduate Research at Minnesota State University, Mankato*: Vol. 3, Article 9.  
Available at: <http://cornerstone.lib.mnsu.edu/jur/vol3/iss1/9>

This Article is brought to you for free and open access by the Undergraduate Research Center at Cornerstone: A Collection of Scholarly and Creative Works for Minnesota State University, Mankato. It has been accepted for inclusion in Journal of Undergraduate Research at Minnesota State University, Mankato by an authorized administrator of Cornerstone: A Collection of Scholarly and Creative Works for Minnesota State University, Mankato.

**Student Agreement:**

I am submitting my research article to be published in the JUR (The Journal of Undergraduate Research at Minnesota State University, Mankato), an electronic journal of the Minnesota State University Undergraduate Research Center.

I/We certify have followed the accepted standards of scientific, creative, and academic honesty and ethics.

I understand that my article submission will be blind-reviewed by faculty reviewers who will recommend acceptance for publication; acceptance with revisions; or reject for publication.

I understand that as author, I retain the right to present any part of the research in any form in other publications.

The JUR has the right to reproduce and reprint published submissions for instructional or promotional purposes.

For complete details, see [\*Journal of Undergraduate Research at Minnesota State University, Mankato policies page\*](#).

**Mentor Agreement:**

I have reviewed the submission, and I support its inclusion in the JUR (The Journal of Undergraduate Research at Minnesota State University, Mankato). I understand that I will be acknowledged as the faculty mentor for the student author(s). To the best of my knowledge, the student has followed the accepted standards of scientific, creative, and academic honesty and ethics.

---

## Health Risks Caused By Wireless Technologies

DurreShahwar ZafarAhmed, Qurrat-ul-Ain ZafarAhmed, *Rakesh Kawatra* (Faculty Mentor)

### Abstract

There are many health issues related to the use of cellular phones, wireless local area networks, and other devices that emit electromagnetic radiation (EMR). Some of these systems have become a part of our daily lives and many of us are in direct or indirect contact for extended period of times with these devices. However, the general public is unaware of the health risks associated with the use of these devices. Our research covers studies done by individuals as well as organizations on the harmful effects on the health of people from these devices and their claims. We also present information about research studies that refute some of these claims. Research under way to find health effects of wireless devices is also covered.

### Introduction

The last few years has seen a proliferation of cell phones, wireless local area networks (WLANs), and other wireless devices across the globe. People from all demographic segments have been observed using some of these systems. Such systems emit electromagnetic waves which under certain conditions can cause undesirable effects on humans. In the case of cell phones, some of the people use these devices for extended periods of time while holding them close to their ears. Therefore, their heads are exposed to the electromagnetic radiation for long periods of time. However, most of these people are unaware of some of the claims researchers have made about the harmful effects of cell phone usage. Although researchers haven't published any conclusive results on these harmful effects, the initial findings are alarming enough that in some countries like the UK, the federal government has mandated that all cell phones carry a government health warning about their harmful effects.

### Harmful effects from cell phone usage

The Wireless Consumers Alliance Web site states that in 1993, Cellular Telecommunications Industry Association (CTIA) hired Dr. George Carlo, an epidemiologist, to manage a six year, \$28 million dollar research program to study the risks of cell phone usage. This study discovered that genetic damage can be caused by cellular phone radiation. According to Dr. Carlo, there is evidence that suggests that cellular radiation can cause genetic damage to blood cells, therefore preventing the blood cells from repairing broken DNA. This could result in growth of tumors and breakdowns in the immune system (Health Concerns).

An article by John Tuohy (2000) published in USA Today stated that Dr. Carlo has found three studies confirming that people who use cell phones are more likely to get tumors on the outside of their brains. This article also states that another study found that people who use cell phones for more than six years are 50% more likely to get benign tumors behind their ears (Tuohy, 2000).

The article “Are Kids at Greater Risk” by Bernard Baumohl (2001) mentions the following harmful effects that cell phone radiation can have on children. It states that the harmful effect on children from cell phone radiation can be more severe than on adults since children’s skulls are thinner and their brains are smaller as compared to adults. Therefore, radiation emitted from cell phones can more easily penetrate their heads. Furthermore, a child’s brain is still developing and therefore it is extremely vulnerable to outside interference and microwaves from cell phones affect children’s brain rhythms. This article also talks about a report published in November in *The Lancet*, the British medical journal, stating that children are more at risk than adults to suffer from “memory loss, sleeping disorders and headaches” from using mobile phones. This article also mentions that according to the Yankee group, a Boston based technology research firm, more than 10 million children in the US from ages 10 –19, or 25 % of those in that age group, own a wireless phone. In Germany the percentage is 30% and in Finland 90%. So more children are using cell phones and are not aware of the health risks associated with them. (Baumohl, 2001)

In the UK, the government advised schools to discourage students under 16 from using cell phones. This decision was based on a study that indicated that children should be discouraged from using the cell phones as their brain is more vulnerable to radiation than an adult’s brain (Mobile Phones will carry Government health warning, 2000).

Some research has also been done to see if exposure to radiation from cell phones increases the risk of getting Alzheimer’s, Parkinson’s, and Multiple Sclerosis. Charles Moore in his article, “How Safe Is Wireless Computer Networking?” (1999) mentions a study done at the University of Lun where the immune system of rats was exposed to two minute zaps of microwave pulses which were similar to the radiation caused by cell phones. The research discovered that these microwave pulses can disable a defense mechanism in the body to prevent harmful proteins and toxins from entering the brain. Once the proteins enter the brain tissue there is a high risk of getting Alzheimer’s, Parkinson’s, and Multiple Sclerosis (Moore, 1999).

A 1996 US study by Dr Eugene Sobel, published in the journal *Neurology*, found that people who are exposed to high electromagnetic field (EMF) levels on the job have nearly four times the normal risk of contracting the Alzheimer’s disease (Tedeschi). An Australian study, conducted at the Royal Adelaide Hospital has revealed a highly significant doubling of cancer rates in a group of mice exposed to electromagnetic radiation equivalent to spending two half-hour periods each day on a digital mobile phone (Hailstone and Hall, 1997). EMR (electromagnetic radiation) is a form of energy which is emitted by cell phones through the keypad, screen, ear-piece and aerial when the phone is switched on, particularly during conversation. Unlike an ordinary phone, a mobile phone’s power unit and transmitter is located in the handset which increases the health risks caused by cell phone radiation.

Charles Moore (1999) cites a Russian study of thousands of workers that were exposed to microwaves during the development of radar in the 1950’s. The health problem indicated by this research was so grave that the Russians established strict limits of 10 microwatts for workers and 1 microwatt for lay people (Moore, 1999).

## **Microwave sickness**

Charles Moore (1999) cites another Russian research on health effects of micro radiation that the research calls “microwave sickness”. This research describes microwave sickness in the following terms:

“Its first signs are low blood pressure and slow pulse; the later and most common symptoms are chronic excitation of the sympathetic nervous system (stress syndrome) and high blood pressure. This phase also often includes headache, dizziness, eye pain, sleeplessness, irritability, anxiety, stomach pain, nervous tension, inability to concentrate, hair loss plus an increased incidence of appendicitis, cataracts, reproductive problems and cancer. The chronic symptoms are eventually succeeded by crisis of adrenal exhaustion and ischemic heart disease (blockage of coronary arteries and heart attack)”

The research further notes that these general effects of magnetic (60 Hz) fields are from electronic devices including cellular telephones. Also it is mentioned in the research that when cell phones are used they are usually held next to the head where the radiation strikes the pineal gland, reducing its production of hormone called melatonin, which inhibits breast cancers (Moore, 1999).

A study conducted by US National Cancer Institute found that employees in seven industries in eastern US who were exposed to microwave signals at workplace for about 20 years experienced a ten fold increase in brain tumors (Moore, 1999).

## **Effects of cell phone usage on eyes**

The Wireless Consumers Alliance Web site cites an article that appeared in the January 2001 issue of Epidemiology reporting the risk of eye cancer caused by radio frequency radiation (RFR) experienced when using mobile phones. An earlier study found that some of the radiation from cell phones does not pass through the skull however they bounce back and forth inside the eye socket. The article also states that the exposures are too weak to increase temperatures and cause adverse biological effects. But some studies indicate that there are adverse biological effects even if cell temperatures are not increased. The biological effects have not been consistently replicated or the information available today is not sufficient to provide concrete evidence. However, a hypothesis states that RFR can speed the development of cancer caused by other agents (Health Concerns).

## **Effects of cell phone usage on memory loss**

Charles Moore (1999) cites a report indicating a direct link between mobile phone usage and memory loss. This conclusion was reached after a controlled study was conducted by a hospital in Bristol, England (Moore, 1999).

## **Effect of cell phone usage on Pacemakers.**

In separate tests done at the Mayo Clinic and the Mount Sinai Medical Center in Miami Beach, patients with pace makers who held their phones operating on digital systems next to their chest experienced a temporary disruption in the pulse generation of the pacemaker. However, the same interference was not noted with cellular telephones that used the analog system also known as the 1<sup>st</sup> generation cellular phone systems (Landler, 1995). Medtronic, Minneapolis has advised its patients to turn off their cell phones that are placed near the breast pocket, to hold the phone at least 10-12 inches away from the chest when using it, and to use the phone on the ear opposite the side the pacemaker is implanted in (Keller, 1995).

### **Health problems with wireless local area networks (WLANs)**

Some people are concerned that Wireless Local Area Network (WLAN) devices being placed in schools may cause health problems in school children. Some of these systems have access points installed in classrooms. Charles Moore states that these access points allow students to access the computer network using laptop computers without using a cable connection. These access points operate at higher frequencies and higher power output levels than the cellular phones. Also users of WLANs are exposed to high powered signals for longer durations than people using cellular phones. These WLANs emit the same kind of Electro Magnetic Radiation (EMR) as cell phones and therefore can potentially cause the same kind of ill health effects as cell phones (Moore, 1999).

### **Counter Research**

Although many researchers and experts have made public statements implying that cell phones and WLANs create health risks, several scientists and experts disagree with these claims. In the US, the public and other concerned groups are burdened to show that cell phones are harmful but the cell phone companies have the benefit of the doubt and claim that cell phones are not harmful to human health.

A BBC report cites a research done by the University of Lund to calculate the effect of cell phone radiation on the blood brain barrier. The researchers exposed rats to microwave pulses that were similar to cell phone radiation. The research found that within two minutes the defense mechanism was disabled and the rats' brain tissue was exposed to proteins and toxins contained in the blood. On the other hand, the BBC reports, the mobile phone manufacturers deny that mobile phones have harmful effects and can "cook" the brain. The BBC also cited a report by the New Scientist by quoting the following "A mild bout of exercise could heat your head more than the puny microwaves that the devices emit." (Mobile phone 'brain risk', 1999)

The Wireless Technology Research program (WTR), which is funded by the wireless phone industry, states that seventy-five studies over the past six years have failed to prove that cell phones cause brain cancer, but the 400 million cell phone users worldwide would be wise to take precautions anyway (Tuohy, 2000).

Charles Moore also cites an incident by Jerry Phillips who worked on a research project which was funded by Motorola in the early 90's. Moore cites that things got unpleasant when data was found showing that Radio Frequency Radiation (RFR) exposure may

cause brain tumors in rats. However, a senior Motorola spokesman strongly denied this claim (Moore, 1999).

The Journal of the American Medical Association (JAMA) and the New England Journal of Medicine (NEJM) released studies that failed to find a causal relationship between cell phone use and cancer. The JAMA study looked at 469 patients with brain cancer compared to 422 people without brain cancer, and found that the cancer patients did not use cell phones substantially more than those without cancer. The study also found that people who did not use cell phones were no less likely to get cancer than those who did. The study's researchers concluded that "the use of cellular telephones was unrelated to the risk of brain cancer" for its study group. (American Cancer Society News Today, 2000)

The Wireless Consumers Alliance Web site cites Dr. Carlo's study that discovered genetic damage caused by cellular phones. Dr. Carlo has also written a book "Cell Phones: Invisible Hazards in the Wireless Age" which suggests that the wireless industry, federal regulators and Congress have not looked into new research showing health hazards caused by wireless phone radiation. The article also mentions that the new studies published by the American Journal of Medicine and NEJM, which are based on data collected from Dr. Carlos's research, concluded that there are no health risks caused by cell phones. However, Dr. Carlo states that the data given to the authors of these studies was changed so that based on the size of the sample the higher rate of cancer was not statistically significant. (Health Concerns)

### **What should consumers know about their cell phones**

The Federal Communications Commission, FCC has decided that the amount of radiation absorbed by the head should not exceed 1.6 watts per kilogram. This value is called the Specific Absorption Rate (SAR) (Health Concerns). SAR is based on the fact that if human tissue is heated up beyond a certain level then it can be dangerous; this level is called the thermal level.

Mathew E. Brunnworth in his article "Cellular Phone Safety Questions Now include Headsets" (2001) states that the SAR tests are based on a calculated amount of energy that can be absorbed by the human body safely. It is calculated by identifying the maximum radio signal level inside the human head and then applying this value to a formula to calculate the SAR. Tests are performed by placing an electrical-field test probe into a dummy head which is filled with a gel. This gel simulates electrical properties similar to human brain tissue. Then, the test measures how much the brain heats up when a cell phone is placed against the dummy's head (Brunnworth, 2001).

However, many scientists doubt the validity of the SAR test as it measures brain temperature after cell phone exposure for only a small amount of time and not actual emissions. Brunnworth also states that in 1999, researchers in Spain concluded that the SAR method of calculating cellular phone radiation really underestimates the actual effect radiation has on the human tissue. Brunnworth further mentions that SAR is an invalid test because there is evidence showing that phone radiation affects protective biological mechanisms in the body below what can be measured at the thermal level. Moreover, SAR does not consider the long term effects of cell phone radiation but just

measures the short term observable behavior effects in laboratory animals. The most significant indication that the SAR test is invalid is because most of the health hazards caused by cell phones are not thermally induced and all of them have a long incubation period (Brunnworth, 2001).

The SAR value for recently manufactured phones can be found by using the FCC ID number for that model. This ID is usually printed on the case of the phone. It may also be necessary to remove the battery pack to see the number. After the ID is found the following site [www.fcc.gov/oet/fccid](http://www.fcc.gov/oet/fccid) provides further instructions for finding the SAR value for your phone.

## **Regulatory Issues**

FCC claims that EMR exposure on ground level from base stations is safe. Cellular and Personal Communications Service (PCS) base stations in the US are required to comply with the RFR limits that are recommended by expert organizations and government agencies responsible for health and safety. Also when antennas are mounted on roof tops, the Radio Frequency (RF) exposure levels on the roofs are higher than those on the ground. However, FCC states that unsafe RF level would be encountered only if the person is very close to or directly in front of the antenna. FCC admits that it is not able to monitor the emissions from all the transmitters that are under the FCC jurisprudence. However, it does have measurement instrumentation for evaluating RF levels in areas that may be accessible to the public or workers. It also conducts an investigation if there is enough evidence to indicate a lack of compliance with the FCC laws.

The FCC and the Food and Drug Administration (FDA) are developing a joint web site to provide information about the latest wireless technologies, current research and related issues and health concerns to consumers. To prevent health risk from wireless related devices, manufactures are regulated to demonstrate to the FCC that their phones comply with FCC limits for safe exposure. FDA and FCC also have the authority to take action if wireless phones have proven to be harmful in any way or if they exceed the FCC safety limits.

Since 1993, the FDA states that research does not show that radio frequency emissions from mobile phone have health effects. At the same time, they state that there is not enough evidence to indicate that wireless phones are safe. Also other international bodies, World Health Organization and expert research commissioned by the British and Canadian governments have arrived at similar conclusions. They are suggesting that further research be conducted to provide concrete evidence supporting either side.

According to the FCC, "Some published exposure limits in Russia and some Eastern European countries have been generally more restrictive than existing or proposed recommendations for exposure developed in North America and other parts of Europe." Research has found that Russian RFR limits are 100 times stricter than those in the US and Western Europe. Switzerland has one of the strictest exposure limits in the world requiring power levels effectively 100 times lower than those of the International Commission on Non-Ionizing Radiation Protection (ICNIRP) and the American National Standards Institute (ANSI). Austria's standard is approximately 5800 times lower than the FCC guidelines for radio frequencies and microwave base station radiation.



## **Future Research Projects which are underway**

- Internal Agency for Research on Cancer, a division of World Health Organization, is coordinating a series of large epidemiological studies looking at whether brain cancer is caused by cell phone usage. At least 13 countries are participating in the studies. Results are expected in 2004.
- FDA and CTIA will continue to conduct research on the changes in the genetic makeup of blood cells exposed to radiofrequency energy and epidemiological studies.
- The National Toxicology Program and The European Commission are also conducting research on the effect of long term exposure to the radiofrequency emissions of mobile phones.
- UK's Department of Health has announced a \$10 million research program on possible health effects of cell phone emissions. One of the specific areas they want to focus on is the non cancer effects, such as effects on brain function.
- National level research is also being conducted by the governments of several countries including Australia, Finland, France, Germany, Italy, Japan, and Sweden. These research endeavors will focus on harmful health effects due to cellular telephone technology. Most of these programs are being coordinated by the World Health Organization and/or European Commission.

## **How to mitigate the harmful effects from cellular telephones**

Brunnworth mentions that in 1998, the Aegis Corporation introduced a shielding technology which deflects up to 99.9% of the radiation coming from the cell phones away from the head and the neck of the user. This does not lower the quality of the cell phone. The Aegis Guard Radiation Shields were not tested through the SAR test. However, these shields were put through other test procedures (Brunnworth, 2001).

The FCC recommends placing more distance between the body and the source of RFR, since the exposure drops drastically through distance. Dr. Carlo says that energy directed into the human body during the ring cycle is similar to when in conversation mode and more if the cell phone antenna is compressed. He suggests keeping the phone in a briefcase and use it through a headset (Health Concerns).

## **Conclusion**

The published research and public statements from experts in the wireless systems and related fields indicate that compared to all the wireless technologies, cell phones are the main cause of health concern. This may be because cell phones are placed in close contact to our brain as compared to other wireless devices. Government agencies in other countries like Switzerland and England have already acknowledged the health risk associated with using wireless technologies and have taken steps to control the risk. In the USA however, the leading agency in charge of wireless communication, FCC, has not done as much to protect the people. FCC should take concrete steps to educate US citizens about the possible harmful effects of using wireless systems. Although many

researchers would like to see conclusive results, first waiting until this information is published could be disastrous since a large population is exposed to radiation from wireless technologies.

## References

1. Moore, C. (1999, December 9). How Safe Is Wireless Computer Networking. *The EMR Network*. Retrieved July 2, 2003, from <http://www.emrnetwork.org/schools/macopinon.htm>
2. Brunnworth, M. E.. (2001, April). Cellular Phone Safety Questions Now Include Headsets. *Aegis Corporation*. Retrieved July 2, 2003, from [http://www.goaegis.com/white\\_papers.html](http://www.goaegis.com/white_papers.html)
3. Landler, M. (1995, April 29). Cellular Phones May Affect Pacemakers. *The New York Times*. Retrieved July 2, 2003, from <http://www.millennianet.com/celfones/nytimes1.html>
4. Tuohy, J. (2000, July 31). Cell Phone expert makes a call: Be wary. *USA Today*. Retrieved July 2, 2003, from <http://www.wirelessconsumers.org/medicalriskusatoday.html>
5. Health Concerns. (n.d.). *Wireless Consumers Alliance*. Retrieved July 2, 2003, from <http://www.wirelessconsumers.org/healthconcerns.html>
6. Baumohl, B. (2001, May 6). Are Kids at Greater Risk? *TIME.com: TIME Magazine*. Retrieved July 2, 2003, from [http://www.thueringen.de/tkm/hauptseiten/grup\\_medien/ab02ihtm/engf02.htm](http://www.thueringen.de/tkm/hauptseiten/grup_medien/ab02ihtm/engf02.htm)
7. Keller, J. J. (1995, April 28). Cellular Phones May Affect Use of Pacemakers. *The Wall Street Journal*. Retrieved July 2, 2003, from <http://www.millennianet.com/celfones/wsjrnl1.html>
8. Mobile Phones Will Carry Government Health Warning. (2000, November 27). *Wireless Consumers Alliance*. Retrieved July 2, 2003, from <http://www.wirelessconsumers.org/UKHealthWarning.htm>
9. Mobile phone 'brain risk'. (1999, November 6). *BBC News World Edition*. Retrieved July 2, 2003, from <http://news.bbc.co.uk/2/hi/health/507112.stm>

10. Frequently asked questions, Radio Frequency Safety, Office of Engineering and Technology. (n.d.). *FCC*. Retrieved July 2, 2003, from <http://www.fcc.gov/oet/rfsafety/rf-faqs.html>
11. Mobile Phones And Health Concerns, Consumer information directory, Consumer and Governmental Affairs Bureau. (n.d.). *FCC*. Retrieved July 2, 2003, from <http://www.fcc.gov/cgb/consumerfacts/mobilephone.html>
12. Handheld Cellular Telephones Unlikely to Cause Brain Cancer. (2000, December 20) *American Cancer Society News Today*. Retrieved July 2, 2003, from <http://www.emmasciencewriter.com/New%20clips/acs/ACS%20%20ACS%20NewsToday%20%20Top%20Stories%20%20Cellular%20Phone%20Use%20Not%20Likely%20to%20Cause%20Brain%20Cancer.htm>
13. Tedeschi, C. (n.d.). *Prolonged exposure to electromagnetic fields may increase Alzheimer's risk*. Retrieved July 2, 2003, from <http://www.usc.edu/hsc/info/pr/1vol3/302/exposure.html>
14. Hailstone, B. and Hall, L. (n.d.). *Mobile Phone in Cancer Link*. Retrieved July 2, 2003, from <http://www.fgf.de/aktuell/newshot/archiv/archiv97/hot970507.html>