

## Reduction of Cell Phone Electromagnetic Radiation Effect on Human Body

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**Abstract:** Electromagnetic waves generated by different wireless systems like mobile systems, satellite systems, microwave links...etc. facilitates our communications throughout the world. These waves have many effects on the human body as well as our daily lives. The effects of electromagnetic waves cause many problems and diseases in the human body like cancer. Nowadays, types of the cancer caused by these waves has increased, because mobile users have increased. Because of the importance of human, this paper will address ways for humans to reduce the effects of electromagnetic waves and to reduce cancer. The proposal consists of many recommendations in wireless systems like mobile systems, guiding the users of wireless users specially mobile users how to reduce these waves effects. Furthermore, this research will describe methods to decrease electromagnetic waves and propose alternative techniques instead.

**Keywords –** Electromagnetic radiation, cell phone, effect of cell phone radiation, reduction of cell phone radiation effect

### I. INTRODUCTION

It is evident that electromagnetic waves generated by different wireless systems like mobile systems, satellite systems, and microwave systems facilitate communication throughout the world. These waves have many negative effects on the human body, on the environment, as well as on our daily lives. The electromagnetic spectrum (EM) contains an array of electromagnetic waves increasing in frequency from Extremely Low Frequency and Very Low Frequency (ELF/VLF), Radio Frequency (RF) and Microwaves, to Infrared (IR) light, Visible Light, Ultraviolet (UV) light, X-rays, and Gamma rays [1]. Figure 1 is the graphical representation of the spectrum of electromagnetic energy or radiation in ascending frequency (decreasing wavelength). The general nature of the effect is noted for different ranges

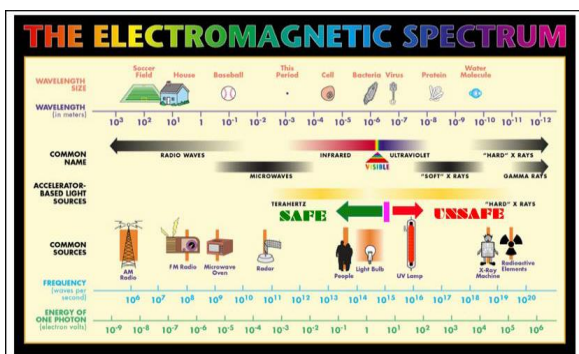


Fig. 1 A graphical representation of the spectrum of electromagnetic energy or radiation in ascending frequency (decreasing wavelength).

Electromagnetic waves have two types of radiation : ionizing radiation and non-ionizing radiation. Ionizing radiation contains sufficient electromagnetic energy to strip atoms and molecules from the tissue and alter chemical reactions in the body. Human beings are constantly exposed to low levels of ionizing radiation from natural sources. This type of radiation is referred to as natural background radiation. The main sources are visible light, ultraviolet light, and infrared light, radioactive materials on the earth's surface; radioactive gases leaking from the earth, cosmic rays from the outer ionosphere, and natural radio activity in the human body.

Non-ionizing radiation is classified at the lower part of the frequency spectrum with energy levels below that required for effects at the atomic level [1]. Figure 2 shows the two radiation types.

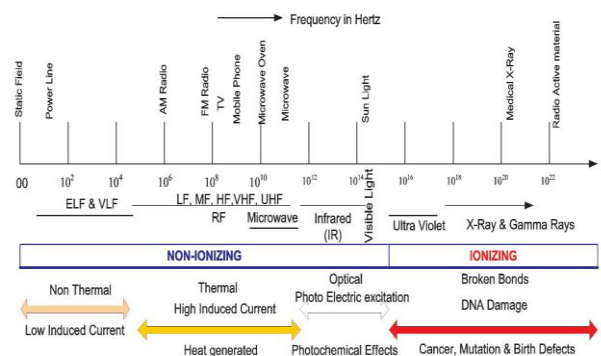


Fig. 2 Ionizing and non-ionizing radiation



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The objectives as outlined in this research after an introduction about the electromagnetic waves types are as follows :

- i) Explaining the effects of electromagnetic waves radiation on human.
- ii) Methods to reduce electromagnetic wave radiation.
- iii) The effect of methods to reduce electromagnetic wave radiation.
- iv) Presenting useful recommendations to the cell phone users for reducing effects of the electromagnetic waves radiation.

This research gives useful information not only to the cell phone users, also to other wireless systems users like satellite systems and microwave systems users in order to reduce the effects of electromagnetic wave radiation on human.

## II. SOURCES OF ELECTROMAGNETIC RADIATION

Cell phones are not only the sources of electromagnetic radiation waves, there are many other sources and have the effect on human body, environment, and even trees as shown in Figure 3.



Fig. 3 Sources of electromagnetic radiation

The most effective radiation is in the microwave band (cell phones are in the band), includes satellite, radar, and microwave repeaters, the effect of cell phones are greater than others because the radiation is directly through the ears with high power as will be presented in next sections.

## III. GOAL OF THIS RESEARCH

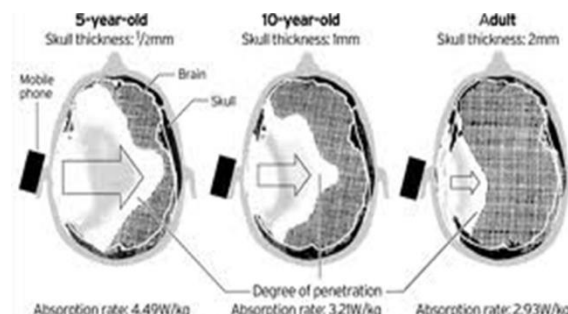
The effects of electromagnetic waves may cause many problems and diseases in the human body like brain cancer. Nowadays, types of the cancer caused by these waves have increased because mobile users have increased, and they use cell phones for long periods of times. Because of the risk cell phones pose to people, this proposal will address how people can reduce the effects of electromagnetic waves and reduce cancer caused by these waves. Also, this proposal describes techniques to improve current

wireless systems.

Research question is : How can we reduce exposure to radiation from cell phones, thereby reducing cancer? The proposal consists of many recommendations in wireless systems, such as mobile systems, which guide the users of wireless users, especially mobile users, on how to reduce the effect of these waves. Furthermore, this research will describe methods to decrease exposure to electromagnetic waves and propose alternative techniques.

## IV. HOW THIS RADIATION AFFECTS BODY AND CAUSE CANCER?

The effect of the electromagnetic radiation of cell phones depends on the age of the human being, the effect on children is more than teenagers, teenagers more than older, Figure 4 shows the effect on the three age stages, because the skull for children is very thin about 0.5 mm thickness, penetration of the radiation is greater and the penetration rate is about 4.49 W/kg,, for the second one shown the skull thickness about 1mm and the penetration rate is about 3.2 W/kg and the penetration is less and for the adults will be less because the skull thickness is about 2mm and the penetration rate will be about 2.93 W/kg.



(a)



(b)

Fig. 4 Effect of the EM radiation on human according to the age step (a) skull thickness (b) more details of ( a )

In Figure 5 radiation penetration in head is shown, this penetration which exposes endothelial cells

which line the minute blood vessels in the brain to mobile phone radiation can damage the blood-brain barrier, a vital safety barrier that stops harmful substances in the blood from entering the brain because, endothelial cells stressed after one hour's exposure to mobile phone radiation limit ( 2 watts / kg of tissue), also changes the protein structure in endothelial cells, allowing toxins to enter brain, as a result cause heart attack, cancer tumors.

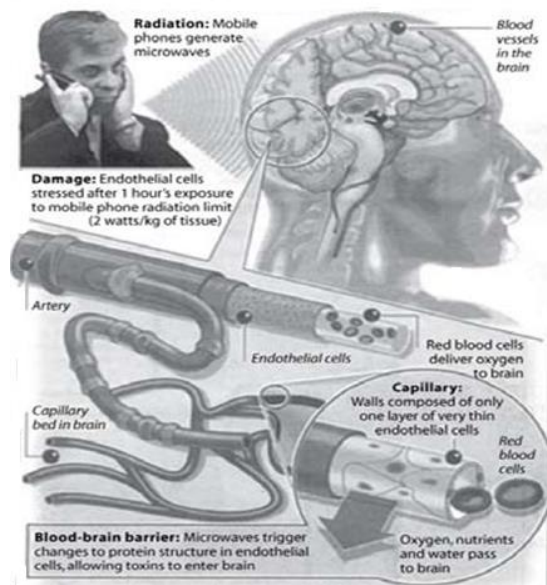


Fig. 5 Effect of cell phone radiation on brain

More effects, in Figure 6 the call phone radiation has been shown after 15 – minute phone call by taking thermo graphic image.

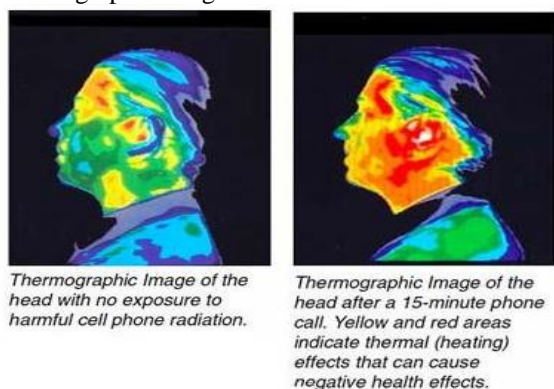


Fig. 6 More effect of cell phone radiation

#### V. MISERABLE STORIES OD CELL PHONE RADIATION EFFECTS

There are several miserable stories of electromagnetic radiation hazard victims in the world, for example, In Taiwan, In the year of 1999, a number of stores in this neighborhood had cell phone base stations installed on their rooftops. Just after a few years, eleven people who had a habit of resting in the shade beside the port had developed

cases of cancer. In the past, more specifically, from the year of 1991-1999, there were absolutely no cases of cancer within this region. The trouble started in 1999 when one citizen died of cancer. From 2000-2007, the number of cancer victims increased to eleven, eleven times that of the prior amount. In comparison to the nearby Nan-Yah Neighborhood which had similar racial and population structures, this neighborhood showed obvious increases in cancer cases after the installment of the base station [2].

The electromagnetic radiation emitted by transmitting cell phone antennas is linked to the occurrence of some types of cancer, according to a study by Brazilian researchers, The study established a direct link between cancer deaths in Belo Horizonte, the third largest city, with the antennae of the mobile telephone network [3], the research was conducted by scientists at the Federal University of Minas Gerais (UFMG), Brasil's Southern state whose capital is Belo Horizonte, According to the study, more than 80 percent of people who die in Belo Horizonte by specific types of cancer live less than 500 meters away from the 300 identified cell phone antennas in the city.

Scientists found between 1996 and 2006 died in Belo Horizonte a total of 4924 victims of cancer types that may be caused by electromagnetic radiation, such as tumors in the prostate, breast, lung, kidneys and liver.

May 31, 2011 - WHO (World Health Organization) just announced that radiation from cell phones can possibly cause cancer, as reported by CNN. February 22, 2011 - Cell Phone Calls Alter Brain Activity, Scientists Say; Fox News, Reuters. Spending 50 minutes with a cellphone plastered to your ear is enough to change brain cell activity in the part of the brain closest to the antenna. May 17, 2010 - According to the International Agency for Research on Cancer (funded in part by WHO, the World Health Organization) using a cell phone for as little as 30 minutes may increase your risk of getting a brain tumor (glioma). The study is reported to have included 13,000 participants over 10 years. March 03, 2010 - Yahoo News and CNN reports that Maine may require a warning about cell phones being a possible cause of brain cancer. Dr. Derva Davis Mt Sinai Medical center, and Dr. David Carpenter Albany University spoke in favor of the proposed bill.

Some illnesses and ailments linked to cell phone radiation include: cancer, brain tumors, Alzheimer, Parkinson, Fatigue, headache, sleep disruptions, altered memory function[4]. From an Israeli study



published in the International Journal of Cancer Prevention, Vol. 1, No. 2, April 2004, Wolf and Wolf reported a fourfold increase in the incidence of cancer in people living within 350 meters of a cell phone tower as compared to the Israeli general population. They also reported a tenfold increase specifically among women. An Austrian Study released in May, 2005, showed that radiation from a cell phone tower at a distance of 80 meters causes significant changes of the electrical currents in the brains of test subjects.

Figure 7 shows the incidence in England of malignant brain tumors close to where you hold your cell phone to your head. After about one decade spent studying the effect of cell phone radiation in England, a study reported on incidence rate of 6 per 100,000 people, roughly 2500 new malignant brain tumors a year [5].

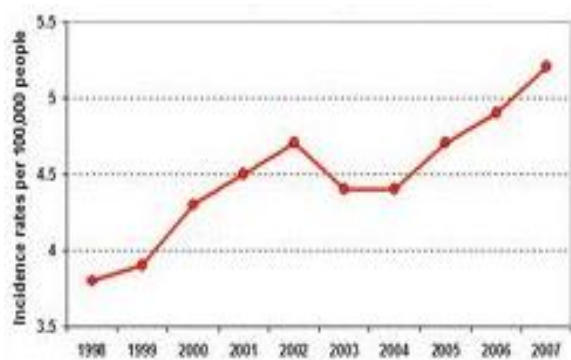


Fig. 7 Incidence rate in England of malignant brain tumors [5]

The above was some evidences about the cell phone radiation effect, because of the paper limitation pages, it can be presenting more and more.

## VI. REDUCTION OF THIS RADIATION EFFECT

As given in paper's title how can this effect be reduced on human body? In this paper, two yupes of reduction has been presented : technically and personally.

A. Technically : all mobile companies can develop this systems that they can reduce microwave systems and use the best alternative which fiber optic cables, Figure 8 is a proposed alternative using fiber optic system instead of microwave link, there are many advantages like increase in data rate transmission, radiation risks atmosphere effects on the system and reduction in radiation effects on human.

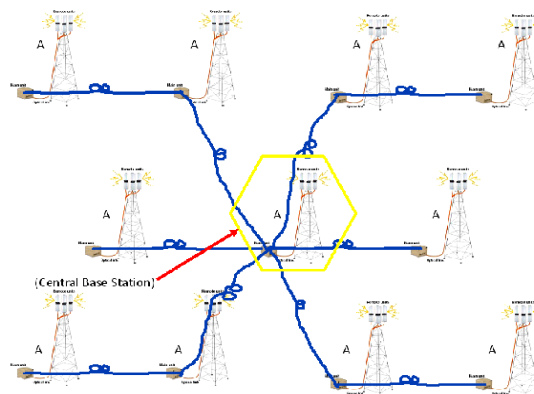


Fig. 8 Fiber optic link as alternative for microwave link [6]

B. Personally : Below are some precautions and recommendations hope be useful for anyone want to reduce the cell phone radiation effect which was the main goal of this research :

1. Phone calls must be limited to those that are absolutely necessary and try to not exceed about five – to – six minutes which is the time the body needs to adjust and if it is possible using hands-free kit and hold the phone more than 20/30cm away from his/her body in order to limit the impact of radiation on yourself.

2. Trying to not carry your phone directly on body, even on stand-by, and do not use it less than one meter away from another person, in order to reduce the effect of 'passive' radiation.

3. When he/she be on the bed try not keep a mobile phone beside the bed at night switched on, because even when on stand-by it is in contact with the nearest phone mast and emits radiation at regular intervals.

4. Avoid using the phone while in any vehicle to be safety from accidents, also, when stationary an enclosed metal container produces the "Faraday cage" effect, which maximizes the damaging impact of radiation, reflecting not only on the person phoning but also on other passengers, especially children. Thus it is essential to step out of the vehicle before making a call, as well as, when want to use it inside train, bus, etc. avoid this case because since its antenna will be constantly scanning for contact using the maximum signal strength, and the radiation from both incoming and outgoing signal will be intensified.

Try to not allowing children to use a mobile phone at all because they are still growing. With their lighter body weight the radiation is more damaging, especially to the brain, weakening the Blood-Brain Barrier (BBB), and to the reproductive organs/ovaries, etc. and those elder should be discouraged from using a mobile phone, as well as anyone in a weakened state (the

radiation will weaken their organism further), and any pregnant woman. Microwave radiation is readily absorbed by the amniotic fluid in which the embryo and then the fetus develops.

5. Avoid using the phone in a confined space such as an elevator, basement, underground station, caravan, etc. In these situations the strength of the signal both sending and receiving is much greater thus the radiation is much more intense.

6. Equip yourself preferably with: a mobile phone with the lowest possible SAR rating (= Specific Absorption Rate of microwave radiation by human body tissues). The regulation limit is 1.1W/kg for eye-sockets and cheeks and a phone with an external antenna, because even if it is less trendy, the omni-directional antenna broadcasts with maximum efficiency and therefore uses a weaker signal than one with an inbuilt antenna. The fashion factor matters less than the health factor.

7. Avoid using the mobile phone who has any metallic object in or on their head, whether magnetic or not, such as amalgam fillings and dental bridges, metal plates, screws, clips, body ornaments, earrings or metal framed glasses. The same is true for those with walking frames, wheelchairs or metal crutches, so as to avoid increasing radiation by the phenomena of reflection, amplification, resonance, passive re-emission, etc...

8. Make use of protective items to shield his/her self from radiation, such as a metal phone carrying case, protective anti-radiation fabric and veils, metallic foil wallpaper, anti-radiation paint, etc, all which have been proved to be effective.

9. Trying as he/she can as possible making calls using landlines which emit no radiation, and which can often be used for free and for unlimited time via the Internet, even for phone calls abroad.

## VII. CONCLUSIONS

The focus of this study is to evaluate ways reduce the effect of electromagnetic waves on humans and to propose alternative techniques. It is a good and useful attempt designing other techniques is better than making adjustments on current wireless systems to reduce these waves. Furthermore, will be a useful contribution to society because it will prevent cancer for many people.

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