Awareness of Electromagnetic Pollution at Homes

Allam Mousa [(1)], Rana Salameh[(2)], Rawan Abu Shmase[(3)], Khaled Hijjeh [(4)]
[(1), (2), (3)] Electrical Engineering Department, An Najah University
[(4)] Planning and Quality Assurance Manager, Jawwal

1- Introduction

If we look inside our homes, we will see our selves surrounded by a huge number of electrical devices spread everywhere in the house, these include TV sets, computer screens, laptops, mp3's, alarm clock's, refrigerators, microwave ovens, hair dryers, and cell phones.

One should take care when using all of these electrical devices, whose main purpose is saving our time and simplifying our life, because they may be dangerous to the health, and so instead of helping, we may get ill or infected. The reason is that all the electrical devices around us radiate different amounts of electromagnetic radiations which cause health problems if they exceed the allowed limits.

To know more about these possibly harmful radiations, the daily amount of radiation power coming from some popular electrical devices, which device radiations are the worst, and how we can protect ourselves from those harmful radiations, we present this study, and we hope that you, as the reader, will consider it, and make a decision to protect yourself.

Accordingly, one should be aware of the electromagnetic field and its possible health hazard. Hence, many institutions and organizations have established some references and standards illustrating the limits that one can not exceed if exposed to an electromagnetic radiation.

As part of its duties and to protect public health in response to public concern, several international organizations where established and these organizations have produced some projects on this topic. One of these organizations is the World Health Organization (WHO) which has established the International electromagnetic field project in frequency range from 0 to 300 GHz [1].

This work presents the types of radiations that a normal person may be exposed to at home; it also shows the standards and limitations set out by several international organizations. Moreover, it discusses many sources of electromagnetic producing devices which are used at home. Finally, this work illustrates the awareness of general people to this source of environmental pollution.

2- Types and Limitations of electromagnetic radiation

There are basically two types of electromagnetic radiation [2], [3];

- **Ionizing**: This has sufficient energy to strip away electrons from atoms (creating two charged ions) or to break some chemical bonds such as X-ray, Gama ray, and Beta ray.

- **Non-ionizing**: refers to any type of electromagnetic radiation that does not carry enough energy per quantum to ionize atoms or molecules that is, to completely remove an electron from an atom or molecule.

As the frequency of the signal increases then the more energy it has, hence the wave may be in the non-ionizing or ionizing range as shown in Fig.1

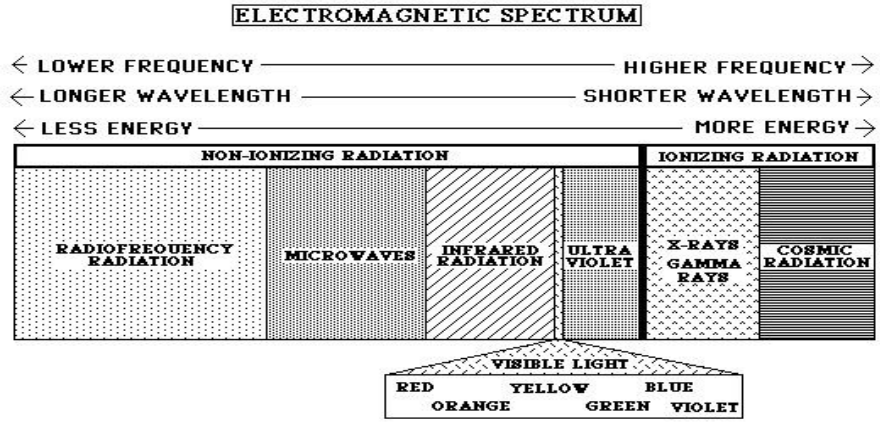


Fig.1: the electromagnetic spectrum showing the two types of electromagnetic radiation.

Radiation effects can be divided into two categories according to its level and time:
1) Stochastic Health Effects: Are associated with long-term, low-level (chronic) exposure, caused by ionizing radiation.
2) Non-Stochastic Health Effects: Appear in cases of exposure to high levels of radiation, and become more severe as the exposure increases. Short-term, high-level exposure is referred to as 'acute' exposure, caused by non-ionizing radiations.

The US Environmental Protection Agency (EPA) radiation protection standards take into account the differences in the sensitivity due to age and gender [4]. Children are growing more rapidly; there are more cells dividing and a greater opportunity for radiation to disrupt the process. A large numbers of organizations are interested in the subject of radiation and health effects. One of these organizations is the International Council of Non-Ionizing Radiation Protection (ICNIRP) which puts the standards for EMF exposure limits for both general public and occupational as shown in Fig.2. [2]. Some other concerned international organizations include; Food and Drugs Administration (FDA), Federal communications Commission (FCC), International Radiation Protection association (IRPA) and Environment Protection Authority in south Australia (EPA-SA) [5-8]

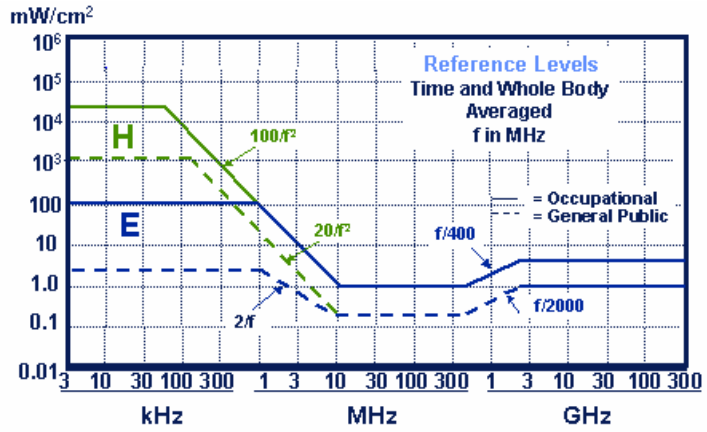


Fig.2: ICNIRP exposure limits of radiation for general public and occupational

Moreover, detailed tables are shown for both general and occupational limits of exposure to either electric or magnetic fields and the combined power density vector S could be found in the main references.

3. Home-used electrical appliances emitting EMF

Most of the electrical appliances used at homes are emitting EMF while operating; this radiation may be with different levels and at different frequencies. All of these appliances are integrated into our modern daily life, they include mobile phones, hairdryers, televisions, radios, microwaves, alarm clocks and even metal framed beds could be to blame. Electromagnetic fields of all frequencies represent one of the most common and fast growing environmental influences where all populations are now exposed to varying degrees of electromagnetic levels even when they are sitting at home. Some of these sources of pollution are stated here for demonstration; many other sources are still present. Some recommendations are given also to decrease the effect of these devices.

-Compact Fluorescent Lamps (CFLs)

Typical fluorescent lamps, including CFLs, which consumers would encounter, emit very low levels of UV waves, the majority of the light emitted by CFLs is localized to the visible region of the spectrum (approximately 400-700 nm in wavelength) [5].

There are many organizations that care about EMF radiations even from these CFL lamps, such as the Illuminating Engineering Society of North America (IESNA).

If you are particularly sensitive to either UV or even visible light (because of some medical conditions), you should be able to use these lamps at the same distance as you would use traditional incandescent lamps.

In the United Kingdom, Health Protection Agency, in a recent study, has found that there are measurable levels of UV from single envelope CFLs when used at distances closer than 1 foot [5]. Hence, in order to protect yourselves from the CFL effects:

1. Don't use CFLs at distances closer than 1 foot, for more than one hour per day.
2. Also, any additional glass, or plastic, or fabric used in lighting fixtures that is between you and the CFL will decrease the amount of radiation, since these materials act as additional UV filters.

-Mobile phones

Mobile phones produce radiofrequency (RF) radiation since most mobile phones transmit and receive RF radiation at a frequency of 900 MHZ. This is in the range of non-ionizing radiation but still it may cause heating, which can lead to severe health effects (These effects are known as thermal effects) [3].

Mobile phones may cause sensations of heating, headaches and nausea. However, whether these effects can result from the RF levels associated with mobile phones has not been verified by scientific studies.

For a phone to pass federal communication commission (F.C.C) certification[6], that phone's maximum SAR level must be less than 1.6 W/kg (watts per kilogram).

Where the SAR (specific absorption rate) is an indication of the amount of radiation that is absorbed into a head whilst using a cellular phone, the higher the SAR rating the more radiation that is absorbed into the head [9].

More over an SAR value is a measure of the maximum energy absorbed by a unit of mass of exposed tissue of a person using a mobile phone, over a given time or more simply the power absorbed per unit mass. SAR values are usually expressed in units of watts per kilogram (W/kg) in either 1g or 10g of tissue [6]. Typical limitations on the SAR values are illustrated in Table 1.

Table 1 mobile phone SAR limits:

Country	measurement protocol	Reference	SAR Limits
Europe	European Specification ES 59005 (1998)	ICNIRP Guidelines 1998	2.0 W/Kg in 10g of tissue
Australia	Australian Communications Authority (ACA) Standard (ACA RS 1999)	Australian Standard AS/NZS 2772.1	1.6 W/Kg in 1g of tissue
US	Federal Communications Commission (FCC) Guidelines (FCC 1997)	American Standard ANSI C95.1 (ANSI 1992)	1.6 W/Kg in 1g of tissue

The SAR level represents the highest SAR level with the phone next to the ear as tested by the F.C.C. Keep in mind that it is possible for the SAR level to vary between different transmission bands and that different testing bodies can obtain different results. Also, it's

possible for results to vary between different editions of the same phone (such as a handset that's offered by multiple carriers) [10]. Typical SAR values for different mobile phone manufactured and types are illustrated in Table 2 and Table 3.

Table 2 Top 10 highest-radiation cell phones (United States)

	Manufacturer and model	SAR level(digital)
1	Motorola V195s	1.6
2	Motorola ZN5	1.59
3	Motorola VU204	1.55
4	Motorola W385	1.54
4a	RIM BlackBerry Curve 8330 (Sprint)	1.54
4b	RIM BlackBerry Curve 8330 (U.S. Cellular)	1.54
4c	RIM BlackBerry Curve 8330 (Verizon Wireless)	1.54
8	Motorola Deluxe ic902	1.53
8a	T-Mobile Shadow (HTC)	1.53
8b	Motorola i335	1.53

Table 3 lowest-radiation cell phones (United States)

	Manufacturer and model	SAR level(digital)
1	Samsung Eternity SGH-A867	0.194
2	Samsung SGH-G800	0.23
3	Samsung Soul	0.24
4	Samsung Innov8	0.287
5	Motorola Razr2 V8	0.36
6	Samsung SGH-T229	0.383
7	Nokia 6263	0.43
8	Samsung SGH-i450	0.457
9	Samsung Rugby SGH-A837	0.46
10	Samsung SLM SGH-A747	0.478

In order to reduce the effect of mobile phone:

1) Use Hands free kits which allow people to make phone calls without having to hold the mobile phone next to their head. RF exposure to the head is reduced by about 100 times when compared to normal mobile phone use due to the increased separation between the antenna and the user's head.
2) Only use for short periods at a time.
3) Keep it in a bag or outer layer of clothing.
4) Turn off in places like hospitals as radiation levels are normally high enough.
5) Don't get a talk plan with lots of free minutes enticing you to use them all up.
6) Swap ears from time to time, put volume higher and hold further away from head.

7) Attach a Biophone to you're phone today.

-Computers and TV screens

Most modern computers give off relatively low levels of EMF, and some television sets and computer screens contain a cathode ray tube (CRT), which bounces electrons off the screen to create an image. The interaction between the electrons and the screen can potentially create low-level x-rays. CRT displays using vacuum tube high voltage rectifiers or regulators also generate x-rays. Because flat screen televisions and computer screens do not use CRTs, they do not produce x-rays. A cathode ray tube, on the other hand, is an emissive device which does require the presence of a sweep-frequency in the 15,000 to 20,000 Hz (VLF) range in order to perform its function [5]. It is important to note also that flat panel TVs incorporating Liquid Crystal Displays (LCD) or Plasma displays are not capable of emitting x-radiation, and do not pose a public health hazard. A Federal standard limiting x-ray emissions from TV receivers to 0.5 mill roentgen per hour (mR/hr) was issued on December 25, 1969. The standard is applicable to all TV sets manufactured after January 15, 1970. The overall effect of the standard is to require that TV receivers must not emit x-radiation above the 0.5 mR/hr level when tested under adverse operating conditions. Test conditions do not represent normal use and ensure that when used under normal conditions, TV sets do not pose a radiation hazard.

An unrelated danger is repetitive stress syndrome, which usually shows up as stiffness in shoulders, arms and wrists. It can include carpal tunnel syndrome, a potentially crippling wrist condition [5].
To minimize the effect of computer radiation:
1- Keep the computer, especially the screen, as far away as possible.
2- The simplest is to stay relaxed while typing.
3- Take a break as soon as you feel any stiffness.

-Laptops

Generally emit low EMF but when used with a mains adaptor plugged in they can cause dizziness and faint spells [5]. In order to reduce the effect of laptop's radiation then;

1- Try to recharge it away from where you are, and then use it from the battery supply.
2- Place a cactus in the office or computer room. The spine of cacti attracts charged ions and can change ionization levels in the room.
3- Take breaks when needed.
4- Very good to attach a Biophone on the monitor.

-Hairdryers

High currents produce heat. The motor gives off high EMF near the handle, dropping only a little at a drying distance of 6-18 inches away from you. The fields are higher when on higher settings. The fact that a hairdryer is only used for a short time at any one interval is not as important as the fact that the user is exposed to high levels of EMF during that period.

Metal hair clips can increase the EMF from the working hairdryer. It is best not to use a hairdryer after 7pm as high levels of EMF near to the head are known to interfere with the body's production of melatonin which helps the body to repair itself [3].

-Electric kettles

Both traditional and jug type create high EMF levels. Heating water using electricity can change its molecular structure. Some people who react badly to this change may suffer from headaches, eye problems or tremors. Neutralize the effect by standing the cup/mug/glass on a Vita flow whilst pouring.

-Beds

Metal framed beds and bedsprings can become magnetized by electricity in wiring and appliances, causing restlessness and insomnia. Try an alternative bed-base and non-spring mattresses, preferably with natural materials. Keep electrical appliances at least 3 ft away from a bed head area.

-Microwave oven

A Federal standard limits the amount of microwaves that can leak from an oven throughout its lifetime to 5 milliwatts (mW) of microwave radiation per square centimeter at approximately 2 inches from the oven surface [5]. This limit is far below the level known to harm people. Microwave energy also decreases dramatically as you move away from the source of radiation. A measurement made 20 inches from an oven would be approximately one-hundredth of value measured at 2 inches.

Microwave ovens are used daily in restaurants, cafeterias, lounges, kitchens, snack bars, and homes. Microwave oven users are often concerned about potential health hazards from the exposure to microwave radiation leakage [5]. With the latest technological advances in door seal design and with proper maintenance, microwave oven leakage has been greatly minimized or even eliminated.

Leak radiation:

Old or faulty door seals are the most common causes of microwave radiation leakage. Mechanical abuse, a build-up of dirt, or simple wear and tear of continued use can cause door seals to be less effective. Theoretically, there will be small amounts of leakage through the viewing glass but measurements have shown this to be insignificant.

Safety tips for operation of microwave ovens:

A summary of some important tips in order to deal with the microwave oven safely can be stated as;

1- Do not operate oven when empty.
2- Exercise extreme caution if you have a pacemaker implant. Microwave radiation may cause pacemaker interference. Persons with pacemaker implants should not be near a microwave

oven unless they are sure that it is in good operating condition and there is no leakage of microwave radiation.

3- Check to see that door seal and inside surfaces of door and oven cavity are clean after each use.
4- Keep out of the reach of children. Do not permit young children to operate the oven.
5- Do not put face close to door window when oven is operating.

4- Awareness of people to this radiation

A survey has been performed to examine if people are aware of the EMF radiated out of the home appliances, several categories are checked as illustrated in table 4. The sample was asked several questions related to their behavior and awareness while dealing with an EMF radiating device then the results were presented accordingly.

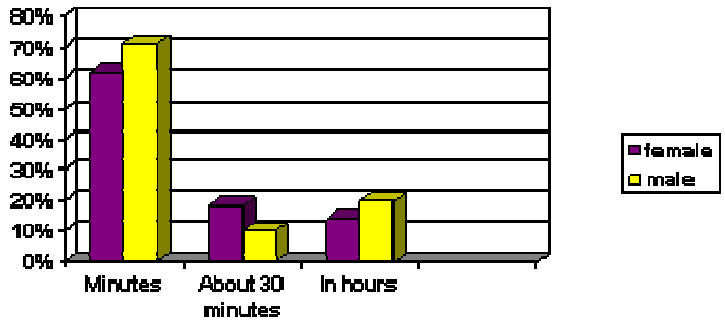
Table 4 population samples categories

	Female	male
Age (25-18)	98%	88%
Age (40-25)	2%	10%
Scientific collage	30%	20%
Human sciences college	22%	47%
Electrical engineering college	46%	33%

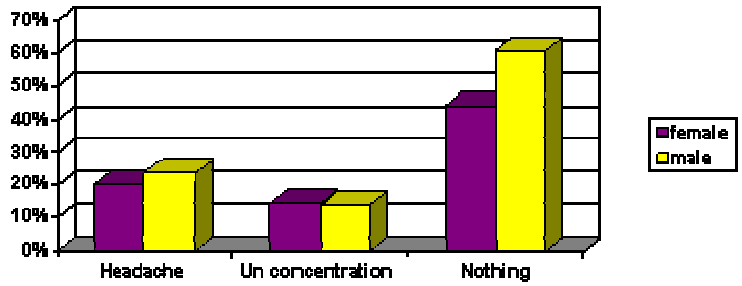
1. **Mobile phone:**

90% of the females own at least on cell phone
99% of males own at least on cell phone.

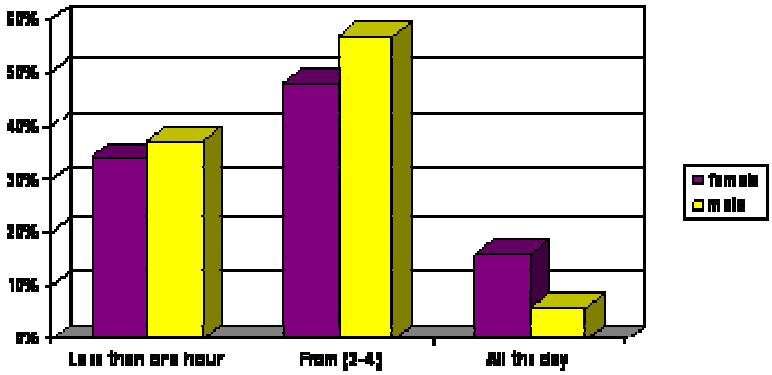
How much time do you spend in a cell phone call daily?



After having a long cell phone call, you notice:

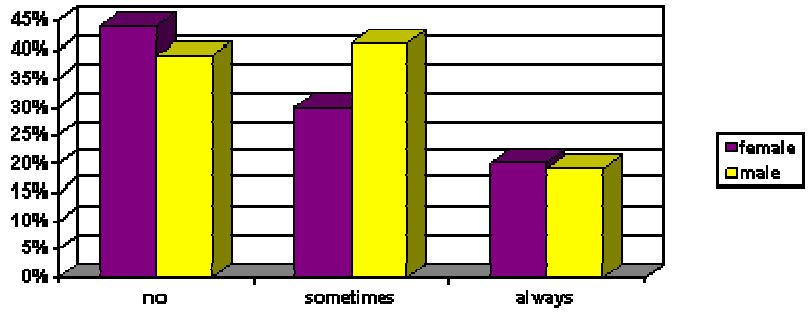


2. Computers and TV screens



3. Microwave oven:

Do you use microwave oven?



Awareness of Electromagnetic radiated out of these devices

1) Do you know that these devices may have health hazard du to EMF radiation

- 72% of females say : yes

- 86.27% of males say : yes

2) Do you care about reading the instructions about amount of radiations from any device they use?

- 62% of females say : yes
- 60.78% of males say : yes

3) Are you ready to reduce their use of the electrical devices or replace it with a more safety devices?

- 82% of females say : yes
- 86.27% of males say : yes

5. Conclusion

As we know the main goal of using radiation is to facilitate people lifes and to solve complicated problems such as diagnoses fatal diseases, metals discovery, and others that are used in electrical appliances and in telecommunications.

In this work we have concentrated on the radiations emitted from those electrical appliances specifically which we use in our homes. We have noticed that there is a conflict about how dangerous those radiation are; manufactures and huge electrical appliances companies claim that they do not exceeds the standard allowed limits of EMF radiation and so there is no danger of using them.

So we concluded that all electrical appliances emit an amount of radiation, this amount varies from one device to another, and that is scientifically approved. Despite the fact that there is no evidence on the relation between EMF radiations and health problems, human body response differs from one person to another, so one may badly react with radiations. In order to protect yourself we advice you to take care while using those appliances and to follow the safety tips.
After applying our survey to a sample of people in the university we have noticed that people are aware of this possible danger but unfortunately their daily behavior is careless.

6. Recommendations

Finally, after completing this study on radiation effects and the possible danger behind the use of electrical devices in our daily life, we may state the following recommendations;

1- You should believe that this danger is possible if limitations are not met.
2- Try to control your use of the electrical devices especially cell phones, CRT computer screens and microwave ovens.
3- Tell your family, friends and every one you know about the existence of these limitations.
4- Be aware of reading the instructions and the information's about the amount of radiations from any electrical devices you buy or you have.
5- Schools, universities and social centers must play a role in increasing the awareness of people about this subject.

7. References

1 World Health Organization (WHO)
2 International Commission on Non-Ionizing Radiation Protection (ICNIRP).
3 Radio Frequency Radiation (RFR)
4 Environment Protection Agency (EPA)
5 Food and Drugs Administration /FDA radiological health program /Compact Fluorescent Lamps (CFLs) – Fact Sheet/FAQ (CFL)
6 Federal communication commission (FCC). www.fcc.gov
7 IRPA (International Radiation Protection Association
8 Environment Protection Authority in South Australia (EPA-SA) www.epa.sa.gov.au/mobilephone.html.
9 Mast Sanity.org (the primary national organization opposing the insensitive sitting of mobile phone and Tetra masts in the UK.)
10 The technology news site CNET www.cnet.com