BIOLOGICAL EFFECTS OF MOBILE PHONE RADIATION – STUDY WITH BASE OF DIFFERENT ROOFING AND FLOORING CONDITIONS

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Abstract:

Nowadays the use of mobile phones is increasing in a rapid rate. The radiations emitted from the mobile phones are creating many harmful effects on human beings. Thus the studies of mobile phone radiations have a manifold importance. The power density emitted from every radiation is collected by using a microwave leakage detecting device. From that the specific absorption rate of different organs and different age groups are determined and analyzed the harmful effects of radiation.

Key words: **Radiation, Power density, Microwave, etc**

INTRODUCTION

Everything around us, visible or not, can be classified either as matter or energy. Matter is characterized by its mass, which is the quantity of matter. According to the mass-equivalence relationship proposed by Einstein, mass also represents the energy equivalence of that matter.

Energy can be best defined as the ability to do work, and there are many different types of energy: potential, kinetic, chemical, thermal, electrical, electromagnetic, and nuclear energy are the most familiar forms. Matter can be transformed into energy and energy can easily be transformed from one type to another. This is how the nuclear energy from a power plant starts as matter and is ultimately transformed into electrical energy, which can be further transformed into electromagnetic energy like the energy in a bulb that lights a room or in an X-ray radiographic device in a radiology facility.

Energy that is emitted and transferred is called radiation, and matter that intercepts radiation and absorbs part or all of it is said to be exposed or irradiated. The sun, for example, transfers all the energy that sustains life on earth through electromagnetic radiation.

The amount energy in any type of energy cited above may vary greatly as different types of energy have different work capacities. Electromagnetic radiation carries a very large range of different energies depending on the radiation frequency or the inverse of the radiation wavelength. We are most familiar with radiation with a wavelength of 10^{-6} to 10^{-7} m because these wavelengths constitute visible light. Longer wavelengths include microwaves and radio waves, whereas shorter wavelengths with higher energy levels include UV light, X-rays and gamma rays.
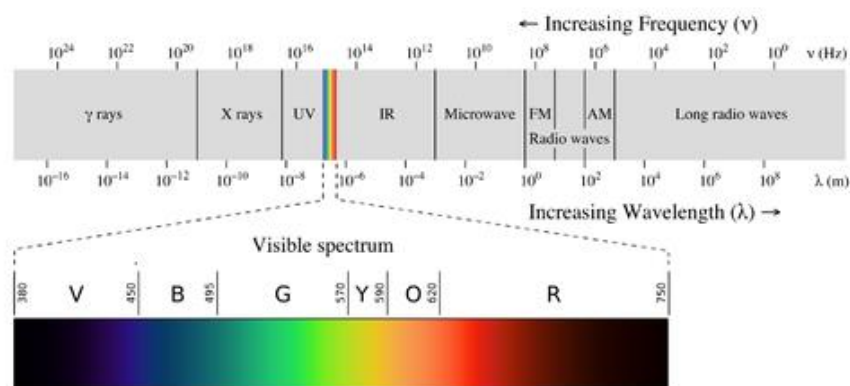

Figure 1.1Electromagnetic spectrum

Just as an atom represents the smallest component of an element of matter, the smallest quantity of electromagnetic radiation is called a "photon". There are light photons, x-ray photons, gamma ray photons, and other types of photons as well, and these photons are characterized by their different energy. In physics, radiation is the emission or transmission of energy in the form of waves or particles through space or through a material medium. This includes: electromagnetic radiation, such as radio waves, microwaves, visible light, x-rays, and gamma radiation (γ) particle radiation, such as alpha radiation (α), beta radiation (β), and neutron radiation (particles of non-zero rest energy)acoustic radiation, such as ultrasound, sound, and seismic waves (dependent on a physical transmission medium)gravitational radiation, radiation that takes the form of gravitational waves, or ripples in the curvature of space time.

Area under Study

Mobile phone technology has made drastic transforms in global telecommunication scenario with exponential growth in cell phones and base towers. The cause of non-ionizing electromagnetic radiations on human health is a subject of severe anxiety with

the massive installation of base stations. With a view to study the near field areas of base stations, we selected certain locations in southern districts of Kollam and Trivandrum in Kerala state, India.

The experimental locations were on the shingled roofing and cement flooring condition. Then the readings are taken for normal condition in which radiation is taken at very close distance, 15 cm away from ear, large sized closed room, and in kitchen and the conditions change like day night. Also reading will take at changing distances of the mobile phone from the ear. The study was carried out in the rural areas like NIlamel, Kadakkal, Ayoor and Kilimannor. In order to detect the radiation we use two sets of handsets. Power densities were measured suing a New Handheld Pocket Digital LCD Microwave Leakage Radiation Detector.

Theory

The power density was estimated and hence the specific absorption rates for different tissues of the human body were estimated using the equation,

$$SAR = \sigma E^2 rms/\rho$$

Where σ is the electrical conductivity and ρ the mass density of the respective tissue to whom the specific absorption rates are estimated.

According to the fundamental physics, Poynitng theorem defines

$E \times H =$ Power density

By getting the value of E_{rms} can be calculated by the equation $E_{rms} = E/\sqrt{2}$

Absorption of the radiation by a body may change according to age, ie. For adult it is 25%-40%

For 7 year old child it is 50% and for 3 year old it is 80%

The values of electric conductivity and mass density of different tissue types used were adopted from the literature and are shown in the Table-1.

Tissue type	Electric conductivity(s/m)	Mass density ρ(kg/m^3)
Brain	0.92	1000
Blood	2	1057
Eye(corona	2.32	1151
Fat	0.19	943
Skin	1.2	1125
Muscle	1.3	1090

Table -1. Electrical conductivity of various type of human tissues

Results and Discussions

Estimated power densities at different locations for different handsets are presented in the Table-1

Type of Hand set	Shingled Roofing & Cement flooring		Power density(W/m^2)	Electric field(V/m))
	Place/Location	Conditions		
Hand Set 1	Normal Condition	Day	96.35	53.9
	Normal Condition	Night	72.5	46.75
	Large Closed Room	Day	94.45	53.51
	Large closed room	Night	99.83	54.66
	15 cm away from ear	Day	95.4	53.8
	15 cm away from ear	Night	81.4	49.54
	Kitchen	Day	92.5	52.96
	Kitchen	Night	98.15	54.55
Hand Set 2	Normal Condition	Day	99.35	54.73
	Normal Condition	Night	96.55	54.1
	Large Closed Room	Day	99.7	54.82
	Large closed room	Night	98.1	54.54
	15 cm away from ear	Day	91.3	52.61
	15 cm away from ear	Night	90.85	52.48
	Kitchen	Day	76.35	48.11
	Kicthen	Night	95.9	53.92

Using these data from the hand set 1 the SAR values for five vital human tissues for different age groups were estimated and are presented in the following table 3 and 4. Weighted mean for an age group of 40 years (adult) has also been presented.

	Shingled Roofing & Cement flooring		Mean Specific Absorption Rate of different part of human body (mW/Kg)					
	Place/Location	Place/Location	Brain	Blood	Eye	Skin	Muscle	Fat
Hand Set 1	Normal Condition	Normal Condition	1.3	2.7	5.9	3.1	3.7	0.6
	Normal Condition	Normal Condition	2.0	4.1	4.4	2.3	2.8	0.4
	Large Closed Room	Large Closed Room	2.6	5.4	5.8	3.1	3.6	0.6
	Large closed room	Large closed room	2.7	5.7	6.0	3.2	3.8	0.6
	15 cm away from ear	15 cm away from ear	2.7	5.5	5.8	3.1	3.7	0.6
	15 cm away from ear	15 cm away from ear	2.3	4.6	4.9	2.6	3.1	0.5
	Kitchen	Kitchen	2.6	5.3	5.7	3.0	3.5	0.6
	Kitchen	Kitchen	2.7	5.6	6.0	3.2	3.8	0.6

Table 3: Mean Specific absorption rate of the Hand set 1

	Shingled Roofing & Cement flooring		Mean Specific Absorption Rate of different part of human body (mW/Kg)					
	Place/Location	Conditions	Brain	Blood	Eye	Skin	Muscle	Fat
Hand Set 2	Normal Condition	Day	2.8	5.7	6.0	3.2	3.8	0.6
	Normal Condition	Night	2.7	5.5	5.9	3.1	3.7	0.6
	Large Closed Room	Day	2.8	5.7	6.1	3.2	3.8	0.6
	Large closed room	Night	2.7	5.6	6.0	3.2	3.8	0.6
	15 cm away from ear	Day	2.5	5.2	5.6	3.0	3.5	0.6
	15 cm away from ear	Night	2.5	5.2	5.6	2.9	3.5	0.6
	Kitchen	Day	2.1	4.4	4.7	2.5	2.9	0.5
	Kitchen	Night	2.7	5.5	5.9	3.1	3.7	0.6

Table 4: Mean Specific absorption rate of the Hand set 2

Using these data the SAR values forsix vital human tissues for different age groups were estimated and are presented in the following table 5

Age group	Mean Specific Absorption Rate of different part of human body (mW/Kg)					
	Brain	Blood	Eye	Skin	Muscle	Fat
Infant	5.60	11.51	12.26	6.57	7.68	1.23
10Year old child	2.79	5.74	6.11	3.27	3.83	0.61
Adult	2.6	5.3	5.6	3	3.5	0.6

Table 5   The estimated SAR for vital human tissues for different age group

By analysing the readings taken for different roofing and flooring conditions and graphs are drawn. We have arrived at many conclusions. The specific absorption rates of organs such as brain ($\sigma = 0.92$), blood ($\sigma = 2$), eye ($\sigma = 2.32$), skin ($\sigma = 1.2$), muscle ($\sigma = 3.77$) have shown values which are a little bit higher than usual. It is because that the absorption by an adult may vary from 25% to 40%. Here we have taken the upper limit 40% and hence we have obtained higher values.

By analyzing the first table we have seen the specific absorption rates of different organs. The specific absorption radiation is varying under the different condition and also different handsets. The more radiation is the condition in which concrete roof with cement floor. In that condition the specific absorption rates of organs such as brain, blood, eye, skin, muscle are very high and also the second hand set has high radiation emits compared to the first hand set. In these organs radiation affect more harmful to eye. In asbestos roofing with cement flooring and in asbestos roofing with tiles flooring have high specific absorption rate on eye. It shows around 6.88.

From the second tabular column we get the effect of radiation on different age groups. It includes adult which has absorption of 40%, child which has absorption of 60%, infant having absorption of 80%. It is clear that E is greater for infant and the high value of E_{infant} getting from shingled roofs and cement floor. So the increasing use of radiation is more affected to infants. E_{adults} absorb only 40% of E_{rms} so the radiation is less affect to the E_{adult}. E_{child} has high value in the condition metal sheet roof and cement floor. It is clear that the people living near the mobile towers in the study regions especially children are exposed to radiation with higher specified rates, especially outdoors. It can be seen that for the range 0 to 18 m distance from the tower the estimated figures of SAR exceed the limit, especially for blood and cornea for the children. The figure 1 shows the distribution of dose rate for different human tissues resulting from the exposure to mobile radiations.
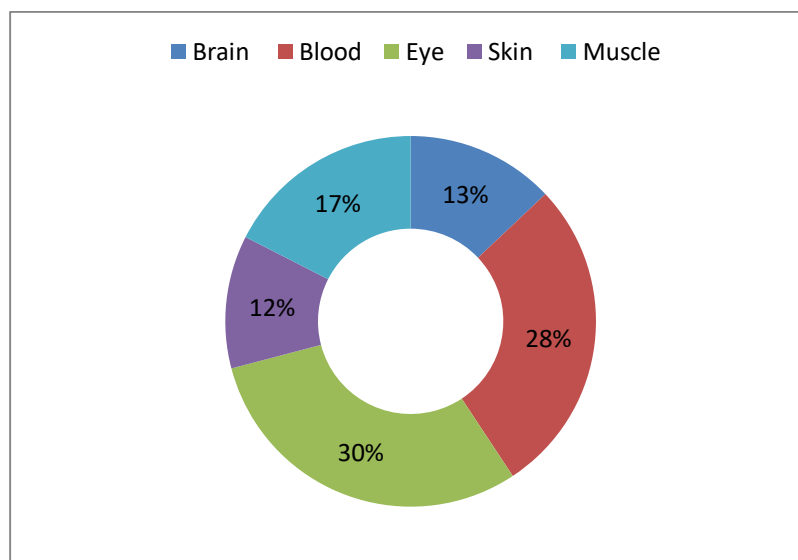
Figure 1 Distribution of SAR values in mW/Kg for different human tissues from mobile radiations

The effect of increased brain activity in children because of cell phone radiation is another area yet to be studied. The skull of a child is thinner, allowing radiation to penetrate deeper compared with that of an adult Children's cells divide at a faster rate, so the impact of radiation can be much larger, which is why we believe the pediatric population is at a higher risk." The figure 2 shows the distribution of dose rate for different age group resulting from the exposure to mobile radiations. It shows that radiation exposure to the children is greater than the other age group.
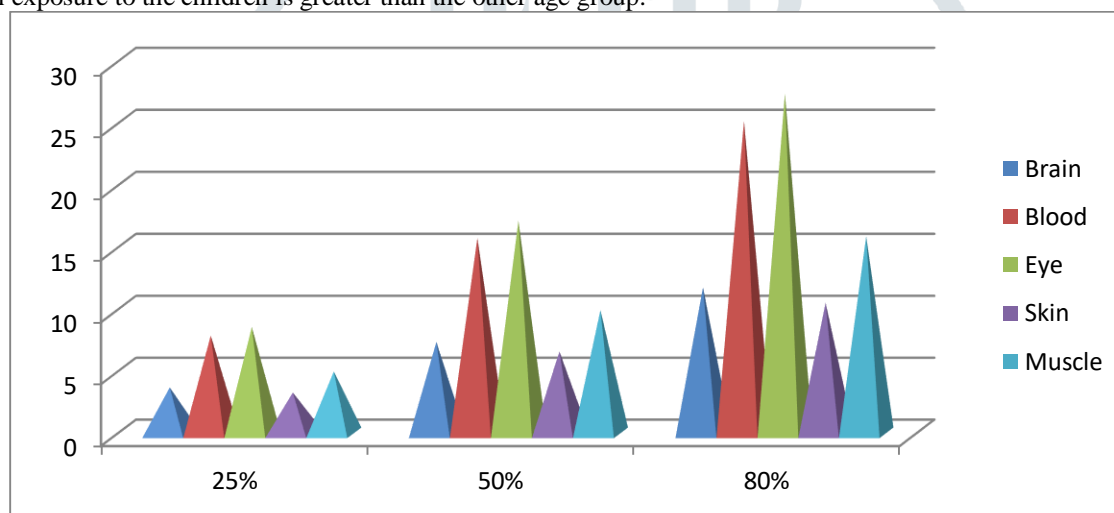

Figure 2: Distribution of dose for different age group verses SAR value for different human tissue

For now, there are no conclusive answers. And the new research joins numerous previous studies on cell phone radiation that have been unable to definitively prove or disprove cell phones' safety.

While the world waits for more research to be conducted, consumers can take steps to limit cell phone radiation exposure by using the speakerphone or a wired earpiece to make calls. "The human brain is sensitive to the electromagnetic radiation emitted by cell phones, but for the brain to be impacted, the cell phone has to be close to the head," So keep your brain away from the antenna."

By analysing the readings taken for the shingled roofing and cement flooring and graphs drawn from the readings, we have arrived at many discussions. The specific absorption rate for organs such as brain(σ=0.92), blood(σ=2), eye(σ=2.32), skin(σ=1.2), muscle(σ=1.3),have shown values which are a little bit higher than usual. It is because that the absorption by an adult may vary from 25% to 40%.here we have taken the upper limit 40% and hence we have obtained higher values. The readings are taken for two handsets, handset-1 and handset-2.the handset-2 have shown larger values.

The study includes adult which have absorption of 40%,child(above7)which have absorption of 60%,infant(less than 7) having absorption of 80%.Thus we can conclude that the phone radiations have harmful effects on all age groups but it is more pronounced for small children of age less than 7. The different readings are taken in shingled roofing and cement flooring. The readings are taken for normal condition in which radiation is taken at very close distance, 15 cm away, in large sized closed room ,in kitchen. The readings are taken at both day time and night time. The radiation is seemed to be high at day than at night time. The high readings are obtained in large sized closed room .On closed conditions and with metal shielding, the radiation is higher. Hence radiation is higher in closed room. Hence using of mobile phone in closed room are not preferable. It may cause many harmful effects. The least reading is obtained in kitchen. In kitchens having granite flooring the radiation will be greater. But we have considered cement flooring and hence the radiation is not too much higher. The radiation level in kitchen may vary based on the size and geographical location.

In all the conditions the readings taken at day time have shown larger values as compared to night. Several atmospheric radiation models are developed for studying the variation of radiation at day and night time. Brutsaert model, Berdahl and Martin models are examples of such models. All models showed good behavior for night time data and less radiation. Always overestimated radiation is obtained at day time. In day time the effect of solar radiation also increases the radiation levels. Thus from the

readings we can conclude that the phone radiations have harmful effects on all age groups but it is more pronounced for small children of age less than ten. The radiation levels may vary according to different environmental conditions, types of roofing and flooring ,time of measurement such as day and night, shielding provided by different things, age of people who is exposed to the radiation.

Conclusions

The results of the study point out that the people existing close to mobile towers are exposed to high levels of non-ionizing radiation originating from the mobile base stations. The observed value from the experiment shows that all the dose value shows the international limit of SAR for adult. But he estimated figures of SAR exceed the limit for children, especially for blood and cornea. It can be concluded that lower age groups are more prone to the effects of mobile tower radiation. As a conclusion we have to say that

- Avoids calls during charging or using it more than necessary
- Children should use mobile phones for essential purposes
- SAR value is not a safety limit of mobile phone radiation
- Keep in speaker mood or use safe headset
- Prefer text massages rather than using cell phone often.
- Switch to flight or off-line mode when not in use.
- Avoid using phones when the signal is weak
- Avoid using mobile phone inside a vehicle
- Store it away from your body
- Do not sleep near your cell phone

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