

# Research for Technical Advancement in Developing of Shield Material to Protect from Wireless Devices

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**Abstract:** As we know that, the mobile phone makes an important place in human life. But along with the benefits, mobile phones are also quite harmful. The electromagnetic radiations (EMR) of the mobile phone can disturb the biological process of the human body and cause brain tumor and cancer like harmful diseases. These EM radiations do greater bodily damage to under 14-year-old children because the brain tissue of children can have absorbed two times more EMR than adults because of their thinner skull that is relatively smaller than adults. In this paper we have made a shield that is made up from the combination of different types of material that is conductive, non-conductive and composite by nature which is capable of preventing EMR from a large extent. The device we used to check the radiation and the SAR is Samsung J2 Pro with model no. SM-J2-10F and to note their values we used Electromagnetic Radiation detector DT-1130. After using the shield with detector DT-1130, we have come to know that the previous radiation value of this device is 1620  $\mu\text{W}/\text{cm}^2$  without using the shield. After applying the shield, the value of radiation is decreasing, which are 912  $\mu\text{W}/\text{cm}^2$ .

**Keywords:** EMR, SAR, DT-1130,  $\mu\text{W}/\text{cm}^2$  and W/Kg.

## I. INTRODUCTION

Now mobile phones have become a crucial part of life all over the world. Nowadays technically mobile phones have an ability of not only making and receiving calls, but can be used as multitasking such as storing data, taking pictures, and can even use a walkie-talkie. The rising of the cellular phone has raised the anxiety about the possible interaction between the electromagnetic fields (EMF) radiation and the biological effects on the human body especially the brain. These concerns have prompted a large volume of research in the recent past. However, most of the previous reviews are engaged to find out the negative impact caused by cell phones. [1]

New studies suggest that mobile phone is suspected to have huge amount of harmful radiation that might double the risk of developing cancer on the side of head where we used to pick the phone, increase brain activity, can damage the nerve around the ears and more importantly it can damage the blood-brain barrier (BBB). Also, new researches show that biological effects are possible without any warming of tissues which is imposed of the current radiation exposure levels. [2]

**In this we have discussed the Impact on Human about the various modern area of EM Radiation:**

### 1.1 Effect of EMR on body

When electromagnetic waves pass through our body an electrical current is induced inside our body. Naturally, electrical impulses are used by our body for thinking, conveying sensory information, controlling heartbeats and for muscular movements. For the precise functioning of a body, a chemical process which takes place in our cell, tissue, organs, and blood depends on an electrical charge that is present in the body. So as a conclusion of it, when an external EMF is interfaced with our body then it may disturb many of the biological processes that may increase in temperature of body tissues and cause brain tumor or cancer which is one of the most visible impacts of such radiations. [3]

### 1.2 Biological Impact of EMR on Human

Mobile phones are suspected to have a huge amount of radiation that is very harmful to human as well as animal also. So that an electromagnetic shield is developed as a safety for human beings to minimize the risk of the electromagnetic radiation. we need electromagnetic shielding for reducing electromagnetic fields. A research by Defender Shield reports that 5-year-old child absorbs more radiation than adults. This research was completed by examining the skull of a 5-year-old child, 10-year-old child, and adult as shown in fig 1.1. As a result of it, 5-year-old and a 10-year-old child were much radiated than that of an adult's brain. So there is a need for electromagnetic shielding to reduce the bad effect of mobile phone radiation that harms the biological process in the human body. [4]

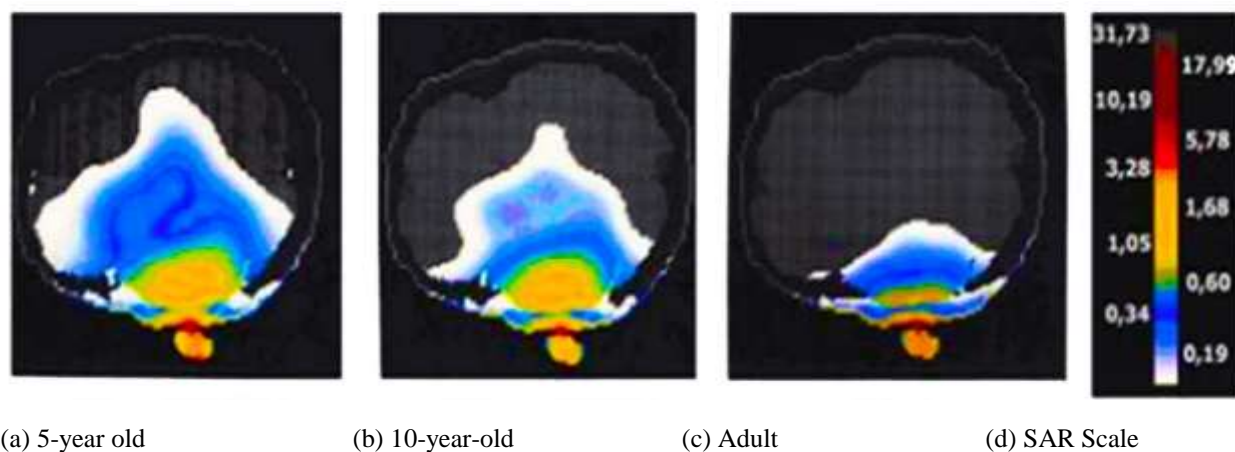


Fig 1.2 Skull model of three different person[4]

### 1.3 Effect of EMR on Children

Children and unborn babies are much effected by EMF radiation than adults. They do face a greater bodily damage because multiple types of research have shown that the brain tissue of children can absorb two times more MWR than adults. Children’s skull is thinner and relatively smaller than adults, that is why the rate of MWR absorption is higher in children. Also, a new study has reported that bone marrow of children is ten times more absorbent of MWR than that of adults. [4]

### 1.4 Specific Absorption Rate (SAR) Measurement

The limit of exposure use as a unit of measurement is known as SAR. A rate in which how much energy is absorbed by the human body exposed to radio and electromagnetic frequency. SAR is power absorbed by the mass of tissue and its unit in watts per kilogram (W/kg). SAR is usually measured either over the whole body (10g of tissues) or over a small volume (1 g of tissue). A regulatory threshold SAR value for the mobile phone device has accessed by every country. 1.6 W/kg units for 1g of tissue and 2.0 W/kg units for 10 g of tissues are being the regulatory unit in India. In India, no mobile company can able to exceed this fix regulatory unit. [5]

### 1.5 Table Harmful Impact of SAR on Human

Sr. No.	SAR	Reported Biological Effects	Year	References
1.	0.000021- .0021 W/Kg	It can change in the cycle of the cell at 960 MHz GSM cell phone	1997	Kwee, (Sage)
2.	0.0004 W/Kg	It can cause a change in the Blood-Brain Barrier (BBB) at 915 MHz GSM cell phone.	1997	Salford, (Sage)
3.	0.0008 W/Kg	It can increase the DNA Strand Breaks.	2009	Kesari and Behari, (Levitt/Lai)
4.	0.0004-0.008 W/Kg	It can cause leakage in Blood Brain Barrier (BBB) at 915 MHz GSM cell phone	1997	Persson, (Sage)
5.	0.001 W/Kg	It affects the cell growth rate and damages the DNA.	2000	de Pomerai, (Sage)
6.	0.0027 W/Kg	It can cause a behavioral change in human after 5 hours of mobile exposure	1994	Navakatikian, (Sage)

7.	0.0037 W/Kg	It may change the repair mechanisms of DNA.	2009	Belyaev et al, (Levitt/Lai)
8.	0.005 W/Kg	It can increase calcium flux in human cells.	1989	Dutta et al (Levitt/Lai)
9.	0.0024 W/Kg to 0.024 W/Kg	It can damage the DNA and DNA repair mechanisms. Also, the low intensities digital cell phone can cause DNA effect in the Human cell.	1989	Phillips, (Sage)
10.	0.0317 W/Kg	It can decrease in eating and drinking and cause abdominal stomach problems.	1990	Ray & Behari, (Sage)
11.	0.3-0.44 W/Kg	More use of cell phone change the cognitive thinking and mental task related to memory retrieval.	2000	Preece, Koivisto et al, (Sage)
12.	0.3-0.44 W/Kg	Within this range, use of cell phone results in change in cognitive thinking and mental tasks related to memory.	2000	Krause et al, (Sage)
13.	0.037 W/Kg	By ultra-wide band pulses - 600/Sec, 30 min, it can cause hyperactivity by nitric oxide synthase inhibitor.	1999	Seamans, (Sage)
14.	0.005 to 0.05 W/Kg	It can increase calcium flux.	1989	Dutta et al, (Sage)
15.	0.121 W/Kg	It can cause a significant decrease in arterial blood pressure (hypertension).	1999	Lu et al, (Sage)
16.	0.14 W/Kg	It can harm the immune response at 100 $\mu$ W/cm <sup>2</sup> .	1996	Elekes, (Sage)
17.	0.26 W/Kg	It can cause harmful effects to the eye.	1992	Kues, (Sage)
18.	0.15-0.4 W/Kg	At 480 $\mu$ W/cm <sup>2</sup> , it can increase the risk of malignancy. Tumors statically	1992	Chou, (Sage)
19.	0.58 - 0.75 W/Kg	With 836 MHz TDMA Digital cell phone, it can cause tumors in the brain.	1996	Adey, (Sage)
20.	to 1.0 W/Kg (max)	With 900 MHz cell phone exposure during sleep, it can changing the patterns of sleep and EEG	1999	Borbely et al, (Sage)

21.	0.6 and 1.2 W/Kg	Increase in DNA single and double strand breaks from RF exposure (2450 MHz)	1996	Lai & Singh, (Sage)
22.	2 - 3 W/Kg	It can cause skin cancer and breast tumors.	1982	Szmigielski, (Sage)

**1.6 Following are some reports that prove the current problems of the bad Impact of EMR on human health:**

- 1) The WHO reported on cell phone radiation and concluded that EMF can increase the risk of brain cancer. They also concluded that long-term and short-term cell phone exposure can damage the brain activities. [6]
- 2) Neuroscientist Dr. Johansson, a professor at Karolinksa Institute in Stockholm, Sweden confirms the danger of electromagnetic radiation. Their studies have shown that EMF has a measurable effect not psychosomatic. [7]
- 3) To prove the bad effect of electromagnetic radiation, an interesting work was done by the Environmental Health Trust with a team in Brazil to calculate the rate of cell phone radiation absorption in the brain. A model has developed that show radiation absorbed by a man and a 3-year-old girl as shown in fig 1.2. The result was analysed after both have 6 minutes' conversation on a cell phone that 3-year-old girl's brain was more affected by EMF and have relatively greater absorption rate in tissues than adult's brain. (The red/orange area represents the areas of radiation). [8]



Fig 1.6 shows the radiation absorbed by adult's and child's brain. [8]

**1.7 Table shows the SAR value in Branded/ Non-Branded:**

Sr. No.	Mobile Phone	Model Number	Given SAR (W/Kg)	Frequency $\mu\text{W}/\text{cm}^2$	Observed SAR (W/Kg)
1.	Samsung J2 Pro 16	SM-J2-10 F	0.780	1620	0.0902
2.	I Phone 5	MF 35 2HNA	1.18	1622	0.0903
3.	Motorola	Moto E (2G)	0.16	1161	0.0646

4.	Samsung J7	SM A710 F	0.296	1509	0.0840
5.	I-Pad	MP2F2HNA	1.19	1412	0.0786
6.	Samsung Galaxy Tab 2	GT-P3100	0.831	1228	0.0683
7.	Intex	Yuvi+	0.902	874	0.0486

## II. TYPES OF MATERIAL

Mainly there are two types of material that is used for developing an electromagnetic radiation shield. They are:

- Conductive material
- Non- Conductive material

**2.1 Conductive Material:** In conductive material, the electrical current will flow in one or directions and current is generated by flow of positively charged holes and negative charged electrons. A metal made material is common example of electrical conductors.

Conductive materials are classified into two parts that are low resistivity or high conductivity and high resistivity or low conductivity. Example of low resistivity or high conductivity materials are silver, copper, gold and aluminium etc which are low in resistivity and high in conductivity. And example of high resistivity or low conductivity are tungsten, carbon, nichrome, magainin etc which are high in resistivity and low in conductivity. [9]

**2.2 Non- Conductive Material:** A non-conductive material does not conduct heat and electricity to the material. These kinds of material are also a type of insulators in which internal and external charges do not move freely. [10]

**2.3 Table shows the list of Conductive and Non-Conductive Material [11]**

Sr. No.	Conductive	Non-Conductive
1.	Copper	Paper
2.	Aluminium	Teflon
3.	Platinum	Glass
4.	Gold	Rubber
5.	Silver	Oil
6.	Air	Asphalt
7.	Plants	Fibre glass
8.	Iron	Porcelain
9.	Steel	Ceramic
10.	Brass	Quartz
11.	Bronze	Cotton
12.	Mercury	Paper
13.	Graphite	Wood
14.	Concretre	Plastic

## III. FORMULA FORMATION

The mobile phone exposure limits use SAR (Specific Absorption Rate) as a unit of measurement. The SAR limit is 1.6 W/Kg for mobile phones. The detector, we used to measure the rate of radiation is Electromagnetic Radiation Detector DT-1130. The unit of measurement of this device is microwatt per square centimeter ( $\mu\text{W}/\text{cm}^2$ ). For calculating the SAR value, we have to convert  $\mu\text{W}/\text{cm}^2$  to W/Kg.

So formula formation is as follows

$$\mu\text{W}/\text{cm}^2 = \text{W}/\text{Kg}$$

Firstly, convert microwatt to watt i.e. 1mw is equal to  $10^{-6}$  which is equal to 1/1000000

Then convert Kg to cm

1 Kg is equal to  $415.54\text{cm}^3$

From this we can find 1 Kg to  $\text{cm}^2$

So 1 Kg is equal to  $55.6855\text{cm}^2$

By this formulation we can convert  $\mu\text{W}/\text{cm}^2$  to  $\text{W}/\text{Kg}$  and easily calculate the SAR value from Electromagnetic Radiation Detector DT-1130.

#### IV. MATERIAL USED IN SHIELD

For development of the shield we used different types of material. The material used is a type of conductive material, non-conductive material. The list of material used in developing of shield is as follows:

- Waste paper/ Newspaper which is non-conductive
- PVC Glue
- A metal Shield mixture which is made up of:
  - Copper
  - Zist
  - Brass



Fig. 4.1 Metal shield mixture

- Aluminium Tape is a conducting material in the form of tape.

#### 5. Device used for Detecting Radiation and SAR (Specific Absorption Rate)

The device used for detecting Radiation and SAR value is Samsung Galaxy J2 Pro 2016 with the model name of SM-J2-10F. The SAR value of this device is  $0.780 \text{ W}/\text{Kg}$ .

#### V. DEVELOPMENT OF SHIELD

For developing Anti-Radiation Shield, there are some steps that are written as follow

- Firstly, make a copy case phone cover which is made of waste paper and new paper.
- After that, apply aluminium tape to the inside and outside of the phone cover,
- Then fix the metal layer which is made up of different metals (i.e. Copper, zist and brass)
- Then again apply aluminium tape on paper made phone cover.
- After all these steps shield is ready to use.



Fig. 6.1 Shield

### VI. DETECTOR USED FOR DETECTING MOBILE RADIATION

To calculate the EMI radiation, we use Electromagnetic Radiation Detector (DT-1130) device.

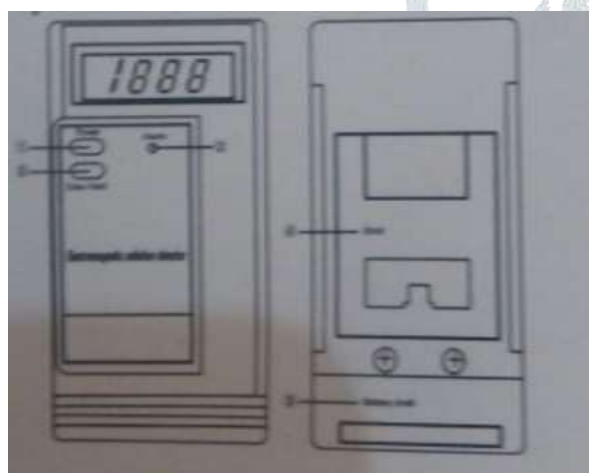
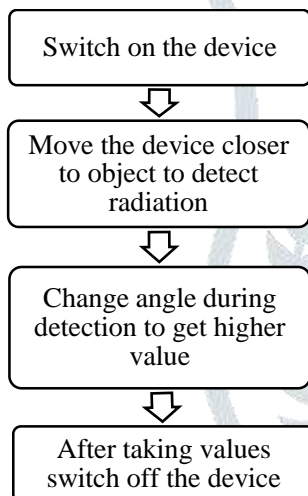


Fig 6.1 diagrammatic representations of Electromagnetic Radiation Detector (DT-1130) device



Fig 6.2 pictorial representations of Electromagnetic Radiation Detector (DT-1130) device

➤ **Step to Radiation detection process**



**VII. READINGS**

4.1 Table shows the previous and after taking the value of device with or without a shield.

Sr. No	Value Taken	Radiation $\mu\text{W}/\text{cm}^2$	SAR (W/Kg)
1.	Previous Value Taken without shield	1620	0.0902
2.	Value Taken with shield	912	0.05078

**VIII. CONCLUSION**

In this paper, we concluded that mobile phone EMR is very dangerous for human as well as for animals. Most affected by EMR are children under the age of 14 and studies show that SAR value from 0.000021- to 3 W/Kg is very harmful that can cause brain tumor and cancer like diseases. The previous radiation value of the device is 1620  $\text{mw}/\text{cm}^2$  and SAR is calculated as 0.09021W/Kg. After applying the shield on device, we have come to know that the value of radiation is 912  $\text{mw}/\text{cm}^2$  and calculated SAR is 0.05078 W/Kg, which is lesser than the previous value. So, we have concluded that after applying shield the Radiation and SAR decreased by 708  $\text{mw}/\text{cm}^2$  and 0.039425 W/Kg respectively from the previous taken values which means 43.7% radiation is reduced by using shield.



## IX. FUTURE DISCUSSION

After studying the recent and past research on electromagnetic shielding, the future direction for this research is to make an effective anti-radiation shield to minimize the total radiation factor in the wireless devices such as mobile phone, to reduce the bad impact of electromagnetic interference in human being that cause harmful diseases.

## CONFLICT OF INTEREST

The authors declare no conflict of interest.

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