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Exposure of 3G and 4G Mobile Phone Radiations on Blood Tissues

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Abstract: *There are concerns of mobile phone radiofrequency radiations that could cause health problems. These mobile phone radiations are absorbed by human body can cause health problems. If such mobile phone radiations are high enough, so they cause thermal effects on human body. In this work blood tissues of human body were exposed to the mobile phone radiofrequency of power 1.5 Watts at 3G and 4G*

Key words: *electromagnetic waves, blood tissues and mobile phone.*

1. Introduction

Mobile phone users are increasing day by day is concern for today's world. The fastest growing system in the world is mobile communication. We can classify electromagnetic radiations into two categories, ionizing and non-ionizing radiation. These radiations generally happen at very low frequency range. Mobile phone is considered as small transmitter as well as receiver. If we bring mobile phone move near the body, then radiation exposure will increases. Different mobile phone emits different radiation. Radiation may not be uniform for a single tower. The radiofrequency waves, emits from mobile phone are non-ionizing radiation, which can be absorbed by human body tissues [1]. Mobile phone radiations are radiofrequency radiations. As the huge raise in mobile phone usage all over the world, the effects of mobile phone radiations on human health are also increased [2]. The high frequency radiations are penetrated into human body, then power is absorbed it. These non ionizing radiofrequency radiations affect the human health indirectly or directly. The power absorption of mobile phone can cause behavior change, memory loss, headache, discomfort, sleep disruption, depression, irritability, nausea, dizziness, appetite loss, muscle spasms, numbness, altered reflexes, tingling; subjects reported buzzing in the head, cardiovascular problems, palpitations of the heart, light headedness, visual disorders, agitation, etc. Mobile phone waves can damage hair cells between the ages of 16-32 years. These hair cells do not redevelop in human being. The high frequency radiation effect may increase in temperature of human body tissues is called thermal effect. These effects may cause development and disruption of cell function. The human being tissue could damage due to the inability of body to dissipate the excessive heat. [3, 4]

The heating effect will take place at the surface of head causing increase in temperature at the time of using mobile phone. The effect of temperature by direct sunlight is less than that of temperature by using mobile phone. Typical base station power levels are really low compare to an analog radio or television transmitter that radiates tens or hundreds of kilowatts even megawatts in some cases. Mobile phone base station power is usually limited to ensure that neighboring cells do not interfere with each other, not for health reasons.

Swedish Lund University Researchers have studied the effects of radiofrequency radiations on brain of rat. They found a leakage of albumin into the brain via a blood brain barrier [5-7]. Other groups of researchers have not established these results in vitro cell studies or whole animal studies. But this study on the blood brain barrier was confirmed by H. Allan et.al [8].

The radiofrequency wave from mobile phone handsets can have more effect on the male reproductive organs such as effects on count morphology, sperm functions, sperm motility etc. Children have great effect of mobile phone radiations as they absorb more energy than adults from the same phone owing to their smaller head and brain size, thinner cranial bones and thinner skin, lower blood, lower cell volume, more elastic ear, greater conductivity of nerve cells and the energy penetration of energy are more deeply. Immune system of children is not as well developed as compared to adults; therefore they are less effective against fighting cancer growth than children. Brain tumors are more deadly as compared to temporal lobe. It was found that mobile phone radiations are harmful for women during pregnancy and greater likelihood for spontaneous abortion, congenital malformations and behavioral problems in their children. It also found that the eggs which form the embryo are damage and affect will become apparent after the child reaches puberty [9]. It is seen that children talk on the mobile phone are likely to suffer from cognitive abilities, decline of attention, disruption of memory and diminishing learning increased irritability in the short term and long term hazards include deterioration of the nervous structures of the brain and depressive syndrome [10].

2 Materials and Method

Let the incident electric field is E_0 and the mobile phone power is P, then radiating power per unit area is represented by the equation.

$$E_0 = 9.50/r \quad \text{..... (1)}$$

Generally mobile phone handset radiates 1watt to 2 watts power so we take 1.5 watt power for calculation. Transmission of electromagnetic wave inside human body is given by

$$E_z = E_0 e^{(-z/\delta)} \quad \text{.....(2)}$$

Ez is field inside the depth z, E_0 magnitude inside boundary, E_0 is the magnitude of field inside the boundary and δ is the skin depth.

Safe frequency range 2000MHz to 30000 MHz is 1.375 $\sqrt{f}$, where f is frequency of EMW [11].
For 3G frequency (2100MHz), E = 63.0104 V/m
For frequency (2300MHz), E = 65.94 V/m

Table 1

Distance from cell phone on cm	E_0 in V/m
1	950.00
2	475.00
3	316.60
4	237.52
5	190.00
6	158.33
7	135.71
8	118.75
9	105.55
10	95.00
11	86.36
12	79.16
13	73.07
14	67.85
15	63.33

Induced electric field radiated from the cell phone hand sets

3. Results and Discussion

Human being uses mobile phone near the body at about 1 mm to 15 or 20 cm. This study was done by taking the distances from 1cm to 15 cm from our body. Table 2 and 3 represents that penetrated electric field is decreased 93.337% in blood tissues of human body at 3G (2100 MHz) and 4G (2300MHz)

Table 2.

Distance from phone in cm	E0 in V/m	E in blood tissue at different depths				
		0.1 mm	0.2 mm	0.3 mm	0.4 mm	0.5 mm
1	**950.00**	**945.3324**	**940.6877**	**936.0659**	**931.4667**	**926.8902**
2	**475.00**	**472.6662**	**470.3439**	**468.0329**	**465.7334**	**463.4451**
3	**316.60**	**315.0445**	**313.4966**	**311.9563**	**310.4235**	**308.8983**
4	**237.52**	**236.353**	**235.1917**	**234.0362**	**232.8863**	**231.7421**
5	**190.00**	**189.0665**	**188.1375**	**187.2132**	**186.2933**	**185.378**
6	**158.33**	**157.5521**	**156.778**	**156.0077**	**155.2412**	**154.4784**
7	**135.71**	**135.0432**	**134.3797**	**133.7195**	**133.0625**	**132.4087**
8	**118.75**	**118.1665**	**117.586**	**117.0082**	**116.4333**	**115.8613**
9	**105.55**	**105.0314**	**104.5154**	**104.0018**	**103.4909**	**102.9824**
10	**95.00**	**94.53324**	**94.06877**	**93.60659**	**93.14667**	**92.68902**
11	**86.36**	**85.93569**	**85.51346**	**85.09331**	**84.67523**	**84.2592**
12	**79.16**	**78.77107**	**78.38404**	**77.99892**	**77.61569**	**77.23434**
13	**73.07**	**72.71099**	**72.35374**	**71.99825**	**71.6445**	**71.29249**
14	**67.85**	**67.51663**	**67.18491**	**66.85481**	**66.52633**	**66.19947**
15	**63.33**	63.01884	62.70921	62.40111	62.09451	61.78943

E inside the blood tissues at f=2100 MHz (3G)

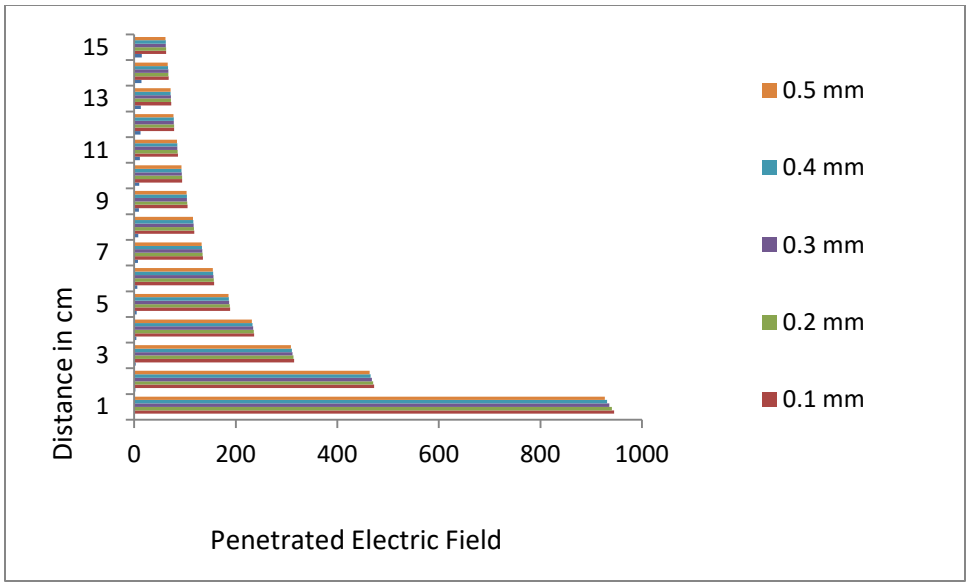

Fig. 1

The variation of penetrated electric field inside the blood tissues at frequency 2100 MHz (3G)

Table 3

Distance from phone in cm	E_0 in V/m	E in blood tissue at different depths				
		0.1 mm	0.2 mm	0.3 mm	0.4 mm	0.5 mm
1	**950.00**	**944.1257**	**938.2877**	**932.4858**	**926.7197**	**920.9893**
2	**475.00**	**472.0628**	**469.1438**	**466.2429**	**463.3599**	**460.4947**
3	**316.60**	**314.6423**	**312.6967**	**310.7631**	**308.8415**	**306.9318**
4	**237.52**	**236.0513**	**234.5917**	**233.1411**	**231.6994**	**230.2667**
5	**190.00**	**188.8251**	**187.6575**	**186.4972**	**185.3439**	**184.1979**
6	**158.33**	**157.351**	**156.378**	**155.411**	**154.45**	**153.495**
7	**135.71**	**134.8708**	**134.0369**	**133.208**	**132.3844**	**131.5658**
8	**118.75**	**118.0157**	**117.286**	**116.5607**	**115.84**	**115.1237**
9	**105.55**	**104.8973**	**104.2487**	**103.6041**	**102.9634**	**102.3268**

10	**95.00**	**94.41257**	**93.82877**	**93.24858**	**92.67197**	**92.09893**
11	**86.36**	**85.82599**	**85.29529**	**84.76786**	**84.2437**	**83.72278**
12	**79.16**	**78.67051**	**78.18405**	**77.7006**	**77.22014**	**76.74265**
13	**73.07**	**72.61817**	**72.16914**	**71.72288**	**71.27938**	**70.83862**
14	**67.85**	**67.43045**	**67.01349**	**66.59911**	**66.1873**	65.77803
15	63.33	62.9384	62.54922	62.16244	61.77806	61.39606

E inside the blood tissues at f=2300 MHz (4G)

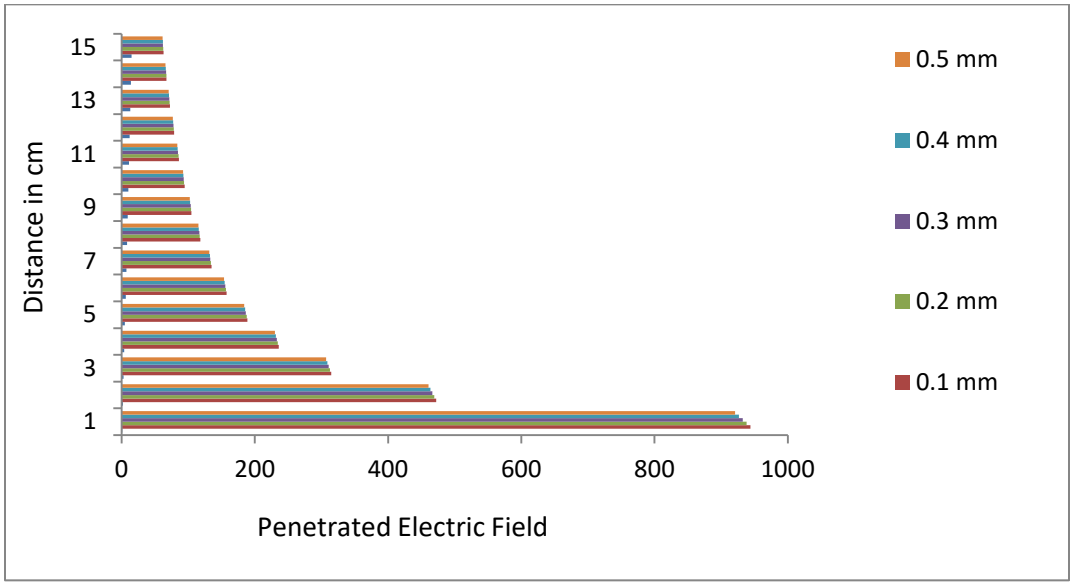

Fig.2

The variation of penetrated electric field inside the blood tissues at frequency 2300 MHz (4G)

4. Conclusion

The penetrated electric field inside the human body decreases with the increase in distance from. When our mobile phone set is at 15cm away, then electric field of mobile phone increases 93.33 percent. The fig.1 and fig.2 represents graphical form of table 2 and table 3. The electromagnetic wave of frequency 2100 MHz, of mobile phone handset are harmful for blood tissues of human body up to 15cm at depth of .0.2 mm. The electromagnetic wave of frequency 2300 MHz, of mobile phone handset are harmful for blood tissue of human body up to up to 14cm at

depth of .0.4 mm. The bold data in tables represents harmful for blood tissues of human body. The penetrated electric field is safe above 15cm distances from the mobile phone handset. People should keep mobile phone away from the body. During call mobile phone hand set should be hands free.

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