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Original Article

Harmful effects of mobile phone waves on blood tissues of the human body

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Abstract. Penetration of electromagnetic waves emitted by mobile phones into human skin and blood was studied. The transmitted waves from these mobile phones were exposed to the human body and were penetrated into the body where field was reduced exponentially with depth. As the reduction in field was due to absorption of power, specific absorption rate was calculated and compared with permissible limit given by International Commission on Non-ionizing Radiation Protection (ICNIRP) and World Health Organization (WHO). It was found that the specific absorption rate values were above the limit at distances 1 to 15 cm from the body, frequencies 800, 900, 1800 and 2450 MHz and effective radiated power of 2 Watts.

Key words: Electromagnetic waves, skin and blood tissues, specific absorption rate.

1. Introduction

Electromagnetic waves are transmitted from the various types of transmission towers and also from cell phones. The radio, TV and mobile phone transmitters and cell phones transmit radio frequency radiation that is, electric and magnetic fields of radiofrequency propagating in the atmosphere. The number of cell phone towers is increased very rapidly. Now 3.75 Lakh cell phone towers has been established in India. The effects of electric field due to cell phones are studied. At source, the magnitude of this electric field is very high and reduces with increase of the distance. Higher is the environmental electric field, higher would be the potential difference induced across the tissues. This high potential difference disturb the chemical reaction rate and normal functioning of the body and results in many diseases (1,2).

The purpose of this paper is to present a selective account of distribution of electromagnetic field in biological bodies. An electromagnetic radiation in the atmosphere means the propagation of electric end magnetic fields oscillating in mutually perpendicular directions and direction of propagation being normal to both of them.

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This radiation induces an electric field inside the human body. The induced electric field goes on reducing when we go inside the body. The field inside the body can be calculated by some simplifications.

The high frequency electromagnetic waves are also emitted from the mobile phone hand sets. These electromagnetic waves are induced by the electric field in the atmosphere around us. These waves are incident on the human body. When these waves are penetrated inside the body, the induced electric field decreases gradually inside the body. This electric field decreases due to the absorption of energy by the different parts of the body (3).

The rapid growth rate of mobile phones and wireless communication systems, alongside various reports of possible adverse effects on health, has caused increased concern around the world over the potential effect of electromagnetic pollution on health and the environment. It is clear that a new level of debate needs to take place between scientists, government and the general public in order to develop appropriate precautionary guidance (4).

Manufacturers are required to report the specific absorption rate (SAR) of their product to the FCC. The SAR is the amount of radio frequency (RF) energy absorbed from the phone into the local tissues. The upper limit of SAR allowed is 1.6 watts per kilogram of body weight. Exposure to RF also depends on the duration and

frequency of cellular phone use, with more use implying more exposure. Finally, older mobile phones involve higher exposure than newer digital equipments (5).

In India 800 & 900 MHz frequencies are used for mobile phones and in other countries 800, 900, 1800 and 2450 MHz frequencies of cell phones are used for the cell phones. In this paper, the calculations of specific absorption rate (SAR) are made for all the four frequencies of mobile phones, so that the calculations become beneficial for the whole world.

There has been concern about possible health consequences from exposure to the RF fields produced by wireless technologies. The fact sheet reviews the scientific evidence on the health effects from continuous low-level human exposure to base stations and other local wireless networks (6). The absorption of electromagnetic waves by the different biological parts of the body may produce the harmful effect on the body. Scientific evidence on the distribution of cancer in the population can be obtained through carefully planned and executed epidemiological studies. Over the past 15 years, studies examining a potential relationship between RF transmitters and cancer have been published (7).

Many studies have been shown the serious health effects associated with electromagnetic radiation, including cancer and reproductive health effects. It is recommended that children and pregnant women keep the mobile phone device away from their head and body (8-10).

The previous studies do not give the exact values of the distances of mobile phones from the human body, which are harmful for the human health. In this paper, the exact harmful distances of mobile phones from the human body are given by the calculations of specific absorption rate (SAR).

2. Material and methods

The electric field E_o in air at a distance r from the cell phone (if we consider cell phone as a point source of power 2 Watt) radiating at power P is given by the equation

$$\frac{P}{4\pi r^2} = \frac{1}{2}\varepsilon_0 E_0^2 c$$

$$E_0 = \left[\frac{P}{2\pi r^2 \varepsilon_0 c}\right]^{\frac{1}{2}} = \frac{7.746\sqrt{P}}{r} \quad \text{.....[1]}$$

where ε_0 is the permittivity of free space and c the speed of radiation (11).

If the electromagnetic waves are radiated from the mobile phone towers of power 2W, the electric field around the towers become (12)

$$E_0 = 10.946/r \quad \text{..... [2]}$$

Now for the tissue of biological material well inside the boundary, field strength will further reduce due to dissipation during propagation inside the body. Electric field decreases exponentially with distance from the boundary and is given by

$$E_z = E_0 e^{\frac{-z}{\delta}} \quad \text{.....[3]}$$

Where E_z is the field inside the depth z and E_0 is the magnitude of field just inside the boundary. The skin depth δ is the distance over which the field reduces to $\frac{1}{e}$ (= 0.368) of its value just inside the boundary. The skin depth again depends upon frequency of radiation. For biological materials, it is given by

$$\delta = \frac{1}{\omega q} \quad \text{.....[4]}$$

$$q = \left[\frac{\varepsilon\mu}{2}\left\{\left(1+P^2\right)-1\right\}\right]^{\frac{1}{2}} \quad \text{..... [5]}$$

where $$P = \frac{\sigma}{\omega\varepsilon} \quad \text{.....[6]}$$

where ω is angular frequency of radiation, ε is permittivity, μ is the permeability and σ is conductivity of biological material (13).

2.1 Specific Absorption Rate (SAR)

The specific absorption rate is defined as the time derivative of the incremental energy (dW) absorbed by or dissipated in an incremental mass (dm) contained in a volume element (dV) of a given density (ρ). It can be defined as (14)

$$SAR = \frac{d}{dt}\left(\frac{dW}{dm}\right) \text{.....[7]}$$

$$SAR = \frac{d}{dt}\left(\frac{dW}{\rho dV}\right)$$

By using Pointing vector theorem for sinusoidally varying electromagnetic fields, we get

$$SAR = \frac{\sigma E_i^2}{2\rho} \text{.....[8]}$$

where σ is the conductivity of the material, E_i is the field inside that material.

This relation represents the rate at which the electromagnetic energy is converted into heat through well-established interaction mechanisms. It provides a valid quantitative measure of all interaction mechanisms that are dependent on the intensity of the internal electric field. At this point some additional information may be relevant. For instance, some effects of radio waves modulated in amplitude at extremely low frequency (ELF) are dependent on the electric field intensity, once specific interaction mechanisms are better understood, they would be expressed in terms of SAR and modulation characteristics, even though the interaction mechanisms may not necessarily be thermal. However, the direction of electric field with respect to the biological structures should be of more importance for a given interaction mechanism (15,16).

3. Results

People keep the mobile phone hand set near their body. If we consider the cell phone hand set as a point source of 2 Watts, it can be considered as the transmission towers which transmit the electric field. This electric field produces an electric blanket around the human body. The incident electric field, transmitted from the mobile phones is calculated by the equation 2 and represented in table 1. The electric field is calculated for the distance 1cm to 15 cm from the mobile phone and the result is given in table 1. Results of table 1 show that the electric field produced around the mobile phone, decreases very rapidly. The electric field is varied 1094.6 V/m to 72.97 V/m from 1 cm to 15 cm respectively. Mobile phones radiate the frequency of 800MHz, 900MHz, 1800MHz and 2450MHz and penetrate inside the body. The penetration of electric field inside the body is calculated by equation 3. The penetrated electric field inside the skin at depth 0.1 mm to 0.5 mm at 1cm to 15 cm from the mobile phone hand set are given in tables 2 to 5 for the electromagnetic waves of frequencies 800, 900, 1800 and 2450 MHz respectively.

After skin, the electromagnetic waves penetrate inside the blood and again the penetrated electric fields are calculated by equation 3. The penetrated electric field inside the blood is represented in tables 6 to 9 due to the electromagnetic waves of frequency of 800, 900, 1800 and 2450MHz respectively. When the high frequency electromagnetic waves which transmit from the cell phone hand sets propagate from the skin to blood, the energy is absorbed by the tissues of the blood. The specific absorption rate (SAR) of the blood tissues are calculated by the equation 8 and given in tables 10 to 13 due to the propagation of electromagnetic wave of frequencies 800, 900, 1800 and 2450MHz respectively.

Table 1. Incident electric field on the human body due to the cell phone hand sets

Distance from cell phone in (cm)	Incident electric field (E_0) in (V/m)
1	1094.6
2	547.3
3	364.86
4	273.65
5	218.92
6	182.43
7	156.37
8	136.82
9	121.62
10	109.46
11	99.50
12	91.21
13	84.2
14	78.18
15	72.97

4. Discussion

Because mobile phone generally situated very near to the body of human beings, thus the electric fields are calculated only 1 to 15 cm from the body. Table 1 represents that the incident electric field transmitted from the cell phone is

Table 2. Penetrated electric field inside the skin due to the electromagnetic wave of frequency, f=800 MHz

Distance from mobile phone(cm)	Electric field (E_0) (V/m)	Penetrated electric field (V/m) in skin at depth, (mm)				
		0.1	0.2	0.3	0.4	0.5
1	1094.6	1072.33	1050.52	1029.14	1008.21	987.70
2	547.3	536.16	525.26	505.16	504.10	493.85
3	364.86	357.43	350.16	343.04	336.06	329.22
4	273.65	268.08	262.63	257.28	252.05	246.92
5	218.92	214.46	210.10	205.82	201.64	197.54
6	182.43	178.71	175.08	171.52	168.03	164.61
7	156.37	153.18	150.07	147.01	144.02	141.09
8	136.82	134.03	131.31	128.63	126.02	123.45
9	121.62	119.14	116.72	114.34	112.02	109.74
10	109.46	107.23	105.05	102.91	100.82	98.77
11	99.50	97.47	95.49	93.54	91.64	89.78
12	91.21	89.35	87.53	85.75	84.01	82.30
13	84.20	82.48	80.80	79.16	77.55	75.97
14	78.18	76.58	75.03	73.50	72.01	70.54
15	72.97	71.48	70.03	68.60	67.21	65.84

Table 3. Penetrated electric field inside the skin due to the electromagnetic wave of frequency, f=900 MHz

Distance from cell phone(cm)	Incident electric field (E_0)	Penetrated electric field (V/m) in skin at depth, (mm)				
		0.1	0.2	0.3	0.4	0.5
1	1094.6	1068.25	1042.52	1017.43	992.94	969.03
2	547.3	534.12	521.26	508.71	496.47	484.51
3	364.86	356.07	347.50	339.13	330.97	323.00
4	273.65	267.06	260.63	254.35	248.23	242.25
5	218.92	213.65	208.50	203.48	197.92	193.80
3	182.43	178.03	173.75	169.56	165.48	161.50
7	156.37	152.60	148.93	145.34	141.84	138.43
8	136.82	133.52	130.31	127.17	124.11	121.12
9	121.62	118.69	115.83	113.04	110.32	107.66
10	109.46	106.82	104.25	101.74	99.29	96.90
11	99.50	97.105	94.76	92.48	90.25	88.08
12	91.21	89.01	86.87	84.77	82.73	80.74
13	84.20	82.17	80.19	78.26	76.38	74.54
14	78.18	76.29	74.46	72.66	70.91	69.21
15	72.97	71.21	69.49	67.82	66.19	64.59

Table 4. Penetrated electric field inside the skin due to the electromagnetic wave of frequency, f=1800 MHz

Distance from cell phone(cm)	Incident electric field (E_0)	Penetrated electric field (V/m) in skin at depth, (mm)				
		0.1	0.2	0.3	0.4	0.5
1	1094.6	1027.69	964.88	905.92	850.55	798.57
2	547.3	513.84	482.44	452.96	425.27	399.28
3	364.86	342.55	321.62	301.96	283.51	266.18
4	273.65	256.92	241.22	226.48	212.63	199.64
5	218.92	205.53	192.97	181.18	170.11	159.71
6	182.43	171.27	160.81	150.98	141.75	133.09
7	156.37	146.81	137.84	129.41	121.50	114.08
8	136.82	128.45	120.60	113.23	106.31	99.81
9	121.62	114.18	107.20	100.65	94.50	88.72
10	109.46	102.76	96.48	90.59	85.05	79.85
11	99.50	93.41	87.70	82.34	77.31	72.59
12	91.21	85.63	80.40	75.48	70.87	66.54
13	84.20	79.05	74.22	69.68	65.42	61.42
14	78.18	73.40	68.91	64.70	60.74	57.03
15	72.97	68.51	64.32	60.39	56.70	53.23

Table 5. Penetrated electric field inside the skin due to the electromagnetic wave of frequency, f=2450 MHz

Distance from cell phone(cm)	Incident electric field (E0)	Penetrated electric field (V/m) in skin at depth, (mm)				
		0.1	0.2	0.3	0.4	0.5
1	1094.6	998.83	912.43	833.05	760.59	694.42
2	547.3	499.69	456.21	416.52	380.29	347.21
3	364.86	333.12	304.13	277.68	253.52	231.47
4	273.65	249.84	228.26	208.26	190.14	173.60
5	218.92	199.87	182.48	166.61	152.11	138.88
6	182.43	166.56	152.06	138.84	126.76	115.73
7	156.37	142.74	130.34	119.00	108.65	99.20
8	136.82	124.91	114.05	104.12	95.07	86.79
9	121.62	111.04	101.37	92.56	84.50	77.15
10	109.46	99.93	91.24	83.30	76.05	69.44
11	99.50	90.84	82.94	75.72	69.13	63.12
12	91.21	83.27	76.03	69.41	63.37	57.86
13	84.20	76.87	70.18	64.08	58.50	53.41
14	78.18	71.37	65.16	59.49	54.32	49.59
15	72.97	66.62	60.82	55.53	50.70	46.29

decreased 93.4% from 1cm to 15cm from the body. Table 2, 3, 4 and 5 reveal that the penetrated electric field is decreased 93.3% in skin due to 800, 900, 1800 and 2450MHz frequency of electromagnetic waves from 1cm to 15cm of cell phone from the body. Table 6 represents that the penetrated electric field decreases 93.54% due to 800MHz frequency of EMW of cell phone from 1cm to 15cm from the body. Table 7 represents that the penetrated

Table 6. Penetrated electric field inside the blood due to the electromagnetic wave of frequency, f=800 MHz

Distance from cell phone (cm)	Penetrated electric field (V/m) in blood at depth, (mm)				
	0.1	0.2	0.3	0.4	0.5
1	1044.77	999.12	951.83	908.50	867.16
2	522.38	498.61	467.21	454.24	433.58
3	348.24	332.39	317.27	302.82	289.04
4	261.19	249.30	237.95	227.12	216.78
5	208.94	199.44	190.35	181.69	173.43
6	174.11	166.19	158.63	151.41	144.52
7	149.24	142.45	135.96	129.77	123.87
8	130.58	124.64	118.96	113.55	108.38
9	116.07	110.79	105.75	100.94	96.34
10	104.47	99.72	95.17	90.84	86.71
11	94.96	90.64	86.51	82.57	78.82
12	87.05	83.08	79.30	75.70	72.25
13	80.36	76.70	73.21	69.88	66.69
14	74.61	71.22	67.97	64.88	61.93
15	69.64	64.47	63.44	60.56	57.80

Table 7. Penetrated electric field inside the blood due to the electromagnetic wave of frequency, f=900 MHz

Distance from cell phone (cm)	Penetrated electric field (V/m) in blood at depth, (mm)				
	0.1	0.2	0.3	0.4	0.5
1	1035.89	980.31	927.74	877.97	830.88
2	517.94	490.15	463.86	438.98	415.43
3	353.80	326.76	309.23	292.65	276.95
4	265.36	245.07	231.92	219.48	207.71
5	212.28	196.05	185.54	175.00	166.17
6	176.90	163.38	154.61	146.32	138.47
7	151.63	140.04	132.52	125.41	118.69
8	132.67	122.53	115.95	109.74	103.85
9	117.93	108.91	103.07	97.54	92.31
10	106.14	98.02	92.77	87.79	83.08
11	96.48	89.10	84.32	79.80	75.52
12	88.44	81.68	77.29	73.15	69.22
13	81.64	75.40	71.36	67.53	63.91
14	75.81	70.01	66.25	62.70	59.34
15	70.75	65.34	61.84	58.52	55.38

Table 8. Penetrated electric field inside the blood due to the electromagnetic wave of frequency, f=1800 MHz

Distance from cell phone in (cm)	Penetrated electric field (V/m) in blood at depth, (mm)				
	0.1	0.2	0.3	0.4	0.5
1	950.23	824.92	716.13	621.70	539.71
2	475.11	412.46	358.06	310.84	269.85
3	316.73	274.96	238.70	207.22	179.89
4	237.55	206.23	179.03	155.41	134.92
5	190.03	164.97	143.22	124.34	107.94
6	158.36	137.48	119.35	103.61	89.94
7	135.74	117.84	102.29	88.80	77.10
8	118.76	103.10	89.50	77.10	67.47
9	105.57	91.65	79.56	69.07	59.96
10	95.01	82.48	71.61	62.16	53.96
11	86.36	74.97	65.09	56.43	49.05
12	79.17	68.73	59.66	51.80	44.97
13	73.09	63.45	55.08	47.81	41.51
14	67.86	58.91	51.14	44.39	38.54
15	63.34	54.99	47.73	41.44	35.97

Table 9. Penetrated electric field inside the blood due to the electromagnetic wave of frequency, f=2450 MHz

Distance from cell phone in (cm)	Penetrated electric field (V/m) in blood at depth, (mm)				
	0.1	0.2	0.3	0.4	0.5
1	892.59	728.65	594.51	485.06	395.76
2	446.54	364.32	297.25	242.52	197.88
3	297.68	242.87	198.16	161.70	131.91
4	223.26	182.15	148.62	121.26	98.93
5	178.61	145.72	118.90	97.00	79.15
6	148.84	121.43	99.08	80.84	65.95
7	127.55	104.08	84.92	69.29	56.53
8	111.62	91.07	74.30	60.63	49.46
9	99.22	80.95	66.05	53.88	43.96
10	89.30	72.86	59.44	48.50	39.57
11	81.17	66.23	54.03	44.08	35.98
12	74.41	60.71	49.53	40.41	32.98
13	68.69	56.04	45.73	37.30	30.43
14	63.77	52.03	42.45	34.64	28.22
15	59.53	48.57	39.62	32.33	26.38

Table 10. Specific absorption rate (SAR) by blood due to EMW of frequency f=800 MHz

Distance from cell phone (cm)	SAR (W/kg) of blood at depth, (mm)				
	0.1	0.2	0.3	0.4	0.5
1	10164.89	9296.01	8436.86	7686.19	7002.61
2	2541.17	2315.17	2032.75	1921.46	1750.65
3	1129.32	1028.86	937.388	853.946	777.996
4	635.293	578.770	527.269	480.366	437.622
5	406.541	370.412	337.417	307.414	280.098
6	282.298	257.200	234.332	213.486	194.499
7	207.411	188.967	172.140	156.823	142.827
8	158.787	144.669	131.784	120.070	109.385
9	125.458	114.304	104.141	94.8829	86.4320
10	101.635	92.6032	84.3454	76.8450	70.0164
11	83.9736	76.5070	69.6938	63.4901	57.8541
12	70.5665	64.2768	58.5609	53.3646	48.6113
13	60.1369	54.7838	49.9117	45.4744	41.4174
14	51.8388	47.2351	43.0225	39.1997	35.7160
15	45.1626	38.7058	37.4789	34.1533	31.1112

Table 11. Specific absorption rate (SAR) of blood due to EMW of frequency f=900 MHz

Distance from cell phone (cm)	SAR (W/kg) of blood at depth, (mm)				
	0.1	0.2	0.3	0.4	0.5
1	11631.65	10416.96	9329.6795	8355.5206	7483.2589
2	2907.851	2604.187	2332.3193	2088.8325	1870.7246
3	1356.843	1157.369	1036.5193	928.3488	831.4131
4	763.2821	651.0202	583.0295	522.1605	467.6586
5	488.4637	416.6274	373.1550	331.9634	299.3087
6	339.2109	289.3423	259.1130	232.0713	207.8382
7	249.2208	212.5780	190.3605	170.4819	152.7011
8	190.7917	162.7417	145.7322	130.5520	116.9034
9	150.7518	128.5729	115.1539	103.1287	92.3658
10	122.1159	104.1462	93.2887	83.5418	74.8181
11	100.8944	86.0537	77.0682	69.0271	61.8212
12	84.7835	72.3178	64.7531	58.0019	51.9370
13	72.2470	61.6249	55.1980	49.4319	44.2743
14	62.2970	53.1293	47.5757	42.6137	38.1688
15	54.2584	46.2777	41.4527	37.1212	33.2445

Table 12. Specific absorption rate (SAR) of blood due to EMW of frequency f=1800 MHz

Distance from cell phone (cm)	SAR (W/kg) of blood at depth (mm)				
	0.1	0.2	0.3	0.4	0.5
1	21737.783	16382.54	12346.43	9305.068	7012.59
2	5434.3315	4103.5847	3086.52	2326.118	1753.08
3	2415.1059	1820.1066	1371.7110	10333.7633	779.0616
4	1358.5256	1023.9092	771.6305	581.4544	438.2384
5	869.3649	655.1907	493.8159	372.2026	280.4933
6	603.7383	455.0266	342.9277	258.4408	194.7437
7	443.5815	334.3052	251.8976	189.8382	143.1088
8	339.5456	255.9028	192.8429	145.3449	109.5920
9	268.3112	202.2193	152.3867	114.8515	86.5527
10	217.3183	163.7778	123.4539	93.0207	70.0973
11	179.5490	135.7235	101.9967	76.6616	57.9209
12	150.8964	113.7235	85.6888	64.5977	48.6859
13	128.6096	96.9217	73.0374	55.0294	41.4823
14	110.8627	83.5479	62.9621	47.4381	35.7586
15	96.5859	72.7989	54.8454	41.3425	31.1487

Table 13. Specific absorption rate (SAR) of blood due to EMW of frequency f=2450 MHz

Distance from cell phone (cm)	SAR (W/ kg) of blood at depth (mm)				
	0.1	0.2	0.3	0.4	0.5
1	24959.07	16632.68	11072.426	7370.813	4905.686
2	6246.62	4158.057	2768.013	1842.551	1226.671
3	2776.02	1847.873	1230.145	819.114	545.104
4	1561.51	1039.400	691.956	460.637	306.605
5	999.392	665.216	442.882	294.759	196.257
6	694.006	461.430	307.536	204.727	136.255
7	509.665	339.358	225.914	150.406	100.111
8	390.308	259.821	172.942	115.1594	76.635
9	308.406	205.285	136.669	90.9451	60.539
10	249.820	166.304	110.683	73.6898	49.051
11	206.402	137.414	91.452	60.8706	40.555
12	172.732	115.463	76.853	51.1566	34.074
13	147.812	98.3831	65.5129	43.5855	29.008
14	127.396	84.807	56.452	37.5906	24.948
15	111.018	73.902	49.176	32.7443	21.800

electric field decreases 93.17% due to 900MHz frequency of EMW of cell phone from 1cm to 15cm from the body. Table 8 & 9 show that the penetrated electric field is decreased 93.34% due

to 1800 and 2450MHz frequency of EMW from 1cm to 15cm from the body.

According to some International agencies as WHO, ICNIRP, the specific absorption rate (SAR) becomes harmful after 1.6 W per kg. of the body weight. For a person of weight 75 kg, the safe limit of SAR is 120 W/kg. It means that, if SAR becomes greater than 120 W/kg. it may be harmful for the tissue life of the human body.

From the above analysis, it is concluded that when high frequency electromagnetic waves transmitted from the mobile phone hand sets penetrate inside the body, the electric field is induced inside the skin and blood of the body. Due to this, the energy of electromagnetic fields is absorbed by the tissues of the blood. When specific absorption rate (SAR) of the blood tissues becomes greater than the safe limit, it becomes harmful for the tissue life. Table 10 & 11 represent that 800 & 900MHz frequency of mobile phones are harmful for the life of the blood tissue till 7 cm from the body up to 0.5 mm depth inside the blood and 8 cm distance from the body is harmful till 0.4 mm depth inside the blood. Table 12 represents that 1800MHz frequency of mobile phones are harmful for the life of the blood tissue till 7 cm up to 0.5 mm depth, till 8 cm distance is harmful up to 0.4 mm depth, till 10 cm distance is harmful up to 0.3 mm depth, till 11 cm distance is harmful up to 0.2 mm depth, till 13 cm distance is harmful up to 0.1 mm depth inside the blood. Table 13 represents that 2450MHz frequency of mobile phones are harmful for the life of the blood tissue till 6 cm distance is harmful up to 0.5 mm depth, till 7 cm distance is harmful up to 0.4 mm depth, till 9 cm distance is harmful up to 0.3 mm depth, till 11 cm distance is harmful up to 0.2 mm depth, till 14 cm distance is harmful up to 0.1 mm depth inside the blood.

The above analysis represent that, mobile phone hand sets should be kept away from our body and the time of the working mobile phone should be as low as possible.

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