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THE EFFECTS OF ELECTROMAGNETIC RADIATION (954 KHZ) ON THE PEOPLE'S HEALTH, LIVING NEAR THE HIGH POWER RADIO BROADCASTING ANTENNA

ARVIND KUMAR [1*], VIJAY KUMAR[2] AND P. P. PATHAK[3]

[1]Department of Physics, Graphic Era University, Dehradun (Uttrakhand) India*
[2]Department of Physics, Graphic Era University, Dehradun (Uttrakhand) India,
[3]Department of Physics, Gurukula Kangri University, Haridwar (Uttrakhand) India

ABSTRACT

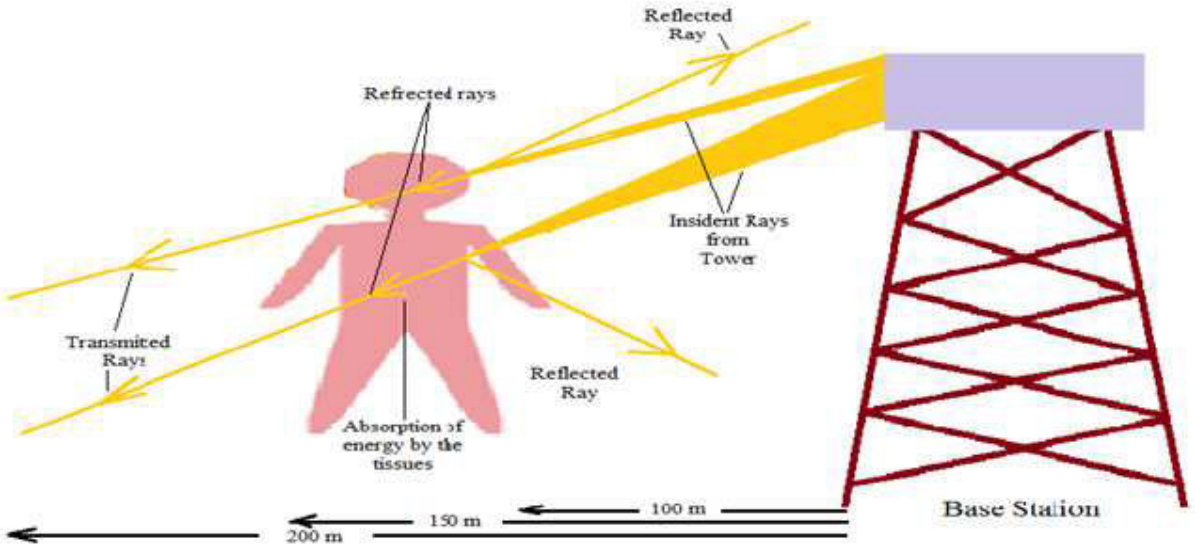
The harmful effects from exposures due to non-ionizing electromagnetic energy of intermediate frequency radiation were studied for the people who are living near radio tower of frequency 954 kHz. The AM radio broadcast (All India radio) towers radiate the electromagnetic energy in atmosphere, which can affect the health of human beings. The penetrated electric fields and specific absorption rate (SAR) inside the human body tissues are calculated by various parameters such as skin depth, conductivity and permittivity of tissues. The penetrated electric fields and specific absorption rate (SAR) inside the selected tissues are calculated at various distances from antenna and compared with the given permissible limit by the international agencies as international communication of non-ionizing radiations and protection (ICNIRP), world health organizations (WHO) etc. The result suggested that EMWs of given frequencies are harmful for the tissue life of the human body at various distances from the All India radio tower.

KEYWORDS: AM broadcasting antenna, Human body tissues, Electric field, Specific absorption rate (SAR) etc.

ARVIND KUMAR
Department of Physics, Graphic Era University, Dehradun (Uttrakhand) India

INTRODUCTION

The radio broadcasting stations of many countries like India, Australia, China, Indonesia, Israel, Japan, New Zealand, Philippines, Taiwan, Turkey, Vietnam, Syria and Qatar are use 954 kHz electromagnetic radiations (EMR) for communication of programming . When the AM radio broadcast tower radiates the electromagnetic energy in atmosphere. An electric field is produced around it. This electric blanket interacts with human body. When this electromagnetic energy penetrates inside the human body, the energy is absorbed by the various body tissues. This energy can raise the temperature of body tissues and can affecttissues life. A biological body is an inhomogeneous lossy dielectric material. The intensity of the internal fields depends on a number of parameters frequency, intensity and polarization of the external field, size, shape and dielectric properties of the body [2]. With a complex dependence on so many parameters, it is apparent that the internal fields in a mouse and a man exposed to the same external field can be dramatically different. And so will be their biological response, regardless of physiological differences. Conversely different exposure conditions depend on different frequenciesand may induce similar fields inside such diverse shapes as a mouse and a man. It should be stressed that very complex field distributions can occur, both inside and outside biological systems exposed to EM fields. Refraction within these systems can focus the transmitted energy, resulting in markedly non-uniform fields and energy deposition. Different energy absorption rates can result in thermal gradients causing biological effects that may be generated locally and are difficult to anticipate and perhaps unique [3]. When EM fields pass from one medium to another, they can be reflected, refracted, transmitted or absorbed depending on the complex conductivity of the exposed body and the frequency of the source.



Figure

represents, the transmitted signals by a radio broadcasting tower, at 100 m, 150 m and 200 m distances and absorption of energy by human body

At frequencies well below 100 kHz, it has been shown that induced electric fields can stimulate nervous tissue. The waves do not necessarily penetrate the entire body; the penetration is limited by the skin effect, which is characterized by the skin depth. The depth to which microwaves can penetrate tissues is primarily a function of the electric and magnetic properties of the tissues and

of the microwave frequency.[1] The excess amount of electric field increases the amount of absorption of energy inside the tissues. The energy of cell becomes more to its required natural energy. In natural process the heat energy is produced inside the human body due to:

- The rate at which thermal energy is produced through metabolic processes (M)
- The rate at which work is produced (W) Total heat energy gain by body = M±W

This energy is spent in five parts as follows:

- The rate of exchange with the surroundings via evaporation (E)
- The rate of heat exchange with the surroundings via radiation (R)
- The rate of heat exchange with the environment via evaporation (C)
- The rate of heat exchange with the surroundings via conduction (D)
- The rate of body heat storage (S).

Total heat energy spent by the body = E ± R ± C ± D ±S [1]

The whole gain energy becomes equal to the spent energy by the body. Thus there is no excess temperature in the body in this natural process. The balance of heat energy is expressed by the following equation

$$M \pm W = E \pm R \pm C \pm D \pm S \quad [2]$$

But when electromagnetic radiation is penetrated inside the body, the energy is absorbed by the tissues of the biological material. It works as a source of production of extra energy inside the body. Therefore,

$$M \pm W + E^{r} = E \pm R \pm C \pm D \pm S \quad [3]$$

In above Eq. [3] E^{r} is the energy of electromagnetic radiation. Above equation becomes un-equilibrium because production of energy becomes greater to the energy inside the body. This excess energy may increase the temperature of the tissues and may be harmful in many other ways for tissues life. Change of body temperature is detected, especially externally at the skin and internally by the specialized region of the brain. The information is integrated in the central nervous system, and regulation is achieved by autonomic and behavioral thermoregulatory reactions. In general, at a given frequency, the lower the water content of the tissue, the deeper a wave can penetrate. Also at the frequencies of interest the lower the frequency and the deeper is the depth of penetration into tissues with given water content. [18, 19]

Review of literature

Electromagnetic fields (EMF) originating both from natural and manmade sources permeate our environment. As people are continuously exposed to EMFs in everyday life, it is a matter of serious health concern; it can be harmful to human health. EMFs interaction with biological tissues may cause oxidative stress under certain circumstances. Since free radicals are essential for brain physiological processes and pathological degeneration. Research focusing on the possible influence of the EMF driven oxidative stress is still in progress, especially in the light of recent studies suggesting that EMF may contribute to the etiology of neurodegenerative disorders.[4]

Electromagnetic fields in both extremely low frequency and radio frequency ranges (RF) activate the cellular stress response. It is clear from the literature, that in order to protect living cells, EMF safety limits must be changed from the current thermal standard, based on energy, to one based on biological responses that occur long before the threshold for thermal changes [5].

Public health

The penetrated electric field inside selected tissues of human beings due to EMW of 954 kHz are calculated. The mammalian cells can be influenced by electromagnetic fields (EMF). The electromagnetic fields have a number of physiological effects on cells and tissues such as alteration of gene expression, cells viability, proliferation, apoptosis mammo-sphere numbers, cells cycle phase, and invasion. The impact of EMF on mammalian cells depends on the density and uniformity of the field, frequency range, exposure time, cell types, culture environment, and medium. This study shows that the impact of EMFs on mammalian cells and the various form of electromagnetic

radiation affect on cultured cells, EMF exposing system and internal field mechanism in the cells [6]. There has been wide public discussion on whether the electromagnetic fields of mobile telephones and their base stations affect human sleep or cognitive functioning. As there is evidence for learning and memory-consolidating effects of sleep and particularly of REM sleep, disturbance of sleep by radiofrequency electromagnetic fields might also impair cognitive functions. Previously realized sleep studies yielded in consistent results regarding short-term exposure. Moreover, data are lacking on the effect that short and long-term exposure might have on sleep as well as on cognitive functions. Therefore, 10 healthy young male subjects were included and nocturnal sleep was recorded during eight consecutive nights. In the second, third, and last night, they were investigated polysomnographic night sleep and cognitive functions [7]

Case control studies

Electric fields exposure metric in a case–control study conducted in Germany to investigate a possible association between radio frequency electromagnetic fields (RF-EMF) emitted from television and radio broadcast transmitters and the risk of childhood leukemia [8]. A case-control study of radio frequency electromagnetic fields and childhood leukemia was conducted in West Germany. The study region included municipalities near high-power radio and TV broadcast towers, including 16 amplitude-modulated and 8 frequency-modulated transmitters. An analysis of amplitude-modulated and frequency-modulated transmitters separately did not show increased risks of leukemia [9]. Far field measurement of electric fields in an area surrounding the GSM and TV broadcast stations in Antalya (Turkey) is presented a great inclination to use of mobile phones as well as FM radios and TV transmitters has brought about a proliferation of new radio base stations. Results show that 164 MHz radio transmitter (~1.1 $\mathrm{mW/kg}$) produces about 60 times stronger local SAR than 1800 MHz GSM transmitter (~0.02 $\mathrm{mW/kg}$) and children are more sensitive than average man for the same electric field intensity, and gather more SAR values [10]. The medium waves, short waves, frequency modulation (FM) radio broadcasting bands, for the television and mobile telephony bands. The criterion limiting exposures on the basis of preventing electrical stimulation of peripheral nerves and muscles to be stricter than that based on thermal consideration. The bands that contribute most to the latter are short wave with 46.2% and mobile telephony with 32.6% of the total exposure [11]. Different types of effects of radiation are also observed by different researches. Raju Poddar et al. [16] analyze the influence on rates by host radiation and Uzma R. et al. [17] study about the effects of high frequency on seedlings.

MATERIALS AND METHODS

The proposed approach is useful to predict the induced electric field around the all India radio tower, penetrated electric field inside the body and specific absorption rate of the tissues of the human body. In this manuscript the power of broadcasting antenna, which radiate the electromagnetic energy at frequency 954 kHz is 100 kW. The EMW of broadcasting antenna is incident on the human body. The wave produced by the dipole antenna has a cylindrical wave front .The incident electric field E_{rms} around the radio broadcasting tower of power P is given by,

$$E_{rms} = \frac{\sqrt{90P}}{r} = 9.487\frac{\sqrt{P}}{r} \quad [4]$$

Where (r) is the distance far from the biological body, by Prasad [12] When a human body is exposed to the EM wave of electric field, it penetrates inside the body. It results into inside or induced electric field (E_z) at a given depth z given by Polk [2]

$$E_z = E_{rms} \exp\left(\frac{-z}{\delta}\right) \quad [5]$$

Where δ is skin depth, which is the distance over which the field decreases to 0.368 of its value just inside the boundary. The values of skin depth are taken from parametric model of dielectric properties of tissues [13].

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).[20] It can be defined as,

$$SAR = \frac{d}{dt}\left(\frac{dW}{dm}\right) \quad [6]$$

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

By using Pointing vector theorem for sinusoid ally varying electromagnetic fields. We get

$$SAR = \frac{\sigma E_z^2}{\rho} \quad [7]$$

Where σ the conductivity of the biological materials, and E_z is the electric 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 valid quantitative measures of all interaction mechanisms are dependent on the intensity of the internal electric fields [14].

RESULTS

Table 1

Penetrated electric fields inside selected human body tissues at frequency 954 kHz at 100 m distance from all India radio broadcasting antenna

Tissue of human body	Penetrated electric field (E_z) in (V/m) at frequency (f) = 954 KHz at depth (0.1 mm - 0.5 mm)				
	0.1 mm	0.2 mm	0.3 mm	0.4 mm	0.5 mm
Bladder	29.9950	29.99023	29.98534	29.98046	29.97558
Blood	29.99305	29.98615	29.97922	29.9723	29.96539
Blood vessel	29.99453	29.98913	29.9836	29.9782	29.9728
Body fluid	29.9906	29.9814	29.9721	29.9628	29.9535
Brain white matter	29.9961	29.9923	29.9885	29.9847	29.9807
Cerebella spinal fluid	29.98958	29.9792	29.9688	29.9584	29.9480
Eye sclera	29.9936	29.9873	29.9810	29.9747	29.9684
Fat	29.9969	29.9938	29.9908	29.9877	29.9846
Gall bladder	29.9922	29.9846	29.9769	29.9692	29.9616
Gall bladder Bile	29.9909	29.9819	29.9728	29.9638	29.9548
Gland	29.9935	29.9872	29.9808	29.9744	29.9680
Heart	29.9949	29.9900	29.9850	29.9800	29.9750
Lung outer	29.9947	29.9895	29.9843	29.9791	29.9739
Lung inner	29.9959	29.9919	29.9879	29.9839	29.9799
Lymph	29.9935	29.9872	29.9808	29.9744	29.9680
Mucous membrane	29.9956	29.9913	29.9869	29.9826	29.9782
Muscle	29.9940	29.9882	29.9823	29.9764	29.9705
Pancreas	29.9935	29.9872	29.9808	29.9744	29.9680
Stomach	29.9937	29.9874	29.9811	29.9749	29.9686
Testis	29.9939	29.9880	29.9820	29.9760	29.9701
Vitreous Humor	29.9906	29.9814	29.9721	29.9628	29.9535

Table 2

Penetrated electric field inside different human body tissues at frequency 954 kHz at 150 m distance from all India radio broadcasting antenna

Tissue of human body	Penetrated electric field (E_z) in (V/m) at frequency (f) = 954 KHz at depth (0.1 mm - 0.5 mm)				
	0.1 mm	0.2 mm	0.3 mm	0.4 mm	0.5 mm
Bladder	19.9967	19.9934	19.9902	19.9869	19.9837
Blood	19.9953	19.9907	19.9861	19.9815	19.9769
Blood vessel	19.9963	19.9927	19.9891	19.9855	19.9818
Body fluid	19.9938	19.9876	19.9814	19.9752	19.9690
Brain white matter	19.9974	19.9949	19.9923	19.9898	19.9873
Cerebella spinal fluid	19.9930	19.9861	19.9792	19.9723	19.9653

Eye sclera	19.9957	19.9915	19.9873	19.9831	19.9789
Fat	19.9979	19.9959	19.9938	19.9918	19.9897
Gall bladder	19.9948	19.9897	19.9846	19.9795	19.9744
Gall bladder Bile	19.9939	19.9879	19.9819	19.9759	19.9698
Gland	19.9957	19.9914	19.9872	19.9929	19.9886
Heart	19.9966	19.9933	19.9900	19.9867	19.9833
Lung outer	19.9965	19.9930	19.9895	19.9860	19.9826
Lung inner	19.9973	19.9946	19.9919	19.9892	19.9866
Lymph	19.9957	19.9914	19.9872	19.9829	19.9786
Mucous membrane	19.9971	19.9942	19.9913	19.9884	19.9855
Muscle	19.9660	19.9921	19.9882	19.9843	19.9803
Pancreas	19.9957	19.9914	19.9872	19.9829	19.9786
Stomach	19.9958	19.9916	19.9874	19.9832	19.9686
Testis	19.9960	19.9920	19.9880	19.9840	19.9800
Vitreous Humor	19.9938	19.9876	19.9814	19.9752	19.9690

Table 3

Penetrated electric field inside different human tissues at frequency 954 kHz at 200 m distance from all India radio broadcasting antenna

Tissue of human body	Penetrated electric field (E_z) in (V/m) at frequency (f) = 954 KHz at depth (0.1 mm - 0.5 mm)				
	0.1 mm	**0.2 mm**	**0.3 mm**	**0.4 mm**	**0.5 mm**
Bladder	14.9975	14.9951	14.9926	14.9902	14.9877
Blood	14.9965	14.9930	14.9896	14.9861	14.9826
Blood vessel	14.9972	14.9945	14.9918	14.9891	14.9864
Body fluid	14.9953	14.9907	14.9860	14.9814	14.9767
Brain white matter	14.9980	14.9962	14.9942	14.9923	14.9904
Cerebella spinal fluid	14.9948	14.9896	14.9844	14.9792	14.9740
Eye sclera	14.9968	14.9936	14.9905	14.9873	14.9842
Fat	14.9984	14.9969	14.9954	14.9938	14.9923
Gall bladder	14.9961	14.9923	14.9884	14.9846	14.9808
Gall bladder Bile	14.9954	14.9909	14.9864	14.9819	14.9774
Gland	14.9968	14.9936	14.9904	14.9872	14.9840
Heart	14.9975	14.9950	14.9925	14.9900	14.9875
Lung outer	14.9973	14.9947	14.9921	14.9895	14.9869
Lung inner	14.9979	14.9959	14.9939	14.9919	14.9899
Lymph	14.9968	14.9936	14.9904	14.9872	14.9840
Mucous membrane	14.9978	14.9956	14.9934	14.9913	14.9891
Muscle	14.9970	14.9941	14.9911	14.9882	14.9852
Pancreas	14.9968	14.9936	14.9904	14.9872	14.9840
Stomach	14.9968	14.9937	14.9905	14.9874	14.9843
Testis	14.9970	14.9940	14.9910	14.9880	14.9850
Vitreous Humor	14.9953	14.9907	14.9860	14.9814	14.9767

Table 4

SAR in W/kg inside different human tissues at the frequency 954 kHz at 100 m from all India radio broadcasting antenna

Tissue of human body	S.A.R. in (W/kg) at frequency (f) = 954 KHz at depth (0.1 mm - 0.5 mm) at 100 m distance				
	0.1 mm	**0.2 mm**	**0.3 mm**	**0.4 mm**	**0.5 mm**
Bladder	0.205648	0.205582	0.205515	0.205448	0.205381
Blood	0.692263	0.691945	0.691625	0.691306	0.690987
Blood vessel	0.282445	0.282343	0.282241	0.282139	0.282036
Body fluid	1.336427	1.335602	1.334774	1.333947	1.333121
Brain white matter	0.087875	0.087853	0.08783	0.087808	0.087786
Cerebella spinal fluid	1.78094	1.779711	1.778477	1.777245	1.776014
Eye sclera	0.536435	0.536211	0.535985	0.535759	0.535534
Fat	0.024509	0.024504	0.024499	0.024494	0.024489
Gall bladder	0.786205	0.785804	0.785401	0.784999	0.784598
Gall bladder bile	1.24677	1.246021	1.24527	1.244519	1.243569
Gland	0.513791	0.513573	0.513354	0.513136	0.512917
Heart	0.283012	0.282919	0.282825	0.282731	0.282637
Lung outer	0.284703	0.284605	0.284506	0.284407	0.284308
Lung inner	0.467009	0.466884	0.46679	0.466634	0.466509

Lymph	0.518732	0.518512	0.51829	0.51807	0.517849
Mucous membrane	0.18898	0.188925	0.18887	0.188816	0.188761
Muscle	0.427631	0.427465	0.427297	0.427129	0.426961
Pancreas	0.518732	0.518512	0.51829	0.51807	0.517849
Stomach	0.497679	0.497472	0.497264	0.497056	0.496848
Testis	0.481221	0.48103	0.480838	0.480646	0.480455
Vitreous Humor	1.336427	1.335602	1.334774	1.333947	1.333121

Table 5

SAR in W/kg inside different human tissues at the frequency 954 kHz at 150 m at 150 m distance from all India radio broadcasting antenna

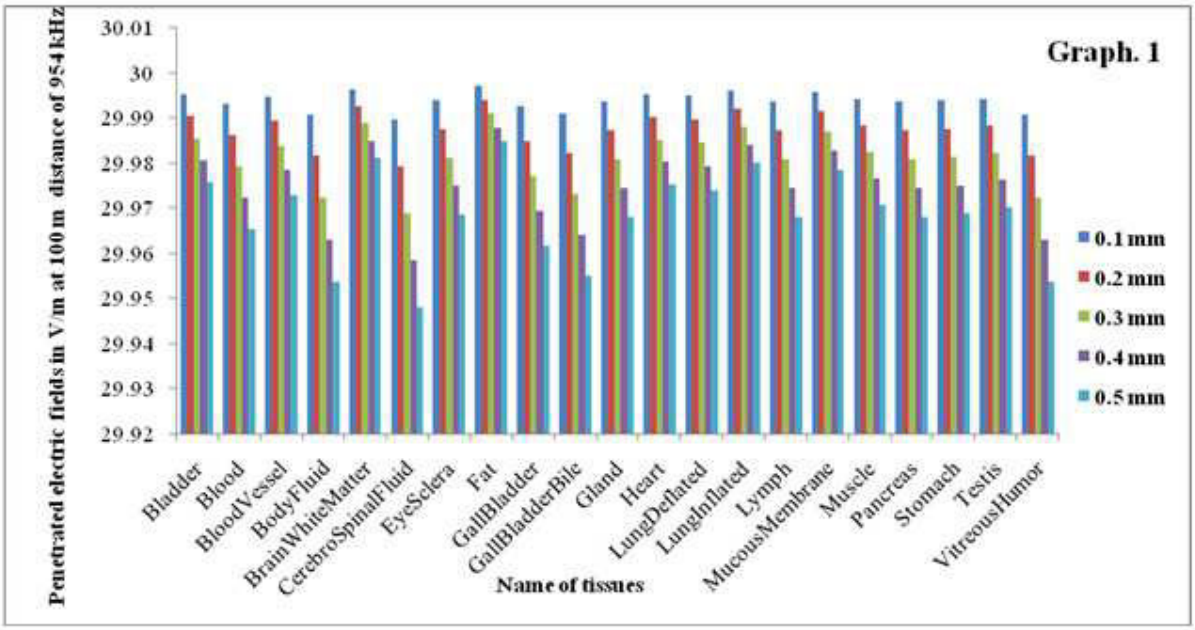
Tissue of human body	S.A.R. in (W/kg) at frequency (f) = 954 KHz at depth (0.1 mm - 0.5 mm) at distance 150 m distance				
	0.1 mm	0.2 mm	0.3 mm	0.4 mm	0.5 mm
Bladder	0.091399	0.09137	0.09134	0.09131	0.09128
Blood	0.307673	0.307531	0.307389	0.307247	0.307105
Blood vessel	0.125531	0.125486	0.12544	0.125395	0.125349
Body fluid	0.593968	0.5936	0.593233	0.592866	0.592498
Brain white matter	0.039055	0.039046	0.039036	0.039026	0.039016
Cerebella spinal fluid	0.79153	0.790982	0.790435	0.789887	0.78934
Eye sclera	0.238416	0.238316	0.238216	0.238115	0.238015
Fat	0.010893	0.010891	0.010889	0.010886	0.010884
Gall bladder	0.349425	0.349246	0.349067	0.34889	0.34871
Gall bladder bile	0.554121	0.553787	0.553454	0.55312	0.552786
Gland	0.228352	0.228255	0.228158	0.22806	0.227963
Heart	0.125783	0.126491	0.126447	0.126403	0.126359
Lung outer	0.126535	0.126491	0.126447	0.126403	0.126359
Lung inner	0.20756	0.207504	0.207449	0.207393	0.207337
Lymph	0.230548	0.230449	0.230351	0.230253	0.230155
Mucous membrane	0.083991	0.083967	0.083942	0.083918	0.083894
Muscle	0.190059	0.189984	0.18991	0.189835	0.189761
Pancreas	0.230548	0.230449	0.230351	0.230253	0.230155
Stomach	0.221191	0.221099	0.221006	0.220914	0.220821
Testis	0.216876	0.213791	0.213706	0.213621	0.213535
Vitreous Humor	0.593968	0.5936	0.593233	0.592866	0.592498

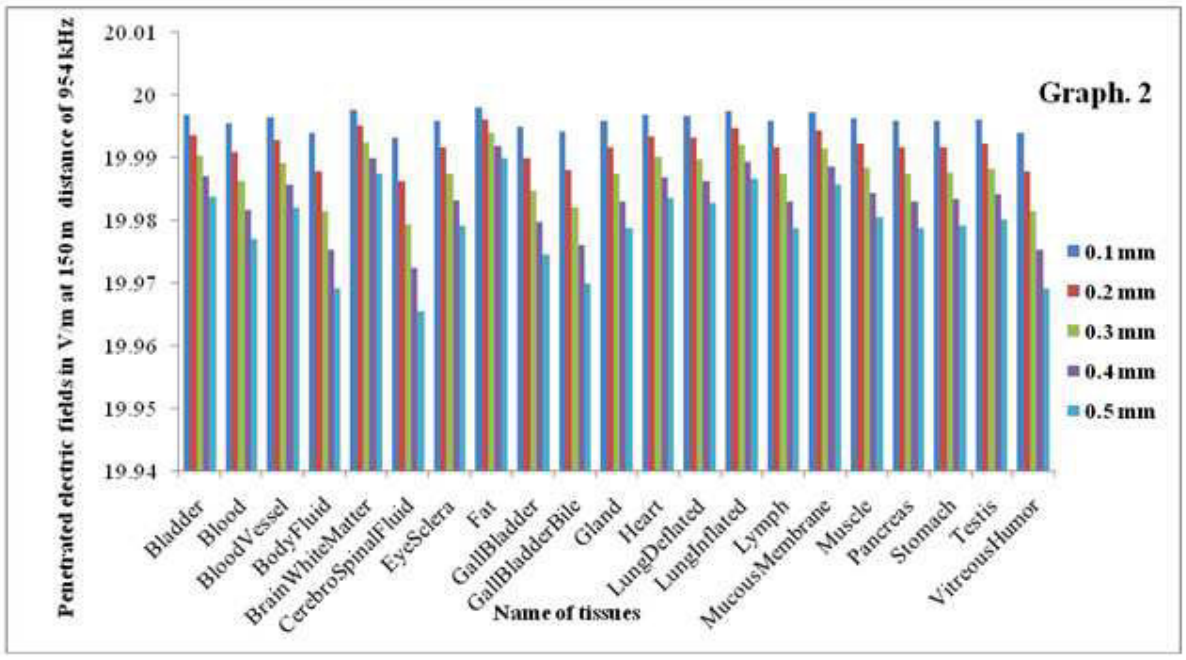
Table 6

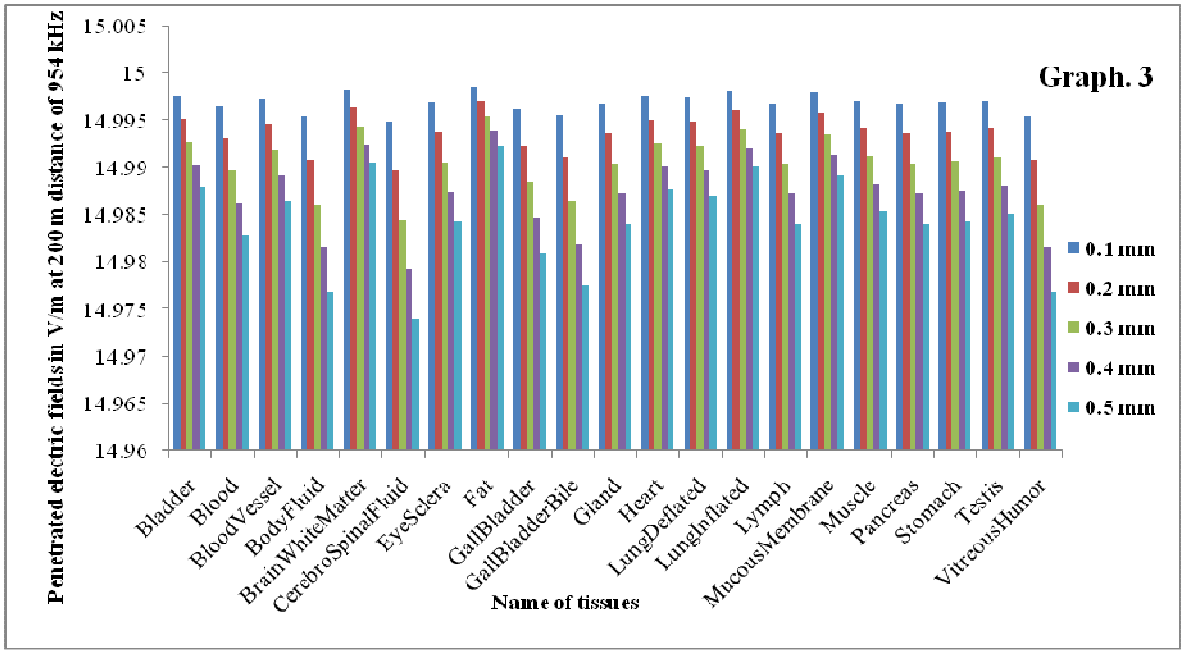
SAR in W/kg inside different human tissues at the frequency 954 kHz at 200 m from all India radio broadcasting antenna

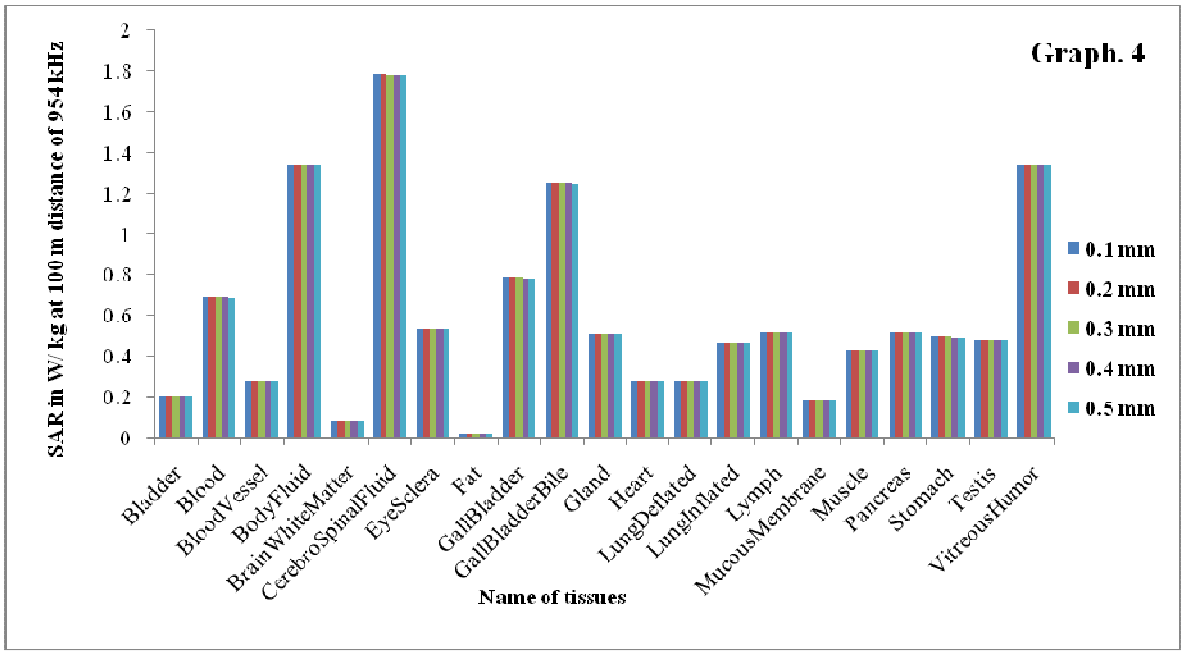
Tissue of human body	S.A.R. in (W/kg) at frequency (f) = 954 kHz at depth (0.1 mm - 0.5 mm) at 200 m distance				
	0.1 mm	0.2 mm	0.3 mm	0.4 mm	0.5 mm
Bladder	0.051412	0.051395	0.051379	0.051362	0.051345
Blood	0.173066	0.172986	0.172906	0.172827	0.172747
Blood vessel	0.070611	0.070586	0.07056	0.070535	0.070509
Body fluid	0.334107	0.3339	0.333693	0.333487	0.33328
Brain white matter	0.021969	0.021963	0.021958	0.021952	0.021946
Cerebella spinal fluid	0.445236	0.444928	0.444619	0.444312	0.444004
Eye sclera	0.134109	0.134053	0.133996	0.13394	0.133883
Fat	0.06127	0.006126	0.006125	0.006124	0.006122
Gall bladder	0.196551	0.196451	0.19635	0.19625	0.196149
Gall bladder bile	0.311693	0.311505	0.311317	0.31113	0.310942
Gland	0.128448	0.128393	0.128339	0.128284	0.128229
Heart	0.070753	0.07073	0.070706	0.070683	0.070659
Lung outer	0.071176	0.071151	0.071126	0.071102	0.071077
Lung inner	0.116752	0.116721	0.11669	0.116627	0.116627
Lymph	0.129683	0.129628	0.129573	0.129517	0.129462
Mucous membrane	0.047245	0.047231	0.047218	0.047204	0.04719
Muscle	0.106908	0.106866	0.106824	0.106782	0.10674

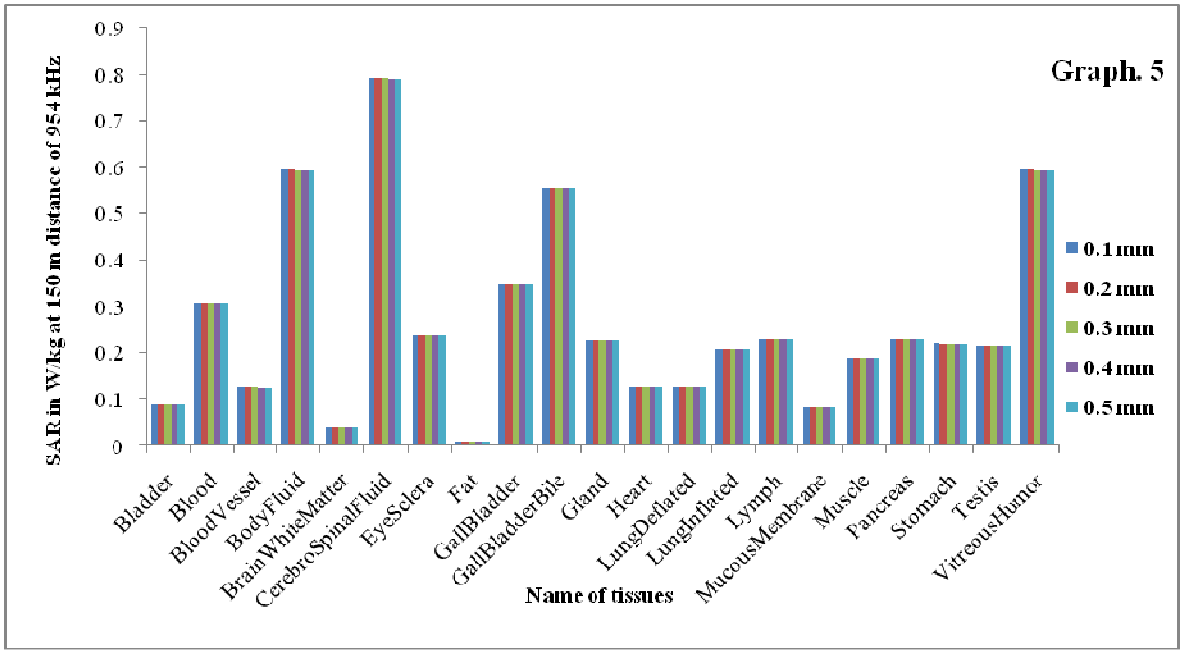
Pancreas	0.129683	0.129628	0.129573	0.129517	0.129462
Stomach	0.12442	0.124368	0.124316	0.124264	0.124212
Testis	0.120305	0.120257	0.120209	0.120162	0.120114
Vitreous Humor	0.334107	0.3339	0.333693	0.333487	0.33328

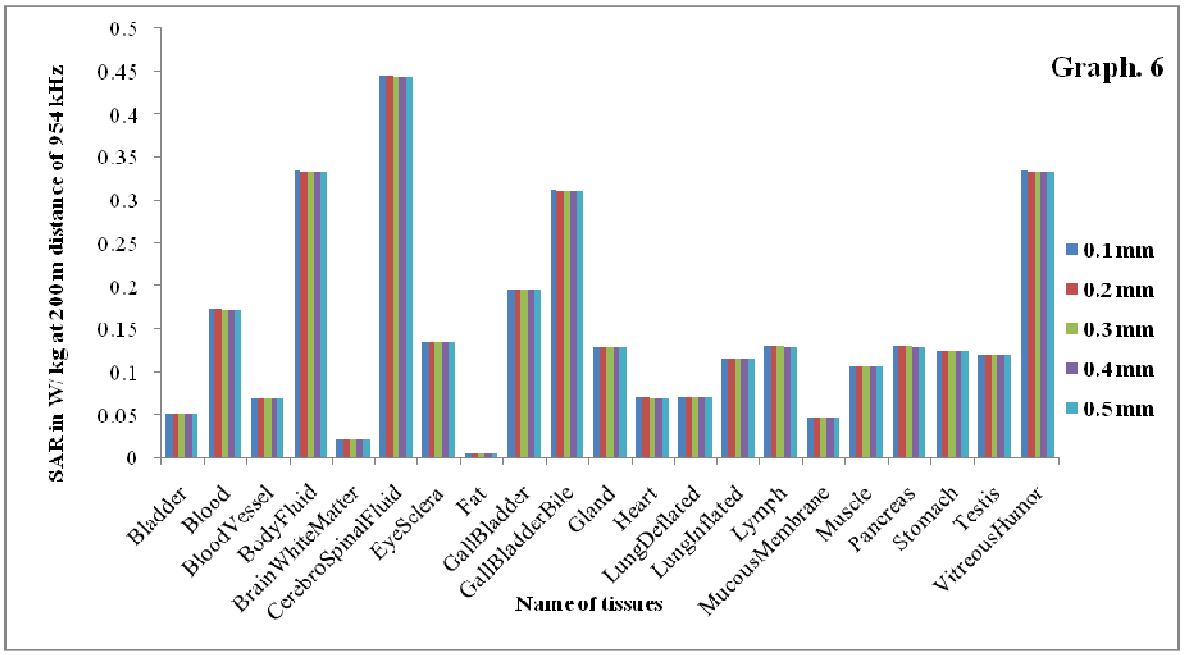





Graph. 3
Penetrated electric fields in V/m at 200 m distance of 954 kHz
15.005
15
14.995
14.99
14.985
14.98
14.975
14.97
14.965
14.96
0.1 mm
0.2 mm
0.3 mm
0.4 mm
0.5 mm
Bladder
Blood
BloodVessel
BodyFluid
BrainWhiteMatter
CerebroSpinalFluid
EyeSclera
Fat
GallBladder
GallBladderBile
Gland
Heart
LungDeflated
LungInflated
Lymph
MucousMembrane
Muscle
Pancreas
Stomach
Testis
VitreousHumor
Name of tissues


Graph. 4
SAR in W/kg at 100 m distance of 954 kHz
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0.1 mm
0.2 mm
0.3 mm
0.4 mm
0.5 mm
Bladder
Blood
BloodVessel
BodyFluid
BrainWhiteMatter
CerebroSpinalFluid
EyeSclera
Fat
GallBladder
GallBladderBile
Gland
Heart
LungDeflated
LungInflated
Lymph
MucousMembrane
Muscle
Pancreas
Stomach
Testis
VitreousHumor
Name of tissues





DISCUSSION

The induced electric field and specific absorption rate inside the tissues due to the radiation of frequency 954 kHz are taken for this study. The radiation produces an electric blanket around the people. The incident electric fields around the all India radio tower are calculated by Eq. (4). This electric field penetrates inside the human body and penetrated electric fields inside the tissues are calculated by Eq. (5). The calculated penetrated electric fields at the distance 100 m, 150 m and 200 m from the broadcasting antenna due to 954 kHz are represented in tables 1, 2 and 3 respectively. The variations of electric fields with respect to the selected tissues are given in graph 1, 2 and 3 for the distances 100 m, 150 m and 200 m from broadcasting antenna respectively. The data of above given tables 1 and 2 and 3 represent that the induced or penetrated electric fields in selected tissues become greater to the safe limit which is mentioned in

ICNIRP guidelines [15]. When this electric field penetrates inside the tissues, the energy is absorbed by the tissues. Specific absorption rate of the selected tissues are calculated by Eq. 7 and represented in table 4 & 5 and 6 due to the electromagnetic waves of frequencies 954 kHz respectively. The variation of SAR with respect to selected tissues at the 100 m, 150 m and 200 m distances from the broadcasting antenna has been given in graph 4, 5 and 6 respectively. These tables also represent that the tissue of the human body, they are living near at the radio broadcasting tower, absorb the given amount of energy. According to some international agencies as world health organization (WHO), international non-ionizing radiation and protection (ICNIRP) the specific absorption rate becomes harmful after 0.08 W/kg, of the whole body weight. It means that, if SAR becomes greater to 0.08 W/kg. It may be harmful for the tissues life of the human body. The safe limit is taken from ICNIRP guidelines. When, the calculated data of SAR given in tables 4, 5 and 6 compared with the safe limits. It is observed that the given frequency of 954 kHz electromagnetic radiation at 100 m distance from broadcasting antenna is harmful for the health of bladder, blood, blood vessel, body fluid, brain white matter, cerebra spinal fluid, eye sclera, gall bladder, gall bladder bile, gland, heart, lung outer, lung inner, lymph, mucous membrane, muscle, pancreas stomach, testis and vitreous humor tissues respectively. For 150 m distance from broadcasting antenna, this radiation is harmful for the health of bladder, blood, blood vessel, body fluid, cerebra spinal fluid, eye sclera, gall bladder, gall bladder bile, gland, heart, lung outer, lung inner, lymph, mucous membrane, muscle, pancreas stomach, testis and vitreous humor tissues respectively. And the amount of absorption energy by human body tissues at 200 m distance from the broadcasting antenna is harmful for the health of blood, body fluid, cerebra spinal fluid, eye sclera, gall bladder, gall bladder bile, gland, lung inner, lymph, muscle, pancreas, stomach, testis and vitreous humor tissues respectively. The radio broadcasting tower generally situated in populated area and very near to the general public. Thus the calculations are made only for 100 m, 150 m and 200 m distances from the antenna.

CONCLUSION

The above calculations and analysis represent that the radiation of 954 kHz is harmful for the tissues of human body at the distance 100 m, 150 m and 200 m from the all India radio broadcasting antenna. This study is done only for some selected tissues. Thus if study will be done for some more tissues of the body, it may be possible that the health of the tissues will become more negative. Thus it is suggested that peoples and workers should keep away from this radiators emitted frequencies of 954 kHz radiation or we can say that these types of radiators should located away from the populated area.

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REFERENCES

1. Kumar V., Sharma A., Kumar A., Ahmad M., and Gupta G. K. Interaction of mobile phone waves with tissues of skeletal muscle and bone of human beings. Journal of pharmacy and biological sciences, 1: 06-16, (2012).
2. Stuchly M.A., and Stuchly S. S., Experimental Radio Wave and Microwave Dosimetry, In: Handbook of Biological Effects of Electromagnetic Fields, Eds, C. Polk and E. Postow, 2 nd. Ed., Boca Raton, CRC Press, pp: 295-336, (1996).
3. World Health Organization, Electromagnetic fields (300Hz to 300GHz), Geneva, WHO, (1993).
4. Consales C., Merla C., Marino C. and Benassi B. Electromagnetic Fields,

Oxidative Stress and neuro-degeneration. International Journal of Cell Biology, 165: 1-16, (2012),
5. Blank M., Goodman R. Electromagnetic fields stress living cells. Pathophysiology, 16: 71-78, (2009).
6. Hosain M. K. Effects of electromagnetic fields on mammalian cells. International journal of electrical and computer engineering, 2: 267- 276, (2012).
7. Fritzer G. , Göder R. , Friege L. , Wachter J., Hansen V., Hinze-Selch D., Josef B. Aldenhoff Effects of short and long-term pulsed radiofrequency electromagnetic fields on night sleep and cognitive functions in healthy subjects. Bioelectromagnetics, 28: 316–325, (2007).
8. Schmiedel S., Brüggemeyer H., Philipp J., Wendler J., Merzenich H., Schüz J. An evaluation of exposure metrics in an epidemiologic study on radio and television broadcast transmitters and the risk of childhood leukemia. Bioelectromagnetics, 30 : 81–91, (2009).
9. Merzenich H., Schmiedel S., Bennack S., Brüggemeyer H., Philipp J., Blettner M. and Schüz J. Childhood leukemia in relation to radio frequency electromagnetic fields in the vicinity of TV and radio broadcast transmitters. Am. J. Epidemiol. 168: 1169-1178, (2008).
10. Ozen S., Helhel S., Colak O.H. Electromagnetic field measurements of radio transmitters in urban area and exposure analysis. Microwave and Optical Technology Letters, 49: 1572–1578, (2007).
11. Paniagua J. M., Rufo M., Jiménez A., Antolín A., Sánchez M. Electrical stimulation vs thermal effects in a complex electromagnetic environment. Science of the total environment, 407: 4717–4722, (2009).
12. Prasad K. D. Electromagnetic Waves In: Electromagnetic Fields and Waves, Ist ed., India: Satya Prakashan, pp: 425-520, (1999).
13. Andreuccetti D., Fossi R. and Petrucci C. Based on the parametric model for the calculation of the dielectric properties of body tissues. Brooks air force base, U.S.A. IFAC-CNR, Florence (Italy), (1997 - 2007).
14. Roje V. Write Antenna theory applied to the assessment of the radiation hazard in the vicinity of the GSM Base Station. Serbian journal of electrical engineering, 1: 15-26, (2003).
15. International communication non-ionizing radiation and protection fact sheet L.F. November. Health Physics, 99: 818 – 836, (2010).
16. Poddar R. Molecular evaluation of virulence genes of swing influenza virus subtype-AH1N1: an analysis of host radiation. International Journal of pharma and bioscience, 2: 167-180,(2011).
17. Rani U., Ismail N., Zibbu G. and Batra A. High frequency shoots regeneration from in vitro raised seedlings of murraya koenigll (L.) spreng. International Journal of Pharma and bioscience, 1: 2-7, (2010).
18. Kumar V., Kumar A., Ahmad M., Pathak P. P. Health effects on human body tissues due to electromagnetic waves of radio broadcasting at the frequency 148.5 kHz, 190 kHz & 210 kHz. International journal of recent scientific research, 3: 1071-1078, (2012).
19. Kumar V., Kumar A., Tyagi A. and Pathak P. P. Health effects due to nonionizing electromagnetic waves in the frequency range (30 kHz-70kHz). International journal of current research, 4: 072-079, (2012).
20. Kumar A., Kumar V. and Pathak P. P. Harmful effects on human body tissues due to electromagnetic waves of radio broadcasting at frequency 1566 kHz . Journal of chemical, biological and physical science, 4: 480-489, (2014).