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## **STUDY OF RATE OF TEMPERATURE CHANGE IN BLOOD TISSUES DUE TO TV / COMPUTER MONITOR RADIATION**

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### **ABSTRACT**

#### **Keywords:**

Extremely low frequency field, Electromagnetic wave, TV/ Computer monitor, Specific absorption rate

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This paper presents a study of low frequency electromagnetic field generated by the TV/ Computer monitor and its distribution in the exposed human body. Computers and electronic devices are an integral part of our work and personal life. The influence of electromagnetic waves on the human body mainly contributes the heat effect, which is generated by the absorption of energy about 100 kHz. Specific absorption rate (SAR) is the most appropriate dosimetric quantity for determining electromagnetic exposure. When a body is exposed to electromagnetic waves for a duration  $\Delta t$  seconds it absorbs the electromagnetic waves and produces a temperature change of  $\Delta T$  otherwise it remains in thermal equilibrium with environment. After penetrate the electric field inside the human body at different depth, the results are if TV is watched at 50 cm, 100 cm and 175 cm distance, the radiation of TV becomes 45, 5.5 and 1.5 times more than 250 cm distance. The radiation of TV is more near the TV / Computer monitor screen and people should watch TV 250 cm away from TV screen. It may become harmful for the health or eye and other tissue.

## INTRODUCTION

Since last three decades there has been suspicion that electromagnetic field (EMF) from power lines, home wiring, airport and military radar, substations, transformers, computers, cell phones and domestic appliances cause everything from brain tumors, leukemia, and other cancers to birth defects, miscarriages, chronic fatigue, headaches, cataracts, heart problems, stress, nausea, chest pain, forgetfulness, depression, aggressive behavior, sleep disturbance and other health problems [1].

This paper presents a study of low frequency electromagnetic field generated by the TV/ Computer monitor and its distribution in the exposed human body. Localized human exposure to electromagnetic field in low frequency range is associated to use of TV/ Computer monitor. Some of the energy is absorbed in the head and rest is whole body of the human being. Almost every gadget at home, at work and everywhere emits many form of electromagnetic waves or radiation (EMW/EMR). Computers and electronic devices are an integral part of our life. As a result, users are exposed to electromagnetic radiation emitted by these electronic machines. Computer monitors and TV set screen generally emit an extremely low frequency field, called ELF. Extremely low frequencies used in our daily lives have attracted a lot of concern on the possible health consequences which may likely result with time. The widespread usage is more prominent in home and work station. Multipurpose usages of domestic appliances and it is proximity to humans could go on and on with time.

Concerns on the possible health consequences during short and long term usage of this technology have given birth to a lot of researches on possible biological effects. Several guidelines exist from various organizations for decades; these guidelines have gone through harmonization where the ones that are widely adopted are provided by IEEE and ICNIRP [2, 3]. When EMW incident on a body, part of the waves are reflected while other are absorbed and the penetration orientation changes at every surface between elements of the body. Part of EM energy absorbed is converted into heat, provoking an elevation of temperature. The energy transformations into the tissues create an increase of the molecular kinetic energy, thereby absorbing the EMW.

National Radiation Protection Commission report, low-frequency electromagnetic waves can cause human cancer, coronary gland disease, Parkinson's disease and Alzheimer's disease. Japanese computer labor and health survey 1995, the Commission had 250 pregnancies do investigators computer operators, of which 18 were suffering from gestosis, 35 miscarriages, 97 stillbirths occurred, the occurrence rate of 60%. Savings, remittances of Posts and Telecommunications System of Hubei Province on the investigation of computer operators found that exposure during pregnancy, 8-10, abnormal pregnancy, 4-6 and occurrence rate of 60% [4].

Classical hyperthermia relies on a temperature of 42–45°C for periods of 30–60 minute to cause irreversible cellular damage [5]. As the tissue temperature rises to 60°C the time required to achieve irreversible cellular damage decreases exponentially. Protein denaturation occurs between 60 and 140°C and leads to immediate cell death. Vaporization of tissue water is superimposed on this process between 100 and 300°C. In addition, carbonization, charring, and smoke generation occurs at 300–1000°C [6].

***Possible effects of EM energy and heat***

It has been known for some time that high intensities of non-ionizing radiation can be harmful due to the ability of its energy to heat biological tissue rapidly. This is the principle by which microwave ovens cook food and exposure to high EM power densities, i.e., on the order of 100 mV/cm<sup>2</sup> or more can result in heating of the human body. Tissue damage can result primarily because of the body inability to cope with or dissipate the excessive heat. The amount of damage of tissue as a result of heating is dependent upon both temperature and time. On a different note, a study [7] reported that millions of people experienced strong EM exposures via clinical diathermy during the last century with only beneficial consequences.

It is essentially important for the existence of animals or humans to maintain body temperature within a certain limited range, while living environments of diverse and varying temperatures. Said the most basic level, the maintenance of body temperature is achieved by balancing heat production within the body and heat loss to the surroundings.

In natural process the heat energy is produced inside the human body due to:

- (i) The rate at which thermal energy is produced through metabolic processes (M).
- (ii) The rate at which the work is produced (W).

Total heat energy gain by the body =  $M \pm W$

This energy is spent in five parts as follows:

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

Total heat energy spent by the body =  $E \pm R \pm C \pm D \pm S$

The whole gain energy becomes equal to the spend energy by the body and equation (1) becomes balanced. Thus there is no excess temperature in the body in this natural process. The balance of heat energy is expressed by the following equation [8];

$$M \pm W = E \pm R \pm C \pm D \pm S \text{ ----- (1)}$$

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.

$$M \pm W + E_R = E \pm R \pm C \pm D \pm S \text{ ----- (2)}$$

where  $E_R$  Energy due to electromagnetic radiation of TV set or computer monitor screen.

Equation (2) becomes unequilibrium because production of energy becomes greater to the energy inside the body. This excess energy may increase the temperature of the tissue and may harmful in many other ways for tissue life. Change of body temperature is detected, especially externally at the skin and internally by a specialized region of the brain. The information is integrated in the

CNS, and regulation is achieved by autonomic and behavioral thermoregulatory reactions. We think that the exposure of radiation is incident only by the front side of monitor. But actually back side of monitor is also radiated electromagnetic waves and back side radiation is more and varying more intensity than front side radiation as shown in figure 1. The radiations are also incident from the monitors kept on the left and right side.

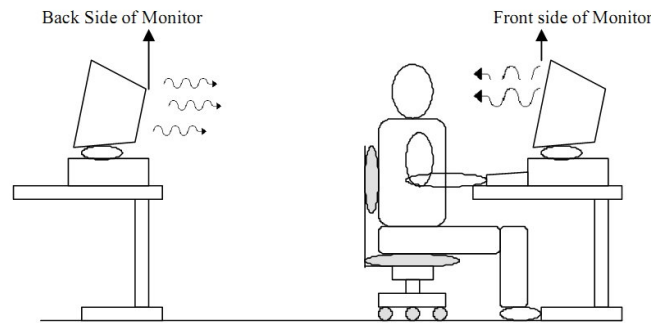


Figure 1 Exposure of radiation of computer monitor from front screen and back side

## MATERIAL AND METHODS

The influence of electromagnetic waves on the human body mainly contributes the heat effect, which is generated by the absorption of energy about 100 kHz [10]. Specific energy rate (W/kg) is the most appropriate dosimetric quantity for determining electromagnetic exposure. It can be determined at any point from the penetrated electric field  $E_i$  (V/m) at that point as,

$$\text{SAR} = (\sigma E_i^2) / \rho \text{ ----- (3)}$$

Where  $\sigma$  is conductivity of the tissue for which the calculation is made and  $\rho$  is the mass density.

The absorption of electromagnetic waves produces temperature change  $\Delta T$ , when a body of specific heat  $C$ , otherwise in thermal equilibrium with environment, is exposed for a duration  $\Delta t$  seconds to these waves, to be given as below;

$$\begin{aligned} C \Delta T &= \text{SAR} (\Delta t) \\ \text{or } \Delta T &= \text{SAR} (\Delta t) / C \text{ ----- (4)} \end{aligned}$$

For estimation of SAR value for blood tissue of human body, conductivity of the blood tissue is taken from Gabriel et al. [9], [10] & [11] and for estimation of rate of temperature change with time, mass density and heat capacity values are taken from Hirata et al. [12].

## RESULTS AND DISCUSSION

Figure 2 SAR for blood tissues due to the radiation of TV /Computer monitor screen

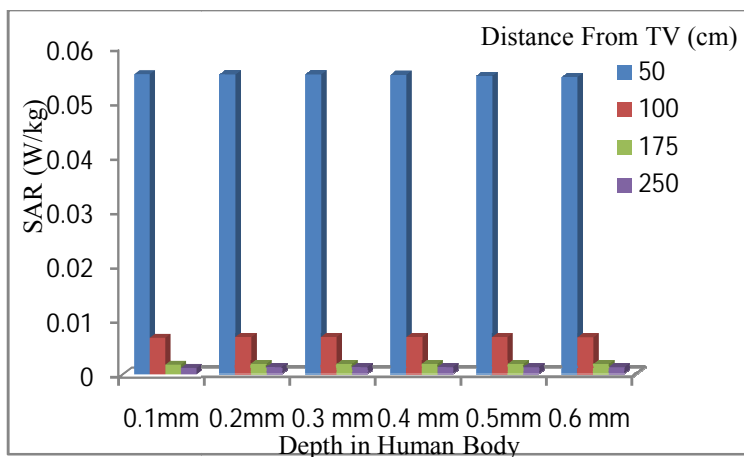


Figure 3 Increased in temperature in blood tissues due to the radiation of TV /Computer monitor screen for 30 minute

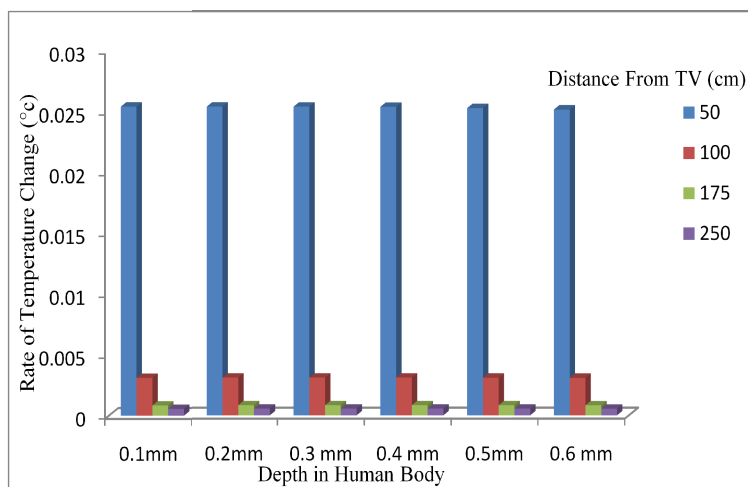


Figure 4 Increased in temperature in blood tissues due to the radiation of TV /Computer monitor screen for 60 minute

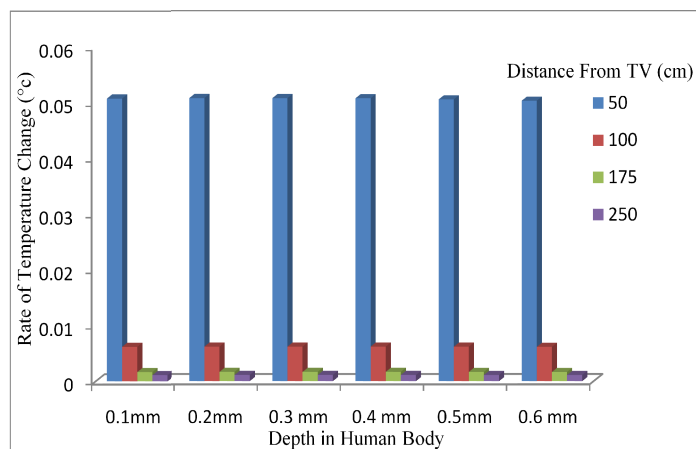


Figure 5 Increased in temperature in blood tissues due to the radiation of TV /Computer monitor screen for 90 minute

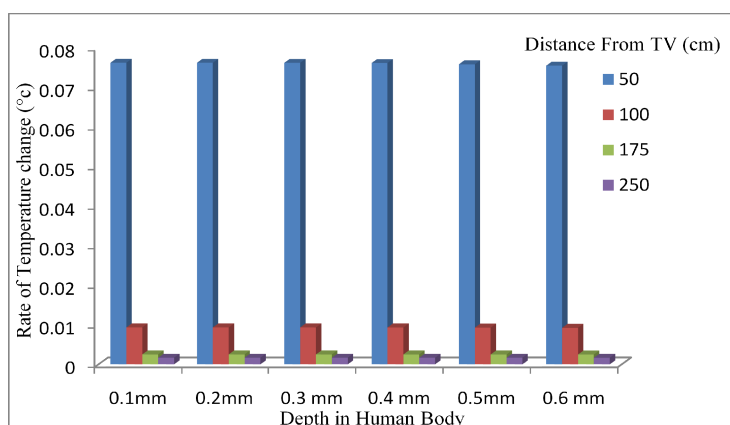


Figure 6 Increased in temperature in blood tissues due to the radiation of TV /Computer monitor screen for 120 minute

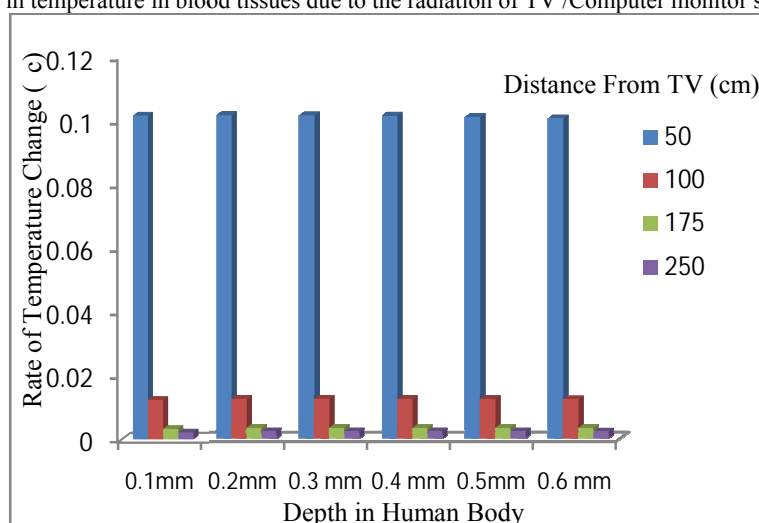


Figure 7 Increased in temperature in blood tissues due to the radiation of TV /Computer monitor screen for 150 minute

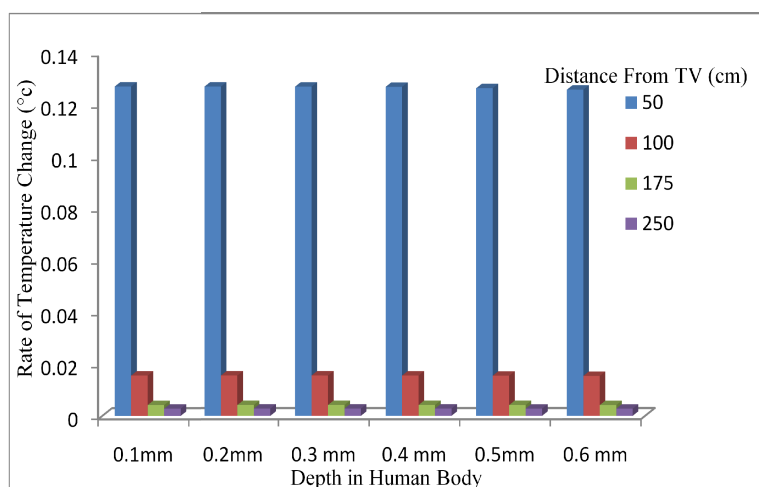
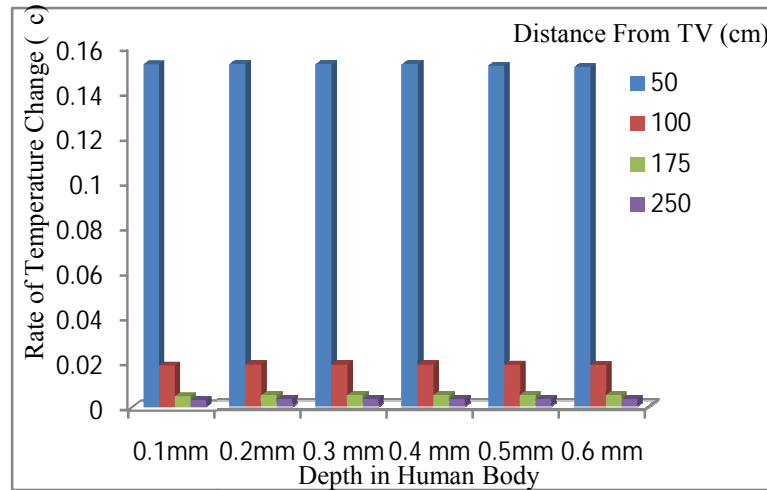


Figure 8 Increased in temperature in blood tissues due to the radiation of TV /Computer monitor screen for 180 minute



Above figures give the results that as the time exposure is increased, the rate of temperature change is also increased. The maximum and minimum temperatures ( $\Delta T$ ) are increased, when TV set is situated at 50 cm distance and at 250 cm distance from the user. The radiation from TV or monitor and increased temperature ( $\Delta T$ ) of tissues becomes 1.49 times greater at 175 cm distance, at 100 cm distance it become 5.54 times greater and at 50 cm distance, it becomes 45.30 times greater than at 250 cm distance of the TV from the user. The increment in temperature of the tissues is harmful in many ways.

Figure 2 represents the SAR of blood tissues due to exposure of radiation of TV / Computer monitor at different distances and 60 cm height from the floor of our home. In this study, the height of TV is taken 60 cm and distances are varying from 50 cm to 250 cm there are many frequencies of radiations are radiated from back and front surfaces of TV set and monitor and we take only (8 – 200) kHz frequency of radiation for this study. According to ICNIRP, WHO and many different international agencies, the absorption of this frequency is safe for human health, but there is no involvement of time in SAR. In figure 3 to 8 we calculate the change in temperature in blood tissues. Actually watching of TV set or working on computer may be from some minutes to some hours. Thus in given tables calculations are made for 30 minutes to 3 hours time exposure.

## CONCLUSIONS

From the above analysis, it is concluded that, the radiation of TV/ monitor can increase the temperature of the tissues of the body. The radiation becomes harmful near the TV set / monitor. The people especially children should keep away from the TV/ monitor and every domestic gadget which radiate electromagnetic radiation. The watching of TV from near becomes harmful for eye sclera tissue and also harmful for the health of other tissues of the body because increase in temperature produces many types of problem.

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