

# ASSESSMENT OF ELECTROMAGNETIC RADIATIONS FROM COMMUNICATION TRANSMISSION TOWERS - A CASE STUDY OF TANZANIA

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### Abstract

*The effects of exposure from electromagnetic radiations of wireless cellular transmission towers to human health have attracted the attention of many researchers. Different works have revealed the harmful of electromagnetic radiation exposure to human health based on distance from the source and period of exposure. As one stays closer and at a pro-longed period from the transmission sites, the possibility of being affected by the radiation source becomes higher. In this work, we review some of the works on assessment of electromagnetic radiation exposure and propose measures for determining safety zones based on the cases of cellular transmission towers in the Tanzania environment to avoid extended exposure to electromagnetic radiation.*

**Key words-** Cellular transmission towers; Electromagnetic radiations; Health effects; Exposure limits

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## 1. INTRODUCTION

The development of any country depends on extent of infrastructure development especially in the telecommunication sector. To accomplish the networks for Telecommunication for accommodating multiple uses of mobile phone applications and broadcasting services requires massive deployment of transmission towers to support capacity and coverage requirements. The installation of transmission towers raises the public concern on the health effects from the exposure of radio frequency (RF) radiations. Prior to installation of any RF transmission towers, the standard and the guidelines provided by International Commission on Non-Ionizing Radiation Protection (ICNIRP) requires to be adhered[1]. However, in some developing countries like Tanzania, despite of the adherence to the standards and guidelines, different RF transmission towers for different services are installed in single sites thus creating difficulties in enforcing compliance to standards and guidelines when towers of different services are co-located around residential areas.

The proliferation of installation of RF transmission towers also increases the level of electromagnetic radiation. Electromagnetic radiations are divided in two categories which are ionizing and non-ionizing. This paper deals with non-ionizing radiations (NIR) which encompass the long wavelength (> 100 nm) and the low photon energy (<12.4 eV) portion of the electromagnetic spectrum, from 1 Hz to 3 x 10<sup>15</sup> Hz. Except for the narrow visible region, the NIR is not

perceived by any of the human senses unless its intensity is so great to be felt as heat [2]. The ability of NIR to penetrate the human body depends on the distance from the source, time taken to stay in the direction of the source as well as shielding mechanism.

Based on the standards and guidelines from the International Committee of Non-Ionizing Radiation Protection and World Health Organization the public exposure limits from cellular towers are provided as shown on table 1 below [1].

**Table 1 .ICNIRP Safety Limits**

Service Frequency	ICNIRP Safety limit E-field [V/m]	ICNIRP Safety Limit Power Density (W/m <sup>2</sup> )
GSM 900	41.9	4.66
GSM 1800	58.4	9.05
WCDMA	61	9.87

As far as these exposure limits are concerned, the side effects can be discussed by considering the time that the object is exposed to radiation and its distance from the source.

This work is organized as follows; Section II reviews some of the literatures that are related to this study. Section III covers our approach where we discuss the methods used to conduct this study and section IV concludes our work paving direction for further works.

## 2. LITERATURE REVIEW

The increase in demand for cellular phones results in massive deployment of cellular towers that radiate signals travelling hundreds of meters to establish contact with individual cell phones [3]. This deployment can be noticed in close proximity to even where people live and conduct their lives like schools, hospitals, markets, and dense populated areas. The radiation from these towers may be associated with health problems to humans [4]. A number of literatures have claimed that the closer and the longer one stays to the radiation source, the more prone one becomes to health.

A study done by Chandran et al., (2012) on the impact of radiation on human health showed that people living within 50m from the radiation source were likely to be affected by diabetes, heart diseases and hearing problems; and that those who live 100m away were likely to suffer respiratory problems, skin diseases, hair loss and anemia [3].

Lai et al., (2010) reveals results which show an increased symptoms and complaints from persons living closer to a RF transmission tower. At less than 10m, symptoms include; nausea, loss of appetite, visual disruptions, and difficulty in moving. Significant differences are reported to occur within 100m for irritability, depressive tendencies, concentration difficulties, memory loss, dizziness, and lower libido. Between 100 and 200m, symptoms included headaches, sleep disruption, feelings of discomfort, and skin problems. Beyond 200m, fatigue is significantly reported more often. Women are significantly reported to reveal symptoms more often than men, except for libido loss. There was no increase in premature menopause in women in relation to distance from towers [5].

Literatures also reveal that there is some evidence of cumulative effects due to radiation. Phillips, et al (1998) reported the DNA damage in cells after 24h exposure to low-intensity RF radiation (RFR) which can lead to gene mutation that accumulates over time [6]. Magras and Xenos (1997) reported that mice exposed to low-intensity RFR became less reproductive. Further, after five generations of exposure the mice were not able to produce offspring which shows that the effects of RFR can pass from one generation to another[7]. Persson et al. (1997) reported an increase in permeability of the blood-brain barrier in mice when the energy deposited in the body exceeded 1.5J/kg, a measurement of the total amount of energy deposited. This suggests that a short-term, high-intensity exposure can produce the same effect as a long-term, low-intensity exposure, and is another indication that RFR effects can accumulate over time [8].

Other biological effects have also been reported after long-term exposure to RF radiations. Effects are observed by Baranski (1972) and Takashima et al. (1979) after prolonged, repeated exposure but not after short-term exposure to RF

radiations [9]. Dumansky and Shandala (1974) and Lai et al. (1989) observed different effects after different exposure durations. Thus, the effects of long term exposure can be quite different from those of short term exposure to RF radiations[10].

Radiations from wireless cellular towers are associated with greater increase in brain tumor due to the damage in the blood brain barrier and the cells in the brain which are concerned with learning, memory and movement [11]. A study by Carl Blackman shows that weak electromagnetic radiations release calcium ions from cell membranes[12] which leaks into the cytosol and acts as a metabolic stimulant, and accelerates growth and healing, but it also promotes the growth of tumors. Another possibility of DNA damage is via increased free radical formation inside cells [13] [14] which further causes cellular damage in the mitochondria. Irreversible infertility is reported in mice [15] and continuous exposure has been associated with reduction in sperm viability and mobility by around 25 percent in men.[16].

Children are more vulnerable to radio frequency radiation emissions as their skulls are thinner, their nervous system still developing and myelin sheath is yet not developed. A pregnant woman and the fetus both are vulnerable because of the fact that these RF radiations continuously react with the developing embryo and growing cells. Microwave radiation damages the placental barrier, implying that pregnant woman should not use cell phone.[17].

The RF exposures adversely affect the heart pace maker, implantable cardiovascular defibrillators and impulse generators [18]. These radiations may stop Pace Maker from delivering pulses in a regular way or may generate some kind of external controlling pulse putting the patient to death. Studies of people who are exposed in their work (occupational exposure), have shown to have elevated levels of health risks. Another study reveals that workers who are in the highest 10% category for electromagnetic exposure are twice as likely to die of prostate cancer as those exposed at lower levels [19].

Exposure to electromagnetic fields has shown to be in connection with Alzheimer's disease, motor neuron disease and Parkinson's disease [20]. All these diseases are involved with the death of specific neurons and are classified as neurodegenerative diseases. Inhabitants living near wireless cellular base stations are also at risk for developing neuropsychiatric problems as headache, memory loss, nausea, dizziness, tremors, muscle spasms, numbness, tingling, altered reflexes, muscle and joint pain, leg/foot pain, depression, and sleep disturbance [21]. More severe reactions include seizures, paralysis, psychosis and stroke. All point to the fact that the current exposure standards for microwaves are not safe for long-term exposure.

### 3. METHODOLOGY

Due to the public concern on the installation of communication transmission towers on the health effects from the exposure of radio frequency radiations (RFR), the assessment was conducted through literature works and we have proved the presence of health effects due to radiation from cellular towers. We cannot abandon the towers as they are the most component of the communication infrastructure. It is the people who need communication and thus towers are installed where users are. Different bodies worldwide and countrywide usually regulate the deployment of towers and their associated radiation.

In the country like Tanzania, The government of Tanzania where the exposure limits has to conform with that of the European Standards for electromagnetic exposure limits has formulated a committee to assess the EMF radiation exposure. The committee has issued the following recommendations on their report [22]:-

- Responsible regulatory authorities in Tanzania (TCRA, TAEC and NEMC) should come up with regulation and guidelines on issues related to communication
- Compliance to the regulation for all telecommunication installations,
- Public education on issues pertaining to the communications matters such as radiation.
- Research collaboration with higher learning universities.
- Procurement of Test Laboratory to be used to measure SAR for mobile phone entering the domestic markets

Some of the recommendations are directed to the network operators. These include;

- Disguise antenna and equipment as part of building to be integral part of the building, structure and landscape. Sharing of the existing sites, masts and other infrastructure
- Consultation with local authorities and communities before new installations are carried out.

The committee assessed the levels of electromagnetic radiation in the VHF, UHF, GSM900, GSM1800 and UMTS bands and found that the actual level was within the limit. However, these assessment were done on short time bases thus requiring more study as they propose to their report [22].

### 4. RESULTS DISCUSSION AND FUTURE WORKS

Since these reviews reveal the health side effects due to cellular tower radiations to human beings living near wireless cellular transmission towers, developing the model for safety zone determination where the RF radiation side effects are minimum or negligible is important. As these side effects are

functions of time or distance, the model will require consideration of other parameters like power of the transmitter, gain of transmitting antenna and its height as well as the distance toward object under exposure. The formulation of this model is left as a direction of our future work.

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