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## Study of Cell Tower Radiation and its Health Hazards on human body

Lalrinthara Pachuau<sup>1\*</sup>, Zaithanzauva Pachuau<sup>2</sup>

<sup>1\*</sup>(Department of Physics, Pachhunga University College, Aizawl -796001, India)

<sup>2</sup>(Department of Physics, Mizoram University, Tanhril –796004, India)

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**Abstract:** In this paper, we present the study of RF radiation from mobile tower and its health effects on human body. Power density of RF radiation from a mobile tower have been measured in close proximity to the mobile base station (GSM 900) at the selected locality in Aizawl, Mizoram, India, which was erected in 2009. Questionnaire was conducted on different health problems faced by the inhabitants living near the base station. The absolute power densities have been measured at different houses which is compared with standard limits given by various authorities like International Commission on Non Ionizing Radiation Protection (ICNIRP), Bioinitiative : 2012 and with the current Indian Standards. Frequency spectrum was analysed at different sites. Different health symptoms of RF exposure faced by the inhabitants within 50m and outside 50m from the tower are analysed and compared. The result is also analysed based on sex. It was found that the inhabitants living within 50m are having more health complaints than those living outside 50m. It was also found that females are having more complaints than males. This type of study is the first time report in the state.

**Keywords:** RF, Non ionizing radiation, Power density, Frequency spectrum, base stations.

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### I. Introduction :

Cellular wireless telephones have become ubiquitous. Wireless technology is based on extensive networks of base stations that connect the users through Radio Frequency (RF) signals. Over the last decade, there has been a great deal of concern about possible health consequences caused by human exposure to RF in general and radiations from base stations in particular<sup>[1],[2],[3]</sup>. It is believed that mobile phones produce RF energy of non-ionizing radiation which is too low to heat the body's tissues, and hence is unlikely to have the same impact on human health as those produced by ionizing radiations such as X-rays<sup>[4]</sup>. Nonetheless, there is still a need to determine the level of health risks caused by RF radiations. Many studies address the impact of mobile phone radiations on human body, only a few consider the effect of human exposure to base stations although such an effect may be greater as more body parts can absorb RF energy<sup>2</sup>.

With the significant increase in mobile phone usage, possible health risks related to RF exposure have become the subject of considerable attention<sup>[3],[5]</sup>. This includes effect from exposure to both cell phones and base stations. Health concerns can be divided into two main categories : short term and long term effects. The short term effect includes brain electrical activity, cognitive function, sleep, heart rate and blood pressure<sup>[6]</sup>. However, the long term effects includes tinnitus, headache, dizziness, fatigue, sensations of warmth, dysesthesia of the scalp, visual symptoms, memory loss and sleep disturbance, muscle problem and epidemiological effects including cancer and brain tumours<sup>[7],[8]</sup>.

In May 2011, International Agency for Research on Cancer (IARC) has classified RF field as possibly carcinogenic to human (group 2B) based on increased risk for glioma, a malignant type of brain cancer associated with wireless phone use<sup>[9]</sup>.

### II. Materials and Methods:

#### 2.1 Questionnaire

To study the health hazards and problems faced by the inhabitants living close to the base station (all living within 100m), questionnaire survey was conducted on 12 different symptoms at the selected site on the eastern part of Aizawl. The questionnaire was similar to that developed for the study on mobile phone users<sup>[9],[10]</sup>. The survey was conducted on 12 different houses on 64 adult persons (31 female, 33 male). The level of complaints for the studied symptoms was expressed by using a scale of: 0 = never, 1= sometimes, 2 = often, 3 = very often. Health hazards faced by the inhabitants were analysed and comparisons have been made based on sex distance (less than 50m and more than 50m).

#### 2.2 Power density measurement:

Power density measurement was carried out on some selected different houses in close proximity to the base station. The main purpose of the measurement is to ensure that RF field emission from each site does not

exceed the public limits and to find any correlation between the health complaints and the power density. The power density  $P_d$  of the RF energy is given by<sup>[11]</sup>

$$P_d = \frac{nP_tG}{4\pi D^2}$$

where  $n$  = Number of transmitters,  $P_t$  = Maximum power from each transmitter,  $G$  = Antenna gain (in decibel),  $D$  = Distance of the site from the transmitter. The power density measurement was done with the instrument HF-60105V4, manufactured by Aaronia, Germany.

### 2.3 Frequency spectrum

Frequency spectrum of the radiation have been recorded at different houses. The same instrument HF-60105V4, manufactured by Aaronia, Germany was used to analyse the frequency spectrum. The instrument is capable of measuring non-ionizing radiation for frequency range of 1MHz to 9.4GHz. In the selected site, other than RF radiation, the other electromagnetic signals present were of TV and Radio which lie outside the GSM 900 frequency range. Hence it has been assumed that the peaks observed were of RF radiation only.

## III. Results and discussions

### 3.1 Analysis of questionnaire

Analysis of the questionnaire is given in Tables 1, 2 and 3. Scale number 2 and 3 are given more considerations. From Tables 1 and 2, it is found that from 12 different symptoms studied, for within and outside 50m from the tower, females are having more complaints than males. Within 50m (Table-1) on scale 2, out of 12 symptoms females are having more complaints on 8 symptoms; on scale 3, females are having more complaints on 3 symptoms. Outside 50m (Table-2), females are having more complaints again. The complaints with more frequencies are fatigue, nausea, dizziness and muscle pain. These 4 symptoms (for less than 50m) are given in figures 1–4 for both the sexes (for scales 2 and 3). Comparison of complaints between all the individuals living within 50m and outside 50m is given in Table 3. It has been observed that those living within 50 m from the base station are having more health complaints than those living outside 50 m for which the graph is given in Figure 6.

**Table 1 : Comparison of complaints between male (25) and female (21) living near the base station within 50m (all the figures are in percentage).**

Sl. No.	Symptom	0		1		2		3	
		M	F	M	F	M	F	M	F
1.	<b>Fatigue</b>	44	23.8	28	47.6	20	9.5	12	19
2.	<b>Nausea</b>	40	38	40	38	12	14.3	4	9.5
3.	<b>Sleep disruption</b>	36	23.8	16	28.6	20	23.8	24	23.8
4.	<b>Feeling of discomfort</b>	56	42.8	20	38	6	19	12	0
5.	<b>Headache</b>	36	14.3	48	57	12	9.5	0	19
6.	<b>Difficulty in concentration</b>	28	28.6	40	52.4	16	19	12	0
7.	<b>Memory loss</b>	32	23.8	40	47.7	16	23.8	8	4.7
8.	<b>Skin problem</b>	32	33.3	32	23.8	12	14.3	20	4.7
9.	<b>Visual disruption</b>	52	66.7	20	14.3	12	14.3	16	4.7
10.	<b>Hearing problem</b>	60	66.7	20	23.8	4	9.5	12	0
11.	<b>Dizziness</b>	64	33.3	24	42.8	24	19	24	4.7
12.	<b>Muscle pain</b>	55	43	15	17	17	18	13	22

Reference : 0 = never, 1= sometimes, 2 = often, 3 = very often

**Table 2 : Comparison of complaints between male (10) and female (8) living near the base station outside 50m (all the figures are in percentage).**

Sl. No.	Symptom	0		1		2		3	
		M	F	M	F	M	F	M	F
1.	Fatigue	75	80	12.5	10	10	12.5	0	0
2.	Nausea	75	80	12.5	10	10	0	12.5	0
3.	Sleep disruption	50	80	37.5	10	10	12.5	0	0
4.	Feeling of discomfort	62.5	90	25	0	10	12.5	0	0
5.	Headache	50	90	37	0	10	12.5	0	0
6.	Difficulty in concentration	62.5	70	25	20	10	12.5	0	0
7.	Memory loss	50	80	50	20	0	0	0	0
8.	Skin problem	37.5	100	50	0	0	12.5	0	0
9.	Visual disruption	37.5	80	37.5	20	0	25	0	0
10.	Hearing problem	50	100	37.5	0	0	12.5	0	0
11.	Dizziness	37.5	100	37.5	0	0	25	0	0
12.	Muscle pain	62	57	22	18	10	15	6	10

Reference : 0 = never, 1= sometimes, 2 = often, 3 = very often

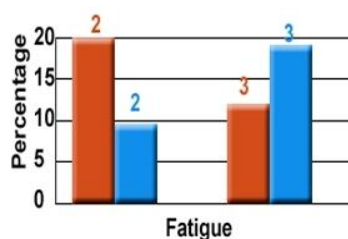
**Table 3 – Comparison of complaints from all the individuals (64) based on distance (in percentage).**

Sl. No.	Symptom	0		1		2		3	
		<50m	>50m	<50m	>50m	<50m	>50m	<50m	>50m
1.	Fatigue	34.7	78	37	11	13	11	15	0
2.	Nausea	39	78	39	11	13	6.5	6.5	6.5
3.	Sleep disruption	30.4	67	22	22	22	11	26	0
4.	Feeling of discomfort	50	78	28	11	13	11	6.5	0
5.	Headache	26	72	52	16	11	11	8	0
6.	Difficulty in	28	67	45.6	22	17.3	11	6.5	0
7.	Memory loss	28	67	43	33	19.6	0	6.5	0
8.	Skin problem	33	72	28	22	13	6.5	13	0
9.	Visual disruption	58.7	61	17	28	13	11	11	0
10.	Hearing problem	63	78	22	16	6.5	6.5	6.5	0
11.	Dizziness	28	72	33	16	22	11	15	0
12.	Muscle pain	21	79	26	16	33	4	20	1

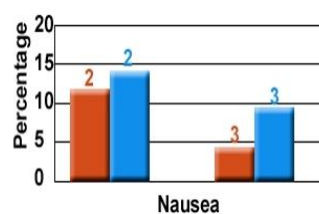
Reference : 0 = never, 1= sometimes, 2 = often, 3 = very often

**Figures 1 – 4 : Comparison of complaints for male and female within 50m from the base station (all the figures are for those living within 50m from the base station).**

Reference : ■ = Male ■ = Female



**Fig. 1**



**Fig. 2**

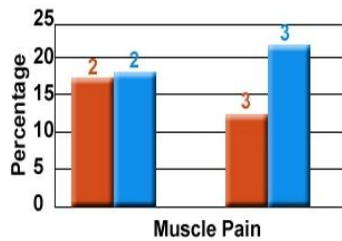


Fig. 3



Fig. 4

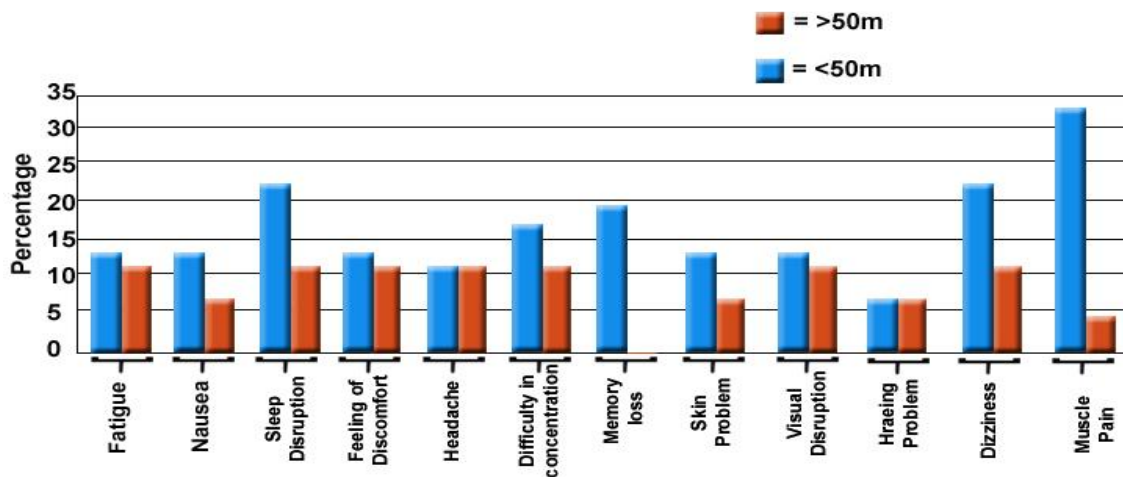


Fig. 5 : Comparison of complaints from all the individuals based on distance

3.2 Power density measurement :

Power density of the RF radiation from the selected tower was measured at different selected houses. The highest measured value was 21 mW/m<sup>2</sup>. Most of the measured values are higher than that of the safe limits recommended by Bioinitiative Report 2012 (0.5mW/m<sup>2</sup>)<sup>[12]</sup>, Salzburg resolution 2000 (1mW/m<sup>2</sup>)<sup>[13]</sup>, EU (STOA) 2001 (0.1mW/m<sup>2</sup>)<sup>[13]</sup>. However, all the measured values were well below the current ICNIRP safe level (4700mW/m<sup>2</sup>)<sup>[13]</sup> and the current Indian Standard (450mW/m<sup>2</sup>)<sup>[14]</sup>. Measured power densities depend to a large extent on the obstructing materials like furnitures, buildings, walls and orientation of the building. That is why the measured power densities vary from place to place. The measured value of power density at different houses is given in Table 4.

Table 4 : Measured values of Power density at different houses (all the houses are of RCC type)

Sl. No.	House /Nature of House	Distance from the tower (m)	Exact site of measurement	Power density (mW/m <sup>2</sup> )	Power (dBm)	% wrt ICNIRP	% wrt Indian Standard	% wrt Bioinitiative Report 2012	Main complaints of inhabitants of the house
1.	RBI Office /RCC	55	Living Room	2.4	-17	0.051	0.53	480	Muscle pain, Fatigue
2.	Residence-1/RCC	74	Living Room	1.5	-19	0.032	0.33	300	Muscle pain, Fatigue, Sleep disorder, Nausea
			Balcony	21		0.445	4.67	4200	
3.	Residence-2/RCC	15	Kitchen	12.2	-10	0.260	2.71	2440	Skin problem, Fatigue, Muscle pain, Dizziness, Sleep disorder
			Bed Room-1	12.3	-10	0.262	2.73	2460	
			Living Room	1.88	-18	0.040	0.42	376	
4.	Residence-3/RCC	59	Bed Room-1	1.95	-18	0.415	0.43	390	Muscle pain, Nausea, Fatigue, Sleep disorder
			Kitchen	1.69	-19	0.360	0.37	338	
5.	Residence-4 /RCC	23	Living Room	2.1	-18	0.044	0.47	420	Muscle pain, Sleep disruption, Fatigue, Feeling of discomfort
6.	CHSS /RCC	93	Main Office	0.0018	-48	0.00004	0.0004	0.36	No complaints

### 3.3 Analysis of Frequency spectrum

Frequency spectrum of the selected mobile tower was recorded at different places. It has been observed that the peak frequency changes in different places. Many frequency peaks are observed at each site. In the selected site, other than RF radiation, the other electromagnetic signals present were of TV and Radio which lie outside the GSM 900 frequency range. Hence it has been assumed that the peaks observed were of RF radiation only.

Frequency spectrum of the radiation is given in Figures 7 and 8.

Figure 7 & 8 : Frequency spectrum of the RF radiation from the tower (GSM 900)



Figure 7



Figure 8

## IV. Conclusion

It has been observed that almost all the measured values of power density at all the sites are higher than that of the safety recommendation of Bioinitiative Report<sup>[12]</sup>, Salzburg resolution 2000<sup>[13]</sup> and EU (STOA) 2001<sup>[13]</sup>, but well below the safety limit recommended by ICNIRP<sup>[13]</sup> and the Department of Telecommunications, Govt. of India<sup>[14]</sup>. However, through questionnaire it has been observed that many inhabitants are still having health complaints on different symptoms after the tower had been erected (in 2009). It has been observed that females are having more health complaints than males. It has also been observed that those living within 50m from the base station are having more health complaints than those living outside 50m. It may be concluded that mobile tower should not be erected in the populated area. It is suggested that human dwelling should be avoided within 50m from the tower.

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