STUDY OF NON SPECIFIC HEALTH SYMPTOMS FACED BY INHABITANTS EXPOSED TO HIGH AND LOW POWER DENSITY FROM MOBILE PHONE TOWER RADIATION

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Abstract- In the present paper, we presented the study of complaints on thirteen (13) different health symptoms faced by inhabitants living near mobile tower – Global System for Mobile Communication (GSM 900) and those inhabitants living in the area where there is no mobile tower. The study was conducted in two different localities in Aizawl in the year 2014. For the study, questionnaires were conducted in both the localities. Power densities were measured in different places in both the localities. Frequency spectrum was taken in each locality. Health complaints between the two localities were compared. It was found that power density is much higher in the area where there is mobile tower than the area where there is no mobile tower. Inhabitants living near mobile tower are having more health complaints than those inhabitants living in the area where there is no mobile tower. Responses from inhabitants who participated in the questionnaire from both the localities were statistically analysed and compared by performing Kruskal Walli's t-test. Out of the thirteen (13) different symptoms studied it was found that the comparisons are statistically significant with $p < 0.05$ in four (4) symptoms. Women were statistically more affected ($p < 0.05$) than male in headache and muscle pain.

Keywords- Frequency Spectrum, Mobile Tower Radiation, Power Density, RF Radiation.

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. 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. 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.

With the significant increase in mobile phone usage, possible health risks related to RF exposure have become the subject of considerable attention. This includes effect from exposure to both cell phones and base stations. The present paper aims to study different symptoms of health effects of RF radiation from mobile tower on nearby inhabitants and those who were not exposed. Health concerns can be divided into two main categories: short term and long term effects. The short term effects include brain electrical activity, cognitive function, sleep, heart rate and blood pressure. However, the long term effects include 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.

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

II.MATERIALS AND METHODS

The mobile base station in Tanhril was erected in 2007 in Aizawl, Mizoram, India. The present study was carried out in 2014, i.e. the inhabitants had been exposed to RF radiation for a period of seven (7) years. Whereas in Lawipu, there is no mobile tower ever.

Questionnaire

To study the health hazards and problems faced by the inhabitants living close to the base station (all living within 100m), questionnaire surveys were conducted on 13 different symptoms at two different localities in Aizawl. The questionnaire was similar to that developed for the study on mobile phone users by Santini et al. The surveys were conducted in two different localities – Tanhril and Lawipu where the inhabitants had been exposed and not exposed respectively. In Tanhril a tower is installed on a roof top in 2006, whereas in Lawipu there is no mobile phone tower, the nearest tower is located in another

locality called Maubawk which is about 1 km away. Questionnaires from those inhabitants living within 100m from the tower are considered in Tanhril (as another tower comes within 100 m if we go farther).

The health complaints of both the localities are compared. The level of complaints for the studied symptoms was expressed by using a scale of : 0 = never, 1 = sometimes, 2 = often, 3 = very often.

B. Power density measurement

Power density measurement was carried out at different houses in both the localities. No mobile phone was turned on in the vicinity while taking readings. Background radiation was measured to be -50 dBm in Tanhril, - 70dBm in Lawipu.

At the same time, absolute power (in dBm) was measured at each site. The main purpose of the measurement is to ensure that RF field emission from each site does not exceed the safe public limits and to find whether there is relation between the health complaints and the measured power densities. The power density P_d of the RF energy is given by:

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

where, n, is number of transmitters; P_t, maximum power from each transmitter; G, antenna gain (decibel); D, distance of the site from the transmitter. However, power density measurement was done with the instrument HF-60105V4, manufactured by Aaronia, Germany.

C. Frequency spectrum

Frequency spectrum of the RF radiation has been taken at both the localities. The frequency peak for each measurement had been recorded. The same instrument HF-60105V4, manufactured by Aaronia, Germany was used to analyse frequency spectrum. The instrument is capable of measuring non-ionizing radiation for frequency in the range of 1 MHz - 9.4 GHz.

III. RESULTS AND DISCUSSIONS

A. Analysis of questionnaire

Analysis of the questionnaire from all the participants is given in Table I. Scale numbers 2 and 3 are given more considerations. From the table it has been observed that health complaints are very few in Lawipu in comparison to that of Tanhril.

It has been observed that those living within 100 m from the base station in Tanhril are having more health complaints than those in Lawipu who are exposed to very weak RF Radiation. In table II, comparisons of health complaints between male and female in Tanhril are given. In figs. 1 & 2 comparisons between health complaints of inhabitants of Lawipu and Tanhril are given (for all the males and females participated in the questionnaire).

From each locality fifty (50) individuals each were participated. In Tanhril, 24 males and 26 females, and in Lawipu the same number 24 males and 26 females participated in the questionnaire.

The detail analysis of comparison of questionnaires between Tanhril and Lawipu is given in table III. For the analysis Kruskal-Walli's t-test is used.

It has been observed that the health complaints are significant ($p < 0.05$, where p is significant level) in different four (4) health symptoms - Fatigue, Headache, Dizziness and Muscle pain out of the studied thirteen (13) symptoms. Out of the four (4) significant symptoms, two (2) of them – Fatigue and Dizziness are significant ($p < 0.05$) in on scale 2, headache is

Sl. No.	Symptom	2		3	
		Lawipu	Tanhril	Lawipu	Tanhril
1.	Fatigue	1	6	0	5
2.	Nausea	2	6	0	5
3.	Sleep disruption	2	5	0	6
4.	Feeling of discomfort	0	4	0	4
5.	Headache	3	8	1	7
6.	Cramp	2	4	1	4
7.	Difficulty in concentration	1	3	1	2
8.	Memory loss	2	3	0	2
9.	Skin problem	2	2	1	3
10.	Visual disruption	1	3	0	2
11.	Hearing problem	3	4	0	4
12.	Dizziness	1	7	0	5
13.	Muscle pain	3	12	2	11

TABLE I . Comparison of health complaints (on scales 2 and 3) between inhabitants in Lawipu and Tanhril for all those who participated in Questionnaire.

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

TABLE II. Comparison of health complaints (on scales 2 and 3) between Male (M) and Female (F) inhabitants in Tanhril.

Sl. No.	symptoms	2		3	
		M	F	M	F
1.	Fatigue	1	5	1	4
2.	Nausea	2	4	2	3
3.	Sleep disruption	3	2	3	3
4.	Feeling of discomfort	1	3	2	2
5.	Headache	2	6	1	6
6.	Cramp	1	3	2	2
7.	Difficulty in concentration	2	1	1	1
8.	Memory loss	1	2	2	0
9.	Skin problem	0	2	1	2
10.	Visual disruption	1	2	1	1
11.	Hearing problem	3	1	1	3
12.	Dizziness	3	4	2	3
13.	Muscle pain	3	9	3	8

Reference : 0 = never, 1= sometimes, 2 = often, 3 = very often significant on scale 3. Muscle pain is significant on both scales 2 and 3.

The significance shows that the inhabitants living in the area where mobile tower is located are having more chance of developing those health problems than the inhabitants living in the area where there is no mobile tower.

In nine (9) different health symptoms – Fatigue, Nausea, Sleep disruption, Memory loss, skin problem, feeling of Discomfort, Visual disruption,

Hearing, Dizziness, problem no comparison were done as the response was zero (0) in scale 2 or 3 in Lawipu. In skin problem, the response is equal from both localities in scale 2. From the other remaining eight (8) symptoms the responses are zero each from Lawipu in scale 3.

TABLE III. Determination of significance level of the comparisons between questionnaires of Lawipu and Tanhril on scales 2 and 3 using Kruskal Walli's t-test.

Sl. No.	Symptom	Scale	t value	df	p value	Remark
1.	Fatigue	2	-2.058	18	0.054	NS
		3	-1.567	18	0.135	NS
2.	Nausea	2	-0.949	18	0.355	NS
		3	-0.493	18	0.628	NS
3.	Sleep disruption	2	0.493	18	0.628	NS
		3				NC
4.	Discomfort	2	-1.095	18	0.288	NS
		3				NC
5.	Headache*	2	-1.897	18	0.074	NS
		3	-2.611	18	0.018	S
6.	Cramp	2	-1.095	18	0.288	NS
		3				NC
7.	Difficulty in concentration	2	0.600	18	0.556	NS
		3				NC
8.	Memory loss	2	-0.600	18	0.556	NS
		3				NC
9.	Skin problem	2				NC
		3	-0.600	18	0.556	NS
10.	Visual disruption	2	-0.600	18	0.556	NS
		3				NC
11.	Hearing problem	2	1.095	18	0.288	NS
		3	-1.095	18	0.288	NS
12.	Dizziness	2	-0.447	18	0.660	NS
		3	-0.493	18	0.628	NS
13.	Muscle pain*	2	-2.466	18	0.024	S
		3	-2.546	18	0.020	S

TABLE IV. Determination of significance level of the comparisons between questionnaires of Male and Female inhabitants in Tanhril on scales 2 and 3 using Kruskal Walli's t-test.

Sl. No.	Symptom	Scale	t value	df	p value	Remark
1.	Fatigue*	2	-2.269	28	0.031	S
		3				NC
2.	Nausea	2	-1.673	28	0.105	NS
		3				NC
3.	Sleep disruption	2	-1.288	28	0.208	NS
		3				NC
4.	Discomfort	2				NC
		3				NC
5.	Headache*	2	-1.950	28	0.061	NS
		3	-2.683	28	0.012	S
6.	Cramp	2	-0.894	28	0.374	NS
		3	-1.474	28	0.152	NS
7.	Difficulty in concentration	2	-1.058	28	0.299	NS
		3	-0.592	28	0.559	NS
8.	Memory loss	2	-0.475	28	0.638	NS
		3				NC
9.	Skin problem	2				NC
		3	-1.058	28	0.299	NS
10.	Visual disruption	2	-1.058	28	0.299	NS
		3				NC
11.	Hearing problem	2	-0.418	28	0.679	NS
		3				NC
12.	Dizziness*	2	-2.683	28	0.012	S
		3				NC
13.	Muscle pain*	2	-2.646	28	0.013	S
		3	-2.443	28	0.021	S

Due to high significant variations of health complaints in Tanhril comparison between health complaints of male and female has been done (table II). Statistical analysis of the comparison is given in table IV. It has been found that in headache (on scale 3) and muscle pain (on both scales 2 and 3) the comparisons are significant. Females are having more complaints than male. The same trend was also observed by R.Santini and Lalrinthara Pachuau and Zaithanzauva Pachuau.

B. Power density measurement

Power density of the mobile phone tower radiation from the selected tower was measured at twelve (12) different selected sites in Tanhril. The lowest measured value was 2μW/m^2, highest measured value was 5.38 mW/m^2. The average value of the measured power density was 2 mW/m^2. All the measured values are higher than that of the safety limits recommended by Bioinitive Report 2012 (0.5 mW/m^2), Salzburg resolution 2000 (1 mW/m^2), EU (STOA) 2001 (0.1mW/m^2). However, all the measured values were well below the current ICNIRP safe level (4700 mW/m^2) and the current Indian Standard (450 mW/m^2). In Lawipu, where there was no mobile tower, power density was measured in twelve (12) different places selected randomly. The lowest measured value was 0.711μW/m^2, the highest measured value was 22μW/m^2 (which is 244 times lower than the corresponding value in Tanhril). The average value of the measured power density was 11 μW/m^2 (which is 181 times lower than the corresponding value in Tanhril), which is well below Bioinitive Report 2012 (0.5mW/m^2), Salzburg resolution 2000 (1mW/m^2), EU (STOA) 2001 (0.1mW/m^2), the current ICNIRP safe level (4700mW/m^2) and the current Indian Standard (450mW/m^2).

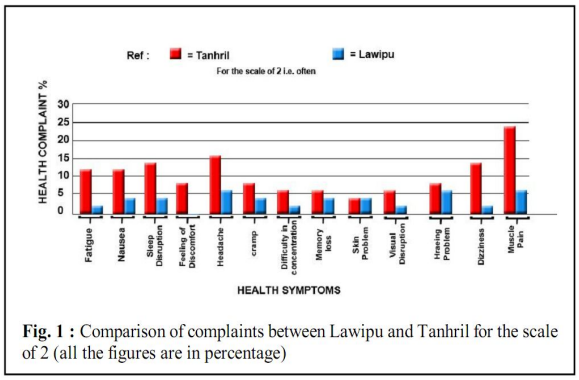

Fig. 1 : Comparison of complaints between Lawipu and Tanhril for the scale of 2 (all the figures are in percentage)

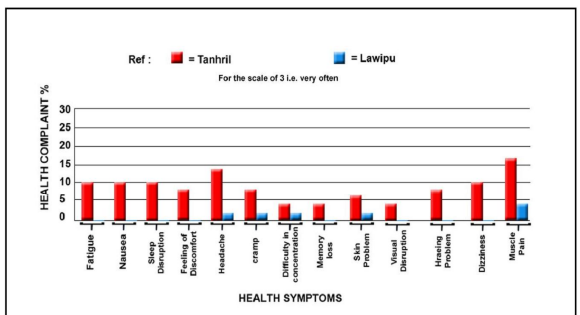

Fig. 2 : Comparison of complaints between Lawipu and Tanhril for the scale of 3 (all the figures are in percentage)

C. Frequency spectrum

Frequency spectrum of the mobile tower was taken at both the localities and shown in figs. 3 and 4. Many frequency peaks are observed at each site with peak frequencies at around 940MHz and 950MHz. In the selected sites, 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.

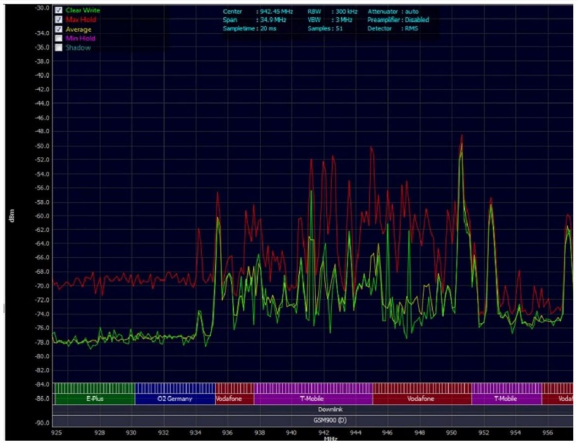

Fig. 3 : Frequency spectrum taken in Lawipu

Fig. 4 : Frequency spectrum taken in Tanhril

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