
COMPARISON OF HEALTH SYMPTOMS FACED BY INHABITANTS EXPOSED TO HIGH AND LOW MOBILE PHONE TOWER RADIATION

LALRINTHARA PACHUAU, ZAITHANZAUVA PACHUAU

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 inhabitants living near mobile tower (where power density is higher) are having more health complaints than those inhabitants living in the area where there is no mobile tower (where power density is lower). Out of the thirteen (13) different symptoms studied it was found that the comparisons are statistically significant with $p < 0.05$ in seven (7) symptoms.

Keywords: frequency spectrum, health complaints, mobile tower radiation, power density, RF radiation.

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 particular¹⁻³. 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-rays⁴. 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 energy².

With the significant increase in mobile phone usage, possible health risks related to RF

exposure have become the subject of considerable attention^{3,5}. 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 pressure⁶. 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^{7,8}.

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 use⁹.

2. Materials and Methods :

The mobile base station in BVT was erected in 2009 in Aizawl, Mizoram, India. The present study was carried out in 2014, i.e. inhabitants are exposed to RF radiation for a period of five (5) years. Whereas in Lawipu, there was no mobile tower ever.

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 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 al¹⁰. The surveys were conducted in two different localities - Bethlehem Vengthlang (BVT) and Lawipu where the inhabitants are exposed and not exposed respectively. In BVT a tower is installed on a roof top in 2009, 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 BVT (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.

2.2 Power density measurement

Absolute power density measurement was carried out at different houses in close proximity to the base station. No mobile phone was turned on in the vicinity while taking readings. Background radiation was measured to be -60 dBm in BVT, - 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 by¹¹:

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

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.

2.3 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. 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 from the tower only.

3. Results and discussions :

3.1 Analysis of questionnaire

Analysis of the questionnaire from all the participants is given in Table 1. 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 BVT. It has been observed that those living within 100 m from the base station in BVT are having more health complaints than those in Lawipu who are exposed to very weak RF Radiation. In figures 1 & 2 comparison between health complaints of inhabitants of Lawipu and BVT are given (for all the males and females participated in the questionnaire). From each locality fifty (50) individuals each were participated. In BVT, 21 males and 29 females, and in Lawipu 24 males

and 26 females participated in the questionnaire. In table 2, the detail analysis of comparison of questionnaires between BVT and Lawipu is given. For the analysis Mann-Whitney U test is used. It has been observed that the questionnaire is significant ($p < 0.05$, where p is significant level) in different seven (7) health symptoms - Fatigue, Sleep disruption, Headache, Cramp, Difficulty in concentration, Skin problem and muscle pain out of the studied thirteen (13) symptoms. Out of the seven significant symptoms, six (6) of them - Fatigue, Sleep disruption, Headache, Cramp, Difficulty in concentration, Skin problem are significant in one scale each i.e. on scale 2 or 3. One health symptom Muscle pain is significant in both the 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 different health symptoms - Fatigue, Nausea, Sleep disruption, Discomfort, Difficulty in concentration, Memory loss, Visual disruption, Dizziness, Hearing problem no comparison were done as the questionnaire reading was zero (0) in scale 2 or 3 in Lawipu.

3.2 Power density measurement

Power density of the RF radiation from the selected tower was measured at fifteen (15) different selected houses in BVT. The lowest measured value was $20 \mu\text{W}/\text{m}^2$, highest measured value was $9.32 \text{ mW}/\text{m}^2$. The average value of the measured power density was $2.57 \text{ mW}/\text{m}^2$. Most of the measured values are higher than that of the safety limits recommended by Bioinitiative Report 2012 ($0.5 \text{ mW}/\text{m}^2$)¹², Salzburg resolution 2000 ($1 \text{ mW}/\text{m}^2$), EU (STOA) 2001 ($0.1 \text{ mW}/\text{m}^2$)¹³. However, all the measured values were well below the current ICNIRP safe level ($4700 \text{ mW}/\text{m}^2$) and the current Indian Standard ($450 \text{ mW}/\text{m}^2$). In Lawipu, where there were no mobile tower, power density was measured in

twelve (12) different places selected randomly. The lowest measured value was $0.711 \mu\text{W}/\text{m}^2$, the highest measured value was $22 \mu\text{W}/\text{m}^2$ (which is 423 times lower than the corresponding value in BVT). The average value of the measured power density was $11 \mu\text{W}/\text{m}^2$ (which is 233 times lower than the corresponding value in BVT), which is well below Bioinitiative Report 2012 ($0.5 \text{ mW}/\text{m}^2$), Salzburg resolution 2000 ($1 \text{ mW}/\text{m}^2$), EU (STOA) 2001 ($0.1 \text{ mW}/\text{m}^2$), the current ICNIRP safe level ($4700 \text{ mW}/\text{m}^2$) and the current Indian Standard ($450 \text{ mW}/\text{m}^2$)¹⁴.

3.3 Frequency spectrum

Frequency spectrum of the mobile tower was taken at different places and shown in Figures 4 and 5. It has been observed that the peak frequency changes at different places over time. This change in peak may be due to time varying nature of the wave. Many frequency peaks are observed at each site with peak frequencies at around 936MHz and 942MHz. 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.

4. Conclusion

It has been observed that in Bethlehem Vengthlang (BVT) the measured average value of power density is higher than that of the safety limit recommendations of Bioinitiative 2012, Salzburg resolution 2000, EU (STOA) 2001; but well below the safety limit recommendations of ICNIRP and the Department of Telecommunications, Govt. of India. However it has been found that many inhabitants are still having health complaints on different symptoms after the tower had been erected in 2009. The most common health complaint is muscle pain. It has also been observed the same trend was also observed by R.Santini¹⁰, Lalrinthara Pachuau & Zaithanzauva Pachuau¹⁵. In Lawipu, power density is very low, the inhabitants are having very few health complaints. Whereas in BVT,

power density is much higher, health complaints are much more compared to those of Lawipu. As it is observed, muscle pain is significant both in scales 2 and 3, the authors suggested that the effect of RF radiation on muscle be more studied. We

conclude that inhabitants exposed to high power densities are having more chance of developing the studied health symptoms; hence mobile tower should not be located in populated area.

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Table 1 : Comparison of health complaints (on scales 2 and 3) between inhabitants in Lawipu and BVT for all those who participated in Questionnaire (all the figures are in percentage).
 Lawipu : Total = 50, BVT : Total = 50 (from those living within 100m from the mobile tower)
Reference : 0 = never, 1= sometimes, 2 = often, 3 = very often.

Sl. No.	Symptom	2		3	
		Lawipu	BVT	Lawipu	BVT
1.	Fatigue	2.5	14	0	10
2.	Nausea	3.5	12	0	10
3.	Sleep disruption	4.5	22	0	10
4.	Feeling of discomfort	0	12	0	12
5.	Headache	5.5	16	2	16
6.	Cramp	4.5	18	2	10
7.	Difficulty in concentration	2.5	14	2	2
8.	Memory loss	4.5	10	0	6
9.	Skin problem	4.5	16	2	8
10.	Visual disruption	2.5	10	0	4
11.	Hearing problem	5	12	0	8
12.	Dizziness	2.5	8	0	3
13.	Muscle pain	5.5	24	4	26

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

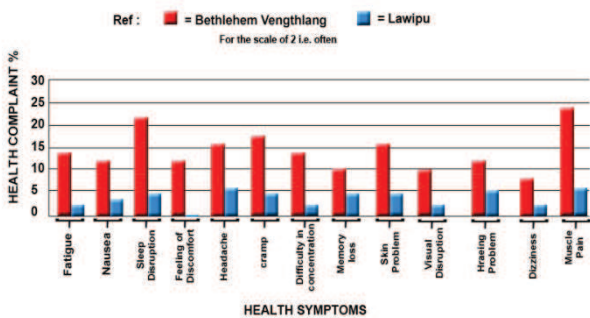


Fig. 2 : Comparison of complaints between Lawipu and BVT for the scale of 3 (all the figures are in percentage)

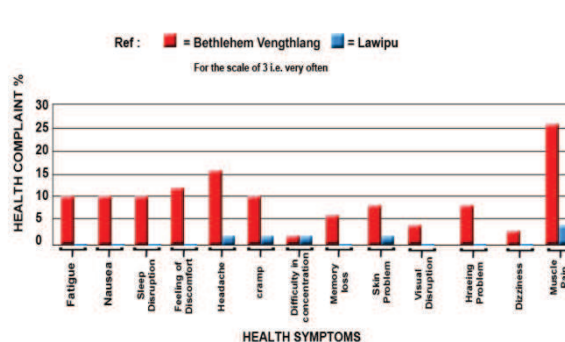


Table 2 : Determination of significance level of the comparisons between questionnaires of Lawipu and Bethlehem Vengthlang (BVT) on scale 2 and 3 using Mann – Whitney U test.
 Ref : * or S = Significant NS = Not significant NC = No comparison

Symptom	Scale	u ($\times 10^3$)	W ($\times 10^3$)	z	p value	Remark
Fatigue*	2	1.100	2.375	-2.201	0.028	S
	3					NC
Nausea	2	1.150	2.425	-1.467	0.142	NS
	3					NC
Sleep disruption*	2	1.02	2.300	-2.663	0.008	S
	3					NC
Discomfort	2					NC
	3					NC
Headache*	2	1.125	2.400	-1.590	0.112	NS
	3	1.075	2.350	-2.434	0.015	S
Cramp*	2	1.075	2.350	-2.226	0.026	S
	3	1.150	2.425	-1.676	0.094	NS
Difficulty in concentration*	2	1.100	2.375	-2.201	0.028	S
	3					NC
Memory loss	2	1.175	2.450	-1.170	0.242	NS
	3					NC
Skin problem*	2	1.100	2.375	-1.990	0.005	S
	3	1.175	2.450	-1.370	0.171	NS
Visual disruption	2	1.150	2.450	-1.676	0.094	NS
	3					NC
Hearing problem	2	1.175	2.450	-1.043	0.297	NS
	3					NC
Dizziness	2	1.175	2.450	-1.370	0.171	NS
	3					NC
Muscle pain*	2	1.025	2.300	-2.508	0.012	S
	3	0.975	2.250	-3.065	0.002	S

Fig. 3 : Frequency spectrum of GSM 900 taken in BVT

Fig. 4 : Frequency spectrum of GSM 900 taken in Lawipu



Lalrinthara Pachuau : Dept. of Physics, Pachhunga University College /Asst. Prof./ Mizoram University/email : rinapachuau@yahoo.com

Zaithanzauva Pachuau : Dept. of Physics /Professor / Mizoram University/ email : zpc21@yahoo.com