

Electromagnetic Radiation Health Effects in Exposed and Non-Exposed Residents in Penang

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Abstract

A comparative study was conducted between residents exposed and not exposed to electromagnetic radiation (EMR) from TELCO towers in Penang Island with the objective of determining the possible health effects using 14 non-specific health symptoms (NSHS). Interviews on 201 respondents were conducted using structured questionnaire for demographic details, health related problems and the public concern. Comparison of symptoms frequencies and its significance (Chi-square test) between the exposed and not exposed residents from the TELCO tower showed statistical significance ($p < 0.05$) for headache, giddiness, insomnia, loss of memory, diarrhea, mental slowness, reduced reaction time and mood swing. The odds ratio for the development of the NSHS scored > 1 for all that gave a conclusion that respondents who were exposed were more likely to suffer symptoms as compared to the respondents who were not exposed to EMR. This outcome showed that the existence of TELCO tower in these communities has detrimental health effects towards the residents who were exposed to the electromagnetic fields radiation that was emitted. Measures to be taken to minimize adverse health effects on residents should include imposing more stringent guidelines in terms of safety distance and radiation intensity, practicing of WHO precautionary approach, encouraging electromagnetic fields radiation related conference, researches and public awareness, sharing of transceivers by TELCO companies and using protective barriers. These steps will ultimately promote a healthier, harmonious and sustainable living environment.

Keywords

Electromagnetic Radiation; Exposure; Non-Specific Health Symptoms; Public Concern

1. Introduction

The development of mobile telecommunication technology has led to substantial growth of the number of mo-

mobile phone base station also known as TELCO tower worldwide. It has raised public concerns and substantial controversy about the potential health effects of radiofrequency electromagnetic fields emissions of mobile phone base station that have not been yet fully understood. There has been increasing public concern on the effects of electromagnetic radiation (EMR) from telecommunication towers (TELCO). These towers have been constructed in housing areas, school compounds, apartment and multi-storey shop-lot rooftops and within compounds of mosques throughout Malaysia and other countries.

On 31st May 2011, the International Agency for Research on Cancer (IARC), a part of WHO designated cell phones as “possible human carcinogen” [Class 2B]. They found evidence of increase in glioma and acoustic neuroma brain cancer for mobile phone (IARC WHO, 2011).

The health effects of EMR are best explained in a study by Hallberg and Oberfeld estimated that 50% of the public exposed to EMR would be sensitive to the radiation effects by 2017. The manifestation of this hypersensitivity would be health complains such as headaches, giddiness, nausea, skin rashes, feeling warm, depression, night sweats, memory loss, disturbances in menstruation and insomnia (Hallberg, 2006).

The studies that have been conducted provide indications that people living in the vicinity of mobile phone base station develop adverse health conditions especially the non-specific health symptoms and cancer (Chiang, 1989; Coggon, 2006; Hutter, 2006; Santini, 2003). There are very few studies on the health effect of electromagnetic fields radiation. Many of the studies already conducted were confined to cell phone radiation. The few studies on the health effects of electromagnetic fields radiation yielded both positive and negative results due to the lack of proper measurement of the intensity of the electromagnetic fields radiation, the number of antennas on the TELCO tower and the presence of confounding factors such as hand phone and WiFi (Wireless Fidelity).

2. Objectives

The objectives of this study were to conduct a comparative study of possible health effects of electromagnetic fields radiation on communities exposed and not exposed to electromagnetic fields radiation from TELCO tower.

3. Methodology

Five communities located in Penang Island were chosen randomly. Four of the communities who were located within the radius of 0 to 150 meters from the TELCO towers and had a power density of more than 200 microwatts per square meter became the EMR exposed samples. One control group was chosen randomly from a community that was located more than 150 meters from the nearest TELCO tower and had power density measurement of less than 200 microwatts per square meter.

All samples of those who were exposed to electromagnetic fields radiation were above 15-year-old, of any race, any gender and were exposed to EMR 10 years or more.

The housing areas for the exposed group were identified via random sampling. Systemic sampling was used for the identification of the houses followed by cluster sampling for the respondents.

The survey was conducted via questionnaires containing past suggested and validated measurements to find out the occurrence of non-specific health symptoms and incidence of cancer among the samples.

Sample size was calculated using the formula $n = (Z_{1-\alpha})^2(P(1-P)/100)/D^2$ which at $P=0.125$ yielded a sample size of $1.96^2(0.125(1-0.125)/0.05^2) = 168$. Therefore a total of 201 sets of questionnaires were filled up via face-to-face interview in September 2013.

Distance between the TELCO tower and the housing areas were obtained through Google maps and the power density of EMR was measured by using TES-92 ElectroSmog Meter. Complaints of non-specific health symptoms (NSHS) derived from a research by Oberfeld, et.al. in 2004 were recorded using interval scale in terms of their frequency of occurrence and severity.

In this study, all the data garnered from the samples were analyzed by utilizing both quantitative and qualitative methods. Statistical Package for Social Science (SPSS) version 16.0 for Window was employed to execute descriptive and statistical analyses.

4. Results

The socio-demographic data is shown in **Table 1**. From the total of 201 respondents, 91 (45.3%) were living at

Table 1. Socio-demographic data.

Characteristics	Sociodemographic			
	N	n(%)	Mean	SD
Radius (m)	<50		91(45.3)	
	51-100		29(14.4)	
	101-150	201	50(24.9)	
	>150		31(15.4)	
Gender	Male		80(39.8)	
	Female	201	121(60.2)	
Age Group(years)	18 - 27		28(13.9)	
	28- 37	193	31(15.4)	47.2
	38- 47		26(12.9)	16.1
	48- 57		47(23.4)	
	>57		61(30.3)	
Ethnicity	Malay		87(43.3)	
	Chinese		100(49.7)	
	Indian	201	13(6.5)	
	Others		1(0.5)	
Length ofS-tay(years)	<5		16(8)	
	6-10	186	33(16.4)	19.6
	11-15		23(11.4)	11
	16-20		41(20.4)	
	>21		73(36.3)	

radius < 50 meters from the TELCO towers, 29 (14.4%) were at radius 51 to 100 meters, 50 (24.9%) were from radius 101 to 150 meters and 31 (15.4%) were from radius >150 meters. Respondents who were from the radius of 0 to 150 meters from the TELCO towers (170 respondents or 84.6%) were considered as exposed to electromagnetic fields radiation whereas those who lived at radius beyond 150 meters from the TELCO tower (31 respondents or 15.4%) were considered as not exposed to the radiation or control group.

The youngest respondent was 16 whereas the oldest was 77. The age range was 61. The mean, median and mode for age was 47.2, 50 and 61 respectively with a standard deviation of 16.1. Distribution by gender was 80 (39.8%) males and 121 (60.2%) female. In relation to ethnicity 87 (43.3%) were Malays, 100 (49.7%) were Chinese, 13 (6.5%) were Indians and 1 respondent (0.5%) was categorized under other race. Ethnicity spread was therefore reflective of the diverse races in Malaysia.

The mean length of stay in the neighborhood was 19.6 years.

From **Table 2**, it was found that out of a total of 14 NSHS, 8 NSHS were statistically significant where the Chi Square test recorded p-value of less than 0.05. The significant NSHS were headache, giddiness, insomnia, loss of memory, diarrhea, mental slowness, reduction in reaction time, and mood swing. The rest of the symptoms that did not have statistically significant association were fatigue, somnolence, vomiting, palpitation and feverish.

Table 3 shows the odds ratio for the development of the NSHS. All NSHS scored > 1 which gave a conclusion that respondents who were exposed were more likely to suffer symptoms as compared to the respondents who were not exposed to EMR.

The OR for respective NSHS in descending order were reduced reaction time (OR = 16.57 corrected), diarrhea (OR = 7.95 corrected), mental slowness (OR = 5.46), vomiting (OR = 5.35 corrected), mood swing (OR = 3.3), insomnia (OR = 3.22), giddiness (OR = 3.07), loss of memory (OR = 2.92), depression (OR = 2.61), headache (OR = 2.58), palpitation (OR = 2.4), feverish (OR = 2.37), fatigue (OR = 2.31) and somnolence (OR = 1.17).

Table 2. Presence of Non-Specific Health Symptoms (NSHS) in exposed and non-exposed respondents.

NSHC	Complaint	Exposed	NotExpose	Total	Chi-Square Test (p Value)
Headache	Y	67	6	73	0.044 - Significant
	N	104	24	128	
Giddiness	Y	65	5	70	0.024 - Significant
	N	106	25	131	
Fatigue	Y	78	8	86	0.050 - Not Significant
	N	93	22	115	
Insomnia	Y	67	5	72	0.018 - Significant
	N	104	25	129	
Somnolence	Y	51	8	59	0.726 - Not Significant
	N	120	22	142	
Memory Loss	Y	63	5	68	0.031 - Significant
	N	108	25	133	
Diarrhea	Y	20	0	20	0.048 - Significant
	N	151	30	181	
Vomiting	Y	14	0	14	0.104 - Not Significant
	N	157	30	187	
Palpitation	Y	25	2	27	0.239 - Not Significant
	N	146	28	174	
Mental Slowness	Y	48	2	50	0.012 - Significant
	N	123	28	151	
Reduced Reaction Time	Y	37	0	37	0.005 - Significant
	N	134	30	164	
Mood Swing	Y	68	5	73	0.015 - Significant
	N	103	25	128	
Depression	Y	49	4	53	0.079 - Not Significant
	N	122	26	148	
Hot or Feverish	Y	55	5	60	0.087 - Not Significant
	N	116	25	141	

Table 3. Odds ratio for non-specific health symptoms.

NSHS	Status	Complaint		Total	Odds Ratio (OR)
		Yes	No		
Headache	E	67	104	73	2.58
	NE	6	24	128	
Giddiness	E	65	106	70	3.07
	NE	5	25	131	
Fatigue	E	78	93	86	2.31
	NE	8	22	115	
Insomnia	E	67	104	72	3.22
	NE	5	25	129	
Somnolence	E	51	120	59	1.17
	NE	8	22	142	
Loss of Memory	E	63	108	68	2.92
	NE	5	25	133	
Diarrhea	E	20	151	20	7.95 (Corrected)
	NE	0	30	181	
Vomiting	E	14	157	14	5.35 (Corrected)
	NE	0	30	187	
Palpitation	E	25	146	27	2.4
	NE	2	28	174	
Mental Slowness	E	48	123	50	5.46
	NE	2	28	151	
Reduced Reaction Time	E	37	134	37	16.57 (Corrected)
	NE	0	30	164	
Mood Swing	E	68	103	73	3.3
	NE	5	25	128	
Depression	E	49	122	53	2.61
	NE	4	26	148	
Hot or Feverish	E	55	116	60	2.37
	NE	5	25	141	

5. Discussion

As compared to the study by Santini, R. et al., headache and sleep disruption were reported statistically significant within the radius of 200 meters from TELCO tower, complaints of irritability, dizziness and loss of memory were reported as significant within the radius of 100 meters from TELCO tower. However, complaints of NSHS like tiredness and depression that reported as significant in the study by Santini was not statistically significant in this study (Santini, 2004).

In another unpublished study by Mara University of Technology, 3 NSHS namely, headache, sleep disturbance and dizziness were noted to be statistically significant up to the radius of 120 meters from the TELCO tower (Year 4 Medical Students, 2008).

The results show that complaints by members of public especially those who reside in the vicinity of TELCO tower that they are experiencing certain NSHS are not discrete cases but were caused by the electromagnetic

fields radiation exposure. No authorities or TELCO companies shall deem the complaints by the public as unfounded or with ill intention to stop or disrupt the operation of the TELCO tower.

6. Recommendations

This study gives evidence that people exposed at up to 150 meters from TELCO towers suffer health effects. The safety distance from the TELCO tower should not be less than 150 meters.

This study has also proven that complained of NSHS were significant among the exposed group where they were exposed to the power density of >200 microwatts per meter square (those who stayed within the radius of 150 meters). In view of the potential negative health impacts and significant evidence of NSHS, it is timely for the authorities to enforce a more stringent guidelines pertaining to the power density emitted from the TELCO tower. As an example, Austria is implementing the ruling where power density is not allowed to be more than 1000 microwatts per square meter and Bio-Initiative Report is also recommending safety limit that not more than 1000 microwatts per square meter (The Bio-Initiative Report, 2012).

This study has indirectly shown that intensity of radiation has significant impact on the health impact. This is evidenced by the relatively fewer cases of complaints of NSHS among the control group.

In order to reduce the intensity of radiation, the authorities should consider requesting all the TELCO companies to share their transceivers over the TELCO tower, as this approach will minimize the net intensity of EMR. Since mobile phone ownership is expected to increase exponentially resulting an installation increase of TELCO towers and transceivers, sharing of transceivers over the TELCO tower will not only reduce the number of TELCO towers but also the intensity of the EMR which will ultimately reduce the net power intensity that will affect the public who are staying in the vicinity of the TELCO tower.

The authorities should consider uploading the localities of each TELCO tower and the details of the TELCO companies who are operating the particular TELCO tower in the official website of the authorities. This measure not only will promote transparency but also will curb the building and operation of illegals TELCO tower. The public will ensure the TELCO towers that are built within their communities are the ones with licenses. This approach empowers the public to be the informants of the enforcement units. Uploading of information to the cyberspace to safeguard the interest of public is also in line with the practice of new public management that is aiming at improve quality, efficacy, transparency and accountability by using information computer technology.

The authorities must take initiative to work closely with tertiary education and research institutions to organize international conferences and encourage interaction among the international experts and scholars in the areas of electromagnetic fields radiation. Grants and scholarships should be allocated for local academicians and scientists to conduct researches in EMR to gain more knowledge and insights into this field.

This study found that there were respondents who were exposed to EMR of up to 10,000 microwatts per square meter and the distance of the TELCO tower was 50 meters away from the respondents' house. As far as the power density of radiation and distance are concerned, both are in compliance to the existing laws of Malaysia and the residents have no legal ground to ask for the TELCO tower to be removed. The sad reality is that until and unless these residents move out from this neighborhood, they will be exposed to the high intensity of EMR.

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