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EFFECT OF ELECTROMAGNETIC FIELDS EMITTED BY CELLULAR PHONE BASE STATION ON HUMAN HEALTH

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ABSTRACT

Background: In today's world Globalization is the new mantra. It is very difficult not to have technology. But with technology, come certain hazards. The only way to beat these is again, better technology. Electromagnetic radiation is everywhere. More and more wireless communication services (cellular phones, wireless internet, etc.) are expected to come up and it seems that there is no way to reverse this trend. A cell phone technology is one of them, which introduce in India few years back, but now its need of society. It also works on electromagnetic radiation. Therefore, the aim of the present study is to find out the effect of cellular phone base station radiation, due to frequent exposure, on human health. **Material & Method** The present study was conducted over a period of three years. This covers urban as well as rural areas of Surat districts. The city of Surat was selected as the urban area while villages surrounding it represented the rural areas. Study obtains information regarding radiation exposure to individuals by means of cellular phone base stations and their effect on human health.**Observation :** Study was under taken in 66 subjects, including control group. The study includes anthropometric parameters and standard cardiovascular autonomic function tests.**Conclusion: We** are not at all against any technologies coming up, we are welcoming all the technologies, but we maintain that health precautions and safety precautions must be taken. Even if effects are of small amplitude and do not seem to be detrimental. But once the energy is absorbed by the biological matter, can cause severe and long lasting damage to human health and effects will enhance due to frequent exposure to source. It might take years for the damage to produce noticeable symptoms.

INTRODUCTION

To find out the answer of our basic but million dollar question…….

Are cell phone base stations safe?

And to find out this, the obvious place to begin with is an internet and we found….

There is very limited data available on the possible effects of electromagnetic fields emitted by cell phone base stations on human health. Independent scientific studies have shown the risks like brain tumor, increase B.P., male infertility etc. But industry sponsored studies have failed to show a clear link between cell phone uses & health risk.

While there are no sufficient evidences that health parameters of rodents is affected by exposure to electromagnetic field, the data are still inconclusive, considering the above fact, we have designed the present project.

What the base stations are?

Mobile phone (cell phone) base stations are low-power multi-channel two-way radios. They emit the electromagnetic wave. In the media we are repeatedly observing the dreadful stories regarding mobile phone base station, even though it is in convincing to the people, who are still having towers on the top of their residing area. The exposure to base station has been accompanied by public debate on the possible adverse effects on human health. There are two direct ways by which health could be affected i.e. thermal (heating) effects and non-thermal effects, as a result of exposure. Mobile phones tower may cause adverse health problems such as headache, sleep disturbance, impairment of short term memory.

AIMS & OBJECTIVE

To find out the effect of cell phone base station radiation, due to frequent exposure, on human health.

MATERIALS & METHODS

108 volunteers were interviewed out of which 96 were selected at start. In second year out of that 30 persons drop out so we studied 66 subjects including control group. In that Group I consist of 34 subject called control group and Group II consist of 32 subject called base station resident group.

Ethical approval and other aspects were taken into consideration while planning the experiments.

SELECTION OF SUBJECTS

The base station residents were identified who had fulfilled the following basic requirements:

- The distance of the base station was not more than 25 feet or 8 meters from the place of residence. The person is residing in the same area for not less than one year.

METHODOLOGY

The study includes Anthropometric parameters; Clinical examination and Autonomic function assessment were performed in both groups.

- ***Anthropometric parameters:***

  This includes height, weight, BMI etc.

- ***Clinical examination***:

  This includes Pulse rate and base-line blood pressure etc.

- ***Autonomic function tests***

Tests used to evaluate the ***Sympathetic activity*** are:

1. B P response to standing
2. Blood Pressure response to sustained handgrip

Tests used to evaluate the ***Parasympathetic activity*** are:

1. Heart rate response to standing
2. Heart rate response to Valsalva maneuver

1. B P RESPONSE TO STANDING

Resting systolic blood pressure was recorded in lying down position and thereafter in standing position after 1 minute. Difference in systolic blood pressure between lying and standing position was recorded. [Ewing D. J. 1988].

If systolic pressure decreased by ≤ 10 mmHg than it was taken as Normal, borderline if 11 – 20 mmHg and abnormal if ≥ 30 mmHg [Ewing D. J., 1988].

2. BLOOD PRESSURE RESPONSE TO SUSTAINED HANDGRIP

After an initial period of rest, base line blood pressure (mmHg) was recorded. Then each subject was told to perform isometric hand-grip (IHG) exercise with the help of hand grip dynamometer. The pressure on maximum compression by hand grip was recorded after 3 hand-grip exercises. Then the subjects were instructed to sustain the hand grip pressure at 30% of the maximum pressure for 5 min. Blood pressure changes were recorded at the interval of one min during the process. Change in Systolic Blood Pressure (SBP) is the most sensitive & specific measurement in diagnosing abnormality.

If systolic pressure decreased by > 16 mmHg than it was taken as Normal, borderline if 11 - 15 mmHg and abnormal if < 30 mmHg [Ewing D. J., 1988].

3. HEART RATE RESPONSE TO STANDING

ECG limb leads were attached to subject with strip recorder running in lead II, Subject was asked to stand from lying as quickly as possible. Measured 30: 15 ratio i.e. ratio of longest R-R interval at 30th beat to shortest R-R interval at 15th beats after standing. [Ewing DJ., 1988].Normal: ≥ 1.04. Borderline: between 1.01-1.04. Abnormal: ≤ 1.00 [Ewing D. J., 1988 and Hutchison's clinical method, 19th ed.1989].

4. HEART RATE RESPONSE TO VALSALVA MANEUVER

The nose clip was applied to the subject and asked to blow into the sphygmomanometer to raise the mercury column to 40 mmHg pressure and retain it at that level for 15 sec. The ECG was recorded 15 sec. during maneuver& 30 sec. after the maneuver. Valsalva ratio was calculated as ratio of maximum heart rate during the strain (during maneuver) to the minimum heart rate after the strain.

If valsalva ratio increased ≥ 1.21 than it was taken as Normal; borderline if it was between 1.11 – 1.20 and abnormal if ≤1.11 [Ewing D. J., 1988 and Hutchison's clinical method, 19th ed. page no. 366, 1989].

OBSERVATION & RESULTS

The study group comprised of 66 of apparently healthy subjects. The autonomic function tests were performed in all these subjects. The data obtained was tabulated with respect to various parameters and was statistically treated and analysed. The data was arranged into suitable tables for discussion under the different headings. The mean difference was taken to be significant at $P<0.05$ levels. Statistical analysis was done using SPSS software version 17 for windows.

Table 1: Autonomic function assessment: B P response to standing in control group

		Blood Pressure (mm of Hg)		*1 Min. After Standing*	
		Systolic	***Diastolic***	***Systolic***	***Diastolic***
Control Group	***Range***	100 – 144	60 – 90	90 – 138	70 – 100
	Mean	117	75	109	84

	±SD	±13.33	±9.01	±13.52	±8.29
Base Station Resident	***Range***	110 – 144	70 – 90	100 – 140	70 – 110
	Mean	132.94	81.81	121.50	92.00
	±SD	±10.70	±9.56	±12.05	±9.20

Table 2: Autonomic function assessment: Blood Pressure response to sustained handgrip

Group ⇩		*B.P. (mm of Hg) Response to Sustained Handgrip*									
		After 1 Min.		*After 2 Min.*		*After 3 Min.*		*After 4 Min.*		*After 5 Min.*	
		SBP	***DBP***	***SBP***	***DBP***	***SBP***	***DBP***	***SBP***	***DBP***	***SBP***	***DBP***
Control Group	***Mean***	121	82	128	90	135	96	140	102	145	105
	±SD	±12.73	±8.11	±13.09	±7.29	±13.50	±6.83	±12.59	±8.83	±11.98	±7.90
Base Station Resident	***Mean***	138.31	88.25	143.44	95.13	148.38	100.56	154.38	106.13	159.25	110.38
	±SD	±12.18	±8.31	±13.94	±7.74	±14.30	±8.71	±15.61	±9.10	±16.68	±9.67

Table 3: Autonomic function assessment: Heart rate response to standing

Group ⇩		**Heart Rate Response to Standing**		
		Shortest R-R Interval (15th Beat)	**Longest R-R Interval (30th Beat)**	**Ratio**
Control Group	***Mean***	0.68	0.85	1.26
	±SD	±0.12	±0.13	±0.13
Base Station Resident	***Mean***	0.68	0.82	1.22
	±SD	±0.10	±0.11	±0.15

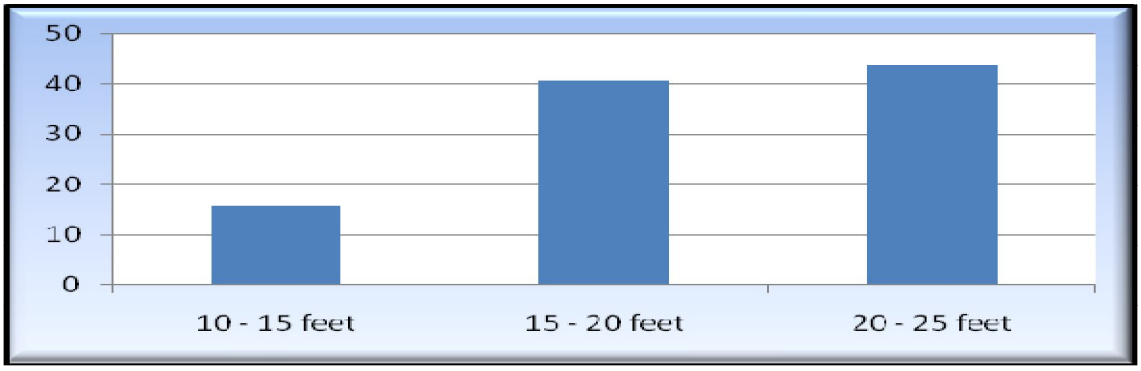
Table 4: Autonomic function assessment: Heart rate response to Valsalva maneuver

Group ⇩		**Heart Rate Response to VALSALVA Maneuver**		
		During Maneuver	**After Maneuver**	**Ratio**
		Shortest R-R Interval	**Longest R-R Interval**	
Control Group	***Mean***	0.75	0.97	1.30
	±SD	±0.12	±0.12	±0.08
Base Station Resident	***Mean***	0.74	0.97	1.31
	±SD	±0.09	±0.10	±0.08

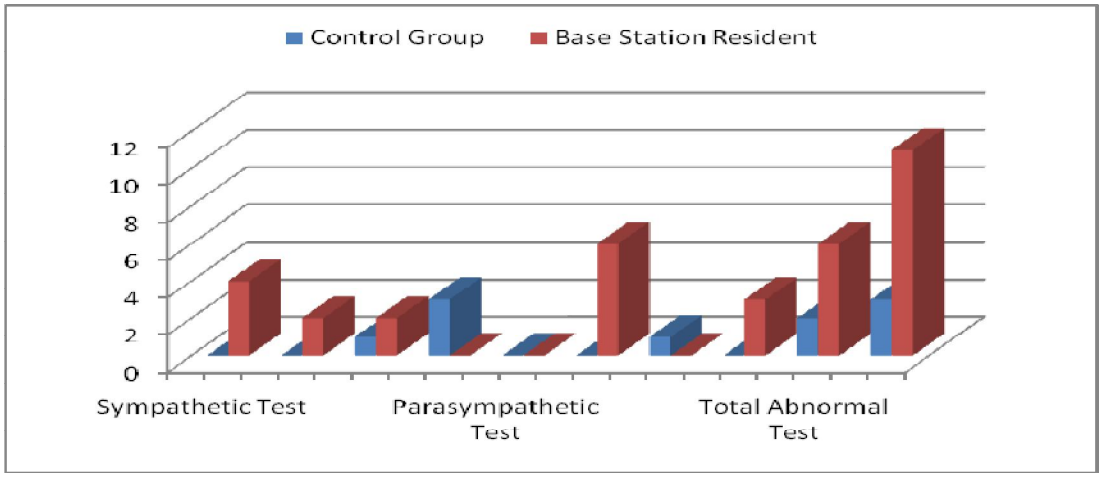
Table 5: ANS Response to different tests

Group	**Sympathetic Test**				**Parasympathetic Test**				**Total Abnormal Test**	
	BP Response to Standing		**Sustained Handgrip Test**		**HR Response to Standing**		**VALSALVA Manoeuver**			
	B	**A**	**B**	**A**	**B**	**A**	**B**	**A**	**B**	**A**
Control Group	**00**	**00**	**01**	**03**	**00**	**00**	**01**	**00**	**02**	**03**
Base Station Resident	**04**	**02**	**02**	**00**	**00**	**06**	**00**	**03**	**06**	**11**

Graph 1: Distance of Residence from Base Station



Graph 2: Response to different ANS tests



DISCUSSION

Alteration of ANS function will greatly influence the functions of vital organs especially the heart i.e. cardiovascular system. Various studies all ready done was not showing similarity in there result or we can say conflicting of results were obtained as an after mark of studies of autonomic activities in relation to the radiation exposure due to mobile phone base stations. The present study was designed to test the autonomic activities in 32 normal health individuals stating close to the base station and there comparison with control group. Abnormal result in more than two of the autonomic function tests are accepted as autonomic dysfunction.

Average values of results i.e. in heart rate or the various changes during ANS function test are significantly different between total abnormal tests in both groups. These changes may considerably influenced by exposure to base station therefore, our experimental protocol seems minimally biased since we confirmed that there were changes in ANS functioning due to frequent exposure to the base station radiation. Noted changes are statistically analyzed. The conclusion of the present study was compared with those of previous studies and results were drawn.

German investigators, Frey et al., (1998) report that exposure to electromagnetic fields during mobile phone use may increase resting blood pressure. Exposure of the right hemisphere to a radio-frequency electromagnetic field for 35 minutes causes an increase in sympathetic efferent activity with increases in resting blood pressure between 5 and 10 mm Hg (Frey et al., 1998). Change in blood pressure due to base station radiations suggesting the slight increase in

resting blood pressure was already suggested by Braune et al. (1998) and Stacy Eltiti et al. (2007)

In our study resting blood pressure i.e. systolic and diastolic blood pressure values were observed to be significantly increased in base station resident group as compared to the control group, which may be due to more pronounced vasoconstriction. The difference in our study with the other investigators is that we prolonged the exposure of the subjects for different duration for more than one year to observe the effect on subjects on being exposed to mobile cell use for a longer duration. Our observations reveal autonomic function changes do not alter in all the subjects but if we compare the study group with the controls than we find the values are significantly increased. Comparison of these results after duration of the exposure for a period of one year we found a significant alteration and are evident from the change in heart rate.

SUMMARY & CONCLUSION

Prolong exposure under the base station and their responses to sympathetic and parasympathetic function were changed. This demonstrates that prolonged exposure capable of causing hazards but required more time to do so. Although radiation exposures due to base station are very low, but once the energy is absorbed by the biological matter can cause severe and long lasting damage to human health. It might take years for the damage to produce noticeable symptoms. So further detail and prolong duration study should be carry out on experimental animal (i.e. histological study) to verify the said effect. *Based on this, we would like to conclude that the persistent & prolonged exposure under the mobile phone base station is a risk factor.*

What should we do to avoid this…Avoid installation of base station on the top of residential, school, or hospital building.

REFERENCES

1. Andrzejak R, Poreba R, Poreba M, Derkacz A, Skalik R, Gac P, Beck B, Steinmetz-Beck A, Pilecki W; The influence of the call with a mobile phone on heart rate variability parameters in healthy volunteers. Ind. Health 2008; 46(4):409-417.
2. Barker AT, Jackson PR, Parry H, Coulton LA, et al.; The effect of GSM & TETRA mobile handsets on blood pressure, catechol levels & heart rate variability. Bioelectromagnetics 2007; 28:433-438.
3. Braune S, Riedel A, Schulte-Monting J, Raczek J. Influence of a radiofrequency electromagnetic field on cardiovascular and hormonal parameters of the autonomic nervous system in healthy individuals. Radiat Res. 2002; 158:352-356.
4. Braune S, Wrocklage C, Raczek J, Gailus T, Lucking CH. Resting blood pressure increase during exposure to a radio-frequency electromagnetic field. Lancet 1998; 351(9119), 1857-1858.
5. Braune S, Wrocklage C, Raczek J, Gailus T, Lucking CH. Resting blood pressure increase during exposure to a radio-frequency electromagnetic field. Lancet 1998; 351(9119), 1857-1858.
6. Ewing D. J., Autonomic function testing (clinical) – Michael Poon's Shrine of neurology. 1985, 1988 in www. Autonomic function testing. (Accessed on 4 Jan. 2003).
7. Huber R, and Schuderer J. Radio frequency electro- magnetic field exposure in humans: Estimation of SAR distribution in the brain, effects on sleep and heart rate. Bioelectromag. 2003; 24:262-276.
8. Mann K, Roschke J, Connemann B, Beta H. No effects of pulsed high-frequency electromagnetic fields on heart rate variability during human sleep. Neuropsychobiology 1998; 38:251-6.
9. Parazzini M, Ravazzani P, Tognola G, Thuroczy G, Molnar FB, Sacchettini A, Ardesi G, Mainardi LT.; Electromagnetic fields produced by GSM cellular phones and heart rate variability. Bioelectromagnetics, Sep 26; 2006.
10. Stacy Eltiti, D. Wallace, A. Ridgewell, K. Zougkou, R. Russo, F. Sepulveda, D. Mirshekar-Syahkal, Paul R., Roger D., Elaine Fox. Does Short-Term Exposure to Mobile Phone Base Station Signals Increase Symptoms in Individuals Who Report Sensitivity to Electromagnetic Fields? A Double-Blind Randomized Provocation Study. Volume: 115, Issue: 11, Publisher: National Institute of Environmental Health

Sciences, 2007; Pages: 1603-1608.
11. Sztajzel J., Heart rate variability: a noninvasive electrocardio-graphic method to measure the autonomic nervous system. Swiss Med Wkly. 2004; 134(35-36):514-22.
12. Tahvanainen K, J Nino, Halonen P, Kuusela T, et al: Cellular phone use does not acutely affect blood pressure or heart rate in humans. Bioelectromag 2004; 25:73-83.
13. Frey et al.: "Headaches from cellular telephones: are they real and what are the impacts". Environ Health Perspect. 1998; 106(3):101-103.