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Effects of Radiation from Mobile Towers on Human Health

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Abstract : *The possible effects of radiation from mobile towers on human health was studied. A survey based on distance from towers, number of cell phone tower in the vicinity of house, age of exposed group, duration of conversation over cell phone was undertaken to see the possible adverse effects of microwave radiation from mobile towers on human health. It was found that neither the proximity to mobile towers, nor the duration of mobile phone had any adverse effect on health. However, haematological analysis showed slightly lowered but statistically insignificant lymphocyte count in the human subjects living at a distance <100 m from mobile towers as compared to those living away from mobile towers.*

Key Words : *: Mobile tower, radiation, human health.*

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Introduction :

Cell phone technology has revolutionized the telecommunication scenario in India. Cell tower antenna transmit EM radiations in the frequency range of 864-894 MHz (CDMA), 935-960 MHz (GSM 900) and 1810-1880 (GSM 1800). Chronic exposures to such frequencies can be dangerous and can lead to many health related problems. These radiations also reduce the competence of the immune system. More young people are experiencing early death as a result of exposure to radiation (Santini et al 2002; Kumar 2010).

A large number of mobile phone base stations are being installed in the residential areas of Patna. So there is a need to conduct a study on the health aspects of people residing near these mobile phone base stations. Therefore this study was undertaken to see the possible adverse effect of microwave radiation on people residing near single as well as multiple mobile towers and on the people of different age-groups.

Methods :

A survey was conducted to study the possible harmful effects of mobile tower radiation on human body with the help of questionnaire. Three hundred and three respondents were categorized into two

groups i.e. those residing within 100 meters distance from mobile towers and those at a distance more than 100 meters. An attempt was also made to find out the impact of single versus multiple mobile towers in the vicinity of residence on human health. Possible confounders could be the socio-economic status, occupation and food and feeding habits. The possible effects on the sleeping patterns of adolescents talking over mobile phones for longer duration during night time was also studied. The health effects based on the duration of exposure to radiation from mobile phone towers was also assessed. The possible effects of mobile tower radiations on various age-groups of people comprising of young (aged 15-30 years), adults (aged 31-45 years), and old (aged 46-60 years) was also investigated. Statistical analyses were done with ANOVA and unpaired t-test (2-tailed). Since the sample sizes were different in the different categories, data were converted to percentage for comparison. The percentage data were then converted to arcsin values to ensure normality of data. Blood analysis was done with the help of automatic haematolyzer.

Results and Discussion :

There was no significant difference in the occurrence of neurological problems (t = 0.16, df = 12, NS), gastro-intestinal problems (t = 0.39, df = 4, NS), cardiovascular problems (t = 0.34 , df = 6, NS) and other health problems (t = 0.24, df = 6, NS) between those residing within 100 meters radius of mobile towers as compared to those living outside 100 meters radius. However, it was found that 41.7% people residing within 100 meters from mobile towers experienced the problem of loss of appetite, 53.6% with lack of concentration, 39.69% with hypertension, and 71.13% with fatigue (Table 1).

Around 12% of the respondents living within 100m radius of mobile phone base station reported of itching problem. Microwave radiation may degrade the immune system and stimulate various allergic and inflammatory responses (Johansson 2009). The high radiation from cell towers can result in an increase in mast cells , which explains the clinical symptoms of itching (Johansson et al 1994). Headache , lack of concentration, hypertension, fatigue and interrupted sleep were found to be higher in the respondents living within 100m radius of mobile base station. Abdel – Rassoul (2007) studied the possible neurobehavioural deficits among inhabitants living nearby mobile phone base stations in Egypt and found that they are at a risk for developing neuropsychiatric problems as headache, memory loss, nausea, dizziness, tremors, muscle spasms numbness, tingling, altered reflexes, muscle and joint pain, leg/foot pain, depression and sleep disturbance. Gadzicka et al (2006) also found more headache in people living at a distance £150 meters from mobile towers. Santini et al (2002) also made a comparision of complaint frequencies in relation with distance from base station and sex, and found significant increase in tiredness, headache, sleep disturbance, discomfort, irritability, depression, loss of memory, dizziness, libido decrease etc. in people living close to mobile towers. Khurana et al (2010) also found greater prevalence of neurobehaviour symptoms in population living at <500m from base station.

There was no significant difference in the occurrence of neurological problems (t = 0.78, df = 12, NS), gastro-intestinal problems (t = 0.08, df = 4, NS), cardiovascular problems (t = 0.91, df = 6, NS) and other health problems (t = 0.36, df = 6, NS) between those residing within 100 meters radius of single mobile tower as compared to those living within 100 meters radius of multiple towers. (Table 2).

Similarly, no significant difference was found in the occurrence of neurological problems (t = 0.93,

Introduction :

Cell phone technology has revolutionized the telecommunication scenario in India. Cell tower antenna transmit EM radiations in the frequency range of 864-894 MHz (CDMA), 935-960 MHz (GSM 900) and 1810-1880 (GSM 1800). Chronic exposures to such frequencies can be dangerous and can lead to many health related problems. These radiations also reduce the competence of the immune system. More young people are experiencing early death as a result of exposure to radiation (Santini et al 2002; Kumar 2010).

A large number of mobile phone base stations

	<100 meters (N=194)		>100 meters (N=109)	
Neurological problems	**n**	**%**	**N**	**%**
Headache	148	76.28 (60.84)	86	78.89 (62.64)
Irritation	100	51.54 (45.88)	63	57.79 (49.47)
Ringing in ears	45	23.19 (28.78)	21	19.26 (26.02)
Depression	13	6.77 (15.07)	2	1.83 (7.77)
Loss of memory	53	27.31 (31.50)	33	30.27 (33.37)
Lack of concentration	104	53.60 (47.06)	51	46.78 (43.14)
Hazy vision	47	24.22 (29.47)	21	19.26 (26.02)
Mean ± S.E.		**36.94 ± 5.74**		**35.49 ± 6.80**
G I Problems				
Nausea	28	14.43 (22.32)	14	12.84 (20.99)
Indigestion	33	17.01 (24.35)	20	18.34 (25.35)
Loss of appetite	81	41.75 (40.24)	32	29.35 (32.79)
Mean ± S.E.		**28.97 ± 5.66**		**26.38 ± 3.44**
Cardiovascular Problems				
Sweating	106	54.63 (47.65)	57	52.29 (46.31)
Palpitation	41	21.13 (27.36)	23	21.10 (27.34)
Hypertension	77	36.69 (37.27)	24	22.01 (27.97)
High Blood Pressure	26	13.30 (21.38)	14	12.84 (20.99)
Mean ± S.E.		**33.42 ± 5.76**		**30.65 ± 5.45**
Other Problems				
Itching	23	11.85 (20.13)	14	7.21 (15.57)
Fatigue	138	71.13 (57.49)	75	68.8 (36.03)
Cold hands and feet	17	8.76 (17.21)	14	12.8 (20.97)
Lethargy	95	48.96 (44.40)	71	65.13 (53.80)
Mean ± S.E.		**34.81 ± 9.71**		**31.59 ± 8.57**

Arcsin values of percentage data are given in parentheses.

Table 2. Health problems based on number of towers within 100 m radius. Data includes all the age groups

	Single tower (N=41)		Multiple towers (N=246)	
Neurological problems	**n**	**%**	**n**	**%**
Headache	39	95.12 (77.21)	195	79.26 (62.89)
Irritation	35	85.36 (67.50)	143	58.13 (49.67)
Ringing in ears	10	24.39 (29.59)	54	21.95 (27.93)
Depression	3	7.31 (15.68)	12	4.87 (12.74)
Loss of memory	13	31.70 (34.26)	85	34.55 (35.99)
Lack of concentration	26	63.42 (52.77)	104	42.27 (40.54)
Hazy vision	15	36.58 (37.21)	53	21.54 (27.65)
Mean ± S.E.		**44.89 ± 8.27**		**36.77 ± 6.17**
G I Problems				
Nausea	8	19.51 (26.21)	36	14.36 (22.48)
Indigestion	10	24.39 (29.59)	60	24.39 (29.59)
Loss of appetite	14	34.14 (35.74)	106	43.08 (41.01)
Mean ± S.E.		**30.51 ± 2.79**		**31.03 ± 5.39**
Cardiovascular Problems				
Sweating	36	87.80 (69.55)	133	54.06 (47.32)
Palpitation	12	29.26 (32.74)	53	21.54 (27.65)
Hypertension	17	41.46 (40.07)	69	28.04 (31.97)
High Blood Pressure	08	19.51 (26.21)	32	13.08 (21.19)
Mean ± S.E.		**42.14 ± 9.56**		**32.03 ± 5.55**
Other Problems				
Itching	08	19.51 (26.21)	30	12.19 (20.43)
Fatigue	38	92.67 (74.28)	179	72.76 (58.52)
Cold hands and feet	06	14.63 (22.48)	49	19.91 (26.50)
Lethargy	25	60.97 (51.33)	131	53.25 (46.86)
Mean ± S.E.		**43.58 ± 12.07**		**38.08 ± 8.85**

Arcsin values of percentage data are given in parentheses.

There was no significant difference in the occurrence of neurological ($F_{2,18}$ = 0.04, NS), gastro-intestinal ($F_{2,6}$ = 0.14, NS), cardiovascular ($F_{2,9}$ = 0.39, NS) and other health problems ($F_{2,9}$ = 0.02, NS) between the three age groups namely 15-30 years, 31-45 years and 46-60 years. However, headache (81.3%), lack of concentration (54.8%), loss of appetite (40%), sweating (55.6%), fatigue (69.1%) and lethargy (51.2%) were found in the younger age group (15-30 years) (Table-4).

Table 3. Health problems based on duration of stay within 100m radius of mobile towers. Data includes all the age groups.

	<5 years (N=180)		>5 years (N=122)	
Neurological problems	**n**	**%**	**n**	**%**
Headache	126	70 (56.78)	109	89.30 (70.89)
Irritation	88	48.88 (44.35)	82	67.21 (55.06)
Ringing in ears	28	15.55 (23.22)	31	17.22 (24.51)
Depression	10	5.55 (13.62)	6	4.91 (12.79)
Loss of memory	48	26.66 (9.01)	48	39.34 (38.84)
Lack of concentration	90	50 (44.99)	67	54.91 (47.81)
Hazy vision	40	22.22 (28.11)	40	32.78 (34.92)
Mean ± S.E.		**31.44 ± 6.71**		**40.69 ± 7.31**
G I Problems				
Nausea	23	12.77 (20.93)	18	14.75 (22.58)
Indigestion	31	17.22 (24.51)	23	18.85 (25.72)
Loss of appetite	63	35 (36.27)	46	37.70 (37.87)
Mean ± S.E.		**27.24 ± 4.63**		**28.72 ± 4.66**
Cardiovascular Problems				
Sweating	89	49.44 (44.67)	35	28.68 (32.37)
Palpitation	33	18.33 (25.34)	31	25.40 (30.25)
Hypertension	36	20 (26.56)	41	33.60 (35.42)
High Blood Pressure	24	13.33 (21.41)	30	24.59 (29.72)
Mean ± S.E.		**29.50 ± 5.17**		**31.94 ± 1.29**
Other Problems				
Itching	22	12.22 (20.45)	18	14.75 (22.58)
Fatigue	113	62.76 (52.39)	89	72.94 (58.64)
Cold hands and feet	16	8.88 (17.33)	15	12.29 (20.51)
Lethargy	72	40 (39.22)	64	52.45 (46.40)
Mean ± S.E.		**32.35 ± 8.24**		**37.03 ± 9.29**

Arcsin values of percentage data are given in parentheses.

There was no significant difference in the occurrence of neurological (t=0.99, df=12, NS), gastro-intestinal (t=0.93, df=4, NS), cardiovascular (t=0.34, df=6, NS) and other health problems (t=0.03, df=6, NS) between those using mobile phones for less than one hour and those using mobile phones for more than one hour. However, the latter group experienced more headache (84.1%), memory loss (42.1%), lack of concentration (71.7%), loss of appetite (54.9%) and sweating (60.7%) (Table 5). Kumar (2010) explains tinnitus, popularly known as 'Ringxiety' – is the psychological disease of hearing phantom sound and cell phone ring and it has been reported among millions of cell phone users in the world. People with severe tinnitus may have trouble hearing, working or even sleeping. The radiation emitted by mobile phones may damage the delicate workings of the inner ear and long term and intensive mobile phone use for more than four years and for longer periods than 30 minutes in a day are at higher risk of developing hear loss.

Table 4. Health problems based on age-group

	15-30 years (N =246)		31-45 years (N = 37)		46-60 years (N = 20)	
Neurological problems	**n**	**%**	**n**	**%**	**n**	**%**
Headache	200	81.30 (64.36)	24	64.86 (53.63)	10	50 (44.99)
Irritation	130	52.85 (46.62)	20	54.05 (47.31)	13	65 (53.70)
Ringing in ears	46	18.69 (25.61)	6	16.21 (23.74)	2	10 (18.42)
Depression	10	4.06 (11.61)	4	10.81 (19.18)	2	10 (18.42)
Loss of memory	82	33.33 (35.26)	10	27.02 (31.31)	7	35 (36.22)
Lack of concentration	135	54.87 (47.79)	15	40.54 (39.54)	5	25 (30)
Hazy vision	51	20.73 (27.08)	10	27.02 (31.31)	9	45 (42.06)
Mean ± S.E.		**36.90 ± 6.60**		**35.15 ± 4.68**		**34.83 ± 5.06**
G I Problems						
Nausea	33	13.41 (21.47)	4	10.81 (19.18)	5	25 (30)
Indigestion	39	15.85 (23.41)	11	29.72 (33.03)	3	15 (22.76)
Loss of appetite	99	40.24 (39.36)	14	37.83 (37.95)	4	20 (26.55)
Mean ± S.E.		**27.98 ± 5.72**		**30.05 ± 5.61**		**26.44 ± 2.09**
Cardiovascular Problems						
Sweating	137	55.69 (48.26)	16	43.24 (41.10)	10	50 (44.99)
Palpitation	47	19.10 (25.91)	11	29.72 (33.03)	5	25 (30)
Hypertension	73	29.69 (33.01)	9	24.32 (29.54)	6	30 (33.16)
High Blood Pressure	25	10.16 (18.58)	8	21.62 (27.70)	8	40 (39.19)
Mean ± S.E.		**31.44 ± 6.33**		**32.84 ± 2.96**		**36.84 ± 3.32**
Other Problems						
Itching	30	12.19 (20.43)	3	8.10 (16.53)	4	20 (26.55)
Fatigue	170	69.1 (56.22)	28	75.66 (60.43)	13	65 (53.70)
Cold hands and feet	22	8.94 (17.39)	4	10.81 (19.08)	4	20 (26.55)
Lethargy	126	51.21 (45.69)	22	59.45 (50.44)	10	50 (44.99)
Mean ± S.E.		**34.93 ± 9.51**		**36.62 ± 11.1**		**37.95 ± 6.81**

Arcsin values of percentage data are given in parentheses.

Table 5. Health problems based on duration of talking over cell phone. Data includes all the age groups.

	<1 hour (N = 182)		>1 hour (N = 102)	
Neurological problems	**n**	**%**	**N**	**%**
Headache	125	68.68 (55.96)	86	84.13 (66.52)
Irritation	94	51.64 (45.93)	51	50 (44.99)
Ringing in ears	26	14.28 (22.19)	30	29.41 (32.84)
Depression	7	3.84 (11.29)	8	7.84 (16.26)
Loss of memory	38	20.87 (27.18)	43	42.15 (40.48)
Lack of concentration	78	42.85 (40.88)	73	71.7 (57.85)
Hazy vision	35	19.23 (26.08)	27	26.47 (30.95)
Mean ± S.E.		**32.79 ± 5.82**		**41.41 ± 6.41**
G I Problems				
Nausea	27	14.83 (22.64)	13	12.74 (20.90)
Indigestion	20	10.98 (19.34)	26	25.49 (30.31)
Loss of appetite	52	28.57 (32.31)	56	54.90 (47.80)
Mean ± S.E.		**24.76 ± 3.89**		**33.00 ± 7.88**
Cardiovascular Problems				
Sweating	90	49.46 (44.68)	62	60.78 (51.16)
Palpitation	40	21.97 (27.94)	22	21.56 (27.64)
Hypertension	43	23.62 (29.07)	34	33.33 (35.23)
High Blood Pressure	28	15.38 (25.08)	16	15.68 (23.26)
Mean ± S.E.		**31.69 ± 4.41**		**34.32 ± 6.13**
Other Problems				
Itching	16	8.79 (17.24)	16	15.68 (23.26)
Fatigue	123	67.57 (55.28)	69	67.64 (55.28)
Cold hands and feet	19	10.43 (18.83)	11	10.78 (19.14)
Lethargy	89	48.90 (44.34)	42	41.17 (39.86)
Mean ± S.E.		**33.92 ± 9.44**		**34.39 ± 8.28**

Arcsin values of percentage data are given in parentheses.

Although 60.3% of respondents living within 100 m radius of mobile towers complained of disturbed sleep as compared to those living outside 100 m radius, the difference was not statistically significant (t=0.14, df=2, NS) (Table-6). Use of mobile phone disturbs stage four of sleep, the stage important for full recuperation of brain and body. Hutter et al (2006) studied the sleeping problems and cognitive performance in subjects living near mobile phone base stations and found that symptoms like headache and difficulty in concentrations showed an association with microwave exposure from base stations.

Table 6. Effect on sleep pattern based on distance from tower. Data includes all the age groups.

	<100 meters (N=194)		>100 meters (N=109)	
Disturbed sleep	117	60.3 (50.89)	43	22.1 (44.42)
Undisturbed sleep	40	20.6 (26.93)	40	36.6 (37.15)
Mean ± S.E.		**38.91 ± 11.98**		**40.79 ± 3.63**

Arcsin values of percentage data are given in parentheses.

There was no significant difference in the mean values of various parameters of blood between those living near mobile base station as compared to those living far from mobile base station. However, a slight decrease in lymphocyte count was found in those living near mobile towers at a distance <100 m as compared to those living away from mobile towers (Table 7). Decreased lymphocytes found in respondents living close to mobile towers may result in a decrease in immune response. Similar findings were reported by Moszczynski et al (1999).

Table 7. Comparison of blood parameters in the age group of 18-21 years.

	Distance from mobile tower		
Parameter	**<100m (N=11)**	**>100m (N=12)**	**Level of significance**
WBC (X 10^3/µL)	8.55 ± 0.49	8.25 ± 0.43	NS
RBC (X 10^6/µL)	4.46 ± 0.09	4.29 ± 0.07	NS
HGB (g/dl)	12.44 ± 0.29	12.87 ± 0.41	NS
HCT (%)	37.04 ± 1.3	38.35 ± 0.72	NS
MCV (fl)	85.09 ± 1.4	89.42 ± 1.70	NS
MCH (pg)	27.89 ± 0.58	29.98 ± 0.95	NS
MCHC (%)	32.75 ± 0.30	33.47 ± 0.50	NS
LYM %	29.80 ± 1.66	33.36 ± 1.76	NS
MXD %	11.32 ± 1.76	8.85 ± 0.75	NS
NEUT %	50.43 ± 4.64	58.03 ± 1.92	NS
Blood Sugar (mg/l)	76.34 ± 4.854	71.11 ± 2.492	NS

The limitations of this study were that there was low rate of participation among the respondents. Further, Electromagnetic fields (EMF) measurement and base station details were not

recorded. Other environmental risk factors including the socio-economic, food and feeding habits, occupation, floor wise position of their residence (in multi-storeyed buildings) were also not assessed. Data were analyzed on the basis of age but not sex. Moreover, the respondents were aware.

Conclusion :

None of the reported association between proximity to mobile towers and mobile phone use and the occurrence of negative health symptoms reached the level of statistical significance. The observed negative symptoms in this study might be due to radiations emitted by the mobile towers or due to environmental factors, stress etc.

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