

POSSIBLE ELECTROMAGNETIC HYPERSENSITIVITY AMONG CELLULAR PHONE USERS IN RELEVANCE TO SELF REPORTED SUBJECTIVE SYMPTOMS AND SENSATIONS AND ADOPTED SAFETY MEASURES

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ABSTRACT

The information of demographic and social characteristics, utilization pattern, general health, association of electromagnetic hypersensitivity (EHS) in terms of self reported symptoms and sensations was collected among 307 Cellphone users in India. Association of EHS was evaluated on the basis of demographic characteristics, gender, utilization, and safety adopted in extensive and normal CP user. Prevalence of overall EHS was found to be associated 87.6% to CP users but most common sensitivity was found 'warmth on ear' (52.4%) and 'Ringing delusion' (23.8%). Other self reported symptoms 'forgetfulness', 'increase in carelessness' and "tremor" were more than 19% and 'headache' was reported by 13% CP users. The CP users who had smoking or drinking habit, were significant associated ($p < 0.05$) for the 'carelessness', 'dizziness' and 'irritation'. The study is of significance and the possibility of EHS was associated to extensive usage of CPs but a large no of data may better support for its significance.

KEYWORDS

Cellular Phone, Survey Questionnaire, Extensive user, Electromagnetic hypersensitivity (EHS), Symptoms and Sensations

1. INTRODUCTION

The neurovegetative or neurasthenic symptoms such as fatigue, headache, concentration difficulties, nausea, heart palpitation and skin complaints such as redness, tingling and burning sensations have been suggested to be triggered by exposure to electromagnetic radiations (EMRs) during cellular phone (CP) use [1-3]. With the introduction of wireless communication technologies such complains related to cellphone, base stations, radar communicating devices, electronic gadgets etc. became more prominent [3]. Since wireless technology has come into existence in the last decades but now the RFR exposure levels has amplified many folds because of the extensive use of RF devices and cell phone. Some individuals who experience the

electromagnetic hypersensitivity (EHS) believe that their association to EHS is caused by an increased exposure of EMRs. Situation associated with these complaints are typically characterized by EMF exposure well below current reference values [4] but studies have not been able to show a reliable connection between EMF exposure symptoms [5]. Electromagnetic hypersensitivity (EHS) has come in common usage in recent years. The term EHS relates to subjects attributing symptoms to exposure to EMR. A number of studies have investigated EHS symptoms and EMR exposure by wireless communication devices or cell phones or base stations [6-7].

In a provocation study of cell phone by [8], twenty subjects reporting EHS symptoms. They reported on increase in symptoms during 30min exposure during RF exposure compared to sham exposure. In a Meta analysis [9], prevalence of EHS was reported to be 0.7% in Finland [6], 1.5% in Sweden [7], 3.2% in California [10], and 4% in UK. But these studies could not establish a causal link between exposures actually exists. Epidemiological studies conducted so far are very controversial and failed to point out a clear relationship between the use of mobile phones and the incident of diseases [11-12]. The contradictory results are parallel on previous findings [13-14]. The earlier studies [7-8] individuals have reported warmth on ear, headache, pain, sensations on eyes or neck or face or in the ears, vertigo and body symptoms which they associated with mobile phone usage.

A cross sectional survey study in Austria [15] has focused on subjective symptoms, sleep quality, and cognitive performance of people living in urban and rural areas for more than one year in nearness to one of 10 selected base stations. The total 365 individuals were randomly selected from the telephone directory or by random walk. They field out a questionnaire. Exposure assessment was based on spot measurement in the sleeping room taken a few days after completion of the questionnaires. From a total of 14 different symptoms, three symptoms (headache, cold hands or feet and difficulties to concentration) were found to be linked with exposure. After taking into account concerns about base stations sleep quality measures were not related to exposure. Many studies of this topic have been done and systemic review of provocation studies could find no robust evidence to support the existence of biophysical hypersensitivity to EMR [5].

Scientific communities are being worried over the confound outcomes of such studies because of EMR is an important biotropic factor, affecting not just human health in general but also affects the nervous activity which includes behaviour and thinking. As we are aware that EMR may cause ionizing and non ionizing effects on living tissue. Non-ionizing radiation behaves exactly like ionizing radiation, but differs in that it has a much greater wavelength and, therefore, less energy. Although this non-ionizing radiation does not have the energy to create ion pairs, some of these waves can cause personal injury. Non-ionizing radiation sources include cell phone, lasers, high intensity sources of ultraviolet light, microwave transmitters and other devices that produce high intensity radio-frequency radiation. Radio sensitivity is the relative susceptibility of cells, tissues, organs, organisms, or other substances to the injurious action of radiation. In general, it has been found that cell radio sensitivity is directly proportional to the rate of cell division and inversely proportional to the degree of cell differentiation, this means that actively dividing cells or those not fully mature are most at risk from radiation [16]. Examples of various tissues/organs/glands and their relative radio sensitivities are as follows. Lymphoid organs, bone marrow, blood, testes, ovaries, intestines have high radio sensitivity where as skin and other organs with epithelial cell lining (cornea, oral cavity, rectum, bladder, vagina, uterine cervix) also have quite high radio sensitivity. Optic lens, stomach, growing cartilage, fine vasculature, growing bone has moderate radio sensitivity. Mature cartilage or bones, salivary glands, respiratory organs, kidneys, liver, pancreas, thyroid, adrenal and pituitary glands have fairly low radio sensitivity and muscle, brain, spinal cord have also low radio sensitivity [16].

We think, in Indian scenario still no efforts have been taken to establish a link between the CP users to EHS as self reported symptoms and sensations. On the basis of demographic characteristics of CP users in India, this was first study which had been tried to generate baseline data of CP users and their fundamental link to self reported symptoms and sensations. Cellphone are used by majority of population throughout the world as one of the best and cost effective communication system. In India they are being used by the common man ranging from rag pickers, rickshaw pullers, farmers, academicians, industrialists and corporate personnel. The no of cellular phone subscribers in India have reached over 929.37 million at the end of May, 2012 [17]. As much as number of cellphone users enlarges in a domain, the possibility of association with EMR, increase. This study is an attempt to develop a cofactor of possibilities of electromagnetic sensitivity through the self reported symptoms and sensations by individuals in Indian scenario. EHS is defined as a phenomenon in which sufferers report a range of symptoms that are triggered by the presence of weak electromagnetic fields [5].

2. METHODOLOGY

The modified methodology of Interphone study [12] was followed to design the basic format of the study. The information regarding to symptoms and sensations with particular relevance to cellular phone usage to the subjects, was collected by the methodology of [18] with minor modifications.

2.1. Study Design

The questionnaire was designed including personnel details, cell phone details, and general health. In the segment of general health, self reported symptoms and sensations were mentioned as headache, clicking sound, forgetfulness, increase in carelessness, dizziness, extreme irritation, stammering, neurophysiologic discomfort, warmth on ear and stammering. Last segment of questionnaire was 'safety measures', and before finalizing the assessment of EHS to individuals, a written consent was taken. The questionnaire was pre tested on some individuals and modifications done before final administration among CP users. The questionnaire was filled by a single experienced investigator so that there was no chance of intra observer error.

2.2. Subjects and assessment of variables

The Information of the individuals was collected by the variables as users - name, address, occupation, monthly income, education, age, height and weight. Second segment included variables as duration of cell phone use, mode of cell phone (generally having ringing mode or vibration mode), received and dialled calls per day and number of adult and non adult cell phone users in individual's family. Then investigator usually expressed the variables of EHS (symptoms and sensations) one by one to know symptom's association with individuals in common language i.e., Hindi and English. Prior express the variable of EHS, the individuals were informed that it is not compulsory to be associated with any symptoms and they were liberated to report 'having no symptoms', if they were not associated to such variable of symptoms in the questionnaire. The variable of EHS were used 'headache', 'ringing delusion', 'forgetfulness', 'increase in the carelessness', 'dizziness', 'extreme irritation', 'stammering', 'neurophysiologic discomfort', 'warmth on ear' and 'tremor'. In the segment of safety measures individuals were asked three important questions as a variables. The safety variables were, (i) generally you hold your cell phone in right or left ear during *call*?, (ii) do you use your cell phone with headphone, speaker mode, or other devices usually?, (iii) do you keep your cellphone in bag, shirt, pant or hanging in neck? (iv) do you switched off your cell phone in night?, and (v) do you put cellphone near your head?.

2.3. Survey strategy and strength

At random 31 districts of India were selected to collect the information about the self reported symptoms in association with cellphone use. All (307) CP users were participated from both the urban and rural areas of the county. The male, female and children were included but the individuals they have no cell phone, were not entertained for study. This survey was conducted during the year 2009-10. Most the individuals were belonging from north India region and student group.

2.4. Data analysis

The details from individuals by questionnaire were transformed into Micro Soft Excel sheet and cross tabulated using EPI INFO soft ware. The significance prevalence of signs and symptoms in relation to age, sex and duration of use of cell phones was tested using Chi Square Test. Fisher's exact test was used where expected cell frequencies were less than five. The level of significance was considered to be 5 percent.

3. RESULTS

We found a 32 CP users were not participated in survey; they did not substantiate their reasons behind it. These numbers of individuals were not included in this study.

3.1. Demographic and Social Characteristics

The total, 307 CP users (age range 14 years to 62 years) were participated including 236(76.87%) males (mean age \pm SD: 28.95 \pm 9.5) and 71(23.13%) females (mean age \pm SD: 25.34 \pm 6.0). Study participants (mean age \pm SD: 28.95 \pm 9.5) between age 14 and 62 years old were enquired for association to EHS. More than half (near 60%) individuals were highly educated upto Post graduate level and approx 75% participants were having formerly smoking or drinking habits. We get an immense contribution from the unemployed student community (near 50%) in this study and mostly they were. Only 24(7.82%) individuals of below 20 years (children) were participated but more than 36% CP user group were associated to (24-27) year's age group. The details of participation and distribution of individuals are summarized in (Table-1.)

3.2. Safety adopted

Most of CP users (above 86%) were reported that generally they did not 'switch off' their cellphone in nights. They were keeping CP approx 3-4 fit distance from their bed during sleeping but near 41% individuals were continue exposed by cellular phone EMR at night because of having CP near the head at 'switch on' mode. Hence they were more prone to EMR. Only 68 individuals were use headphone. Right ear side CP users (68%) were larger than the left side (32%).

3.3. Cellphone exploitation

We found four major groups (LU, NU, MU, HU) on the basis of CP exploitation in individuals whole life. Individuals were separated for the utilization of cellphone as (1) LU (low user range \geq 500 hours CP use in individual's life); (2) NU (normal user range $<$ 500 – 1000 \geq hours CP use in individual's life) (3) MU (moderate user range $<$ 1000-5000 \geq hours CP use in individual's life) and (4) HU (heavy user range $>$ 5000 hours use in individual's life). Moderate (MU-31.6%) and lower (LU-30.9%) group users were equally participated and participation of other groups were near 21% (NU-21.17%) and below (HU-16.29%).

Table 1. Association of EHS to individual's demographic charecteristics (n = 307).

	Individual's group	no of participants	no of individuals associated to EHS	headache	ringing delusion	forgetfulness	increase in carelessness	dizziness	irritation	stammering	neurophysiologic discomfort	warmth on ear	tremor	no symptoms
Age	<20	15	15 (100)	2 (13.33)	2 (13.33)	1 (6.67)	1 (6.67)	3 (20.00)	0 (0.00)	2 (13.33)	0 (0.00)	10 (66.67)	4 (26.67)	0 (0.00)
	20-23	77	73 (94.81)	16 (20.78)	24 (31.17)	17 (22.08)	13 (16.88)	4 (5.19)	5 (6.49)	8 (10.39)	1 (1.30)	48 (62.34)	14 (18.18)	4 (5.19)
	24-27	111	100 (90.09)	13 (11.71)	24 (21.62)	19 (17.12)	26 (23.42)	5 (4.50)	8 (7.21)	9 (8.11)	2 (1.80)	54 (48.65)	22 (19.82)	11 (9.91)
	28-31	56	51 (91.07)	5 (8.93)	10 (17.86)	5 (8.93)	8 (14.29)	5 (8.93)	4 (7.14)	3 (5.36)	2 (3.57)	31 (55.36)	8 (14.29)	5 (8.93)
	>31	48	30 (62.5)	4 (8.33)	11 (22.92)	8 (16.67)	8 (16.67)	2 (4.17)	6 (12.50)	3 (6.25)	3 (6.25)	18 (37.50)	2 (4.17)	18 (37.50)
Sex	Female	71	64 (90.14)	14 (19.72)	14 (19.72)	10 (14.08)	10 (14.08)	3 (4.23)	4 (5.63)	3 (4.23)	1 (1.41)	45 (63.38)	16 (22.54)	7 (9.86)
	Male	236	205 (86.86)	26 (11.02)	57 (24.15)	40 (16.95)	46 (19.49)	16 (6.78)	19 (8.05)	22 (9.32)	7 (2.97)	116 (49.15)	34 (14.41)	31 (13.14)
Education	Below Graduates	36	28 (77.78)	3 (8.33)	13 (36.11)	9 (25.00)	7 (19.44)	6 (16.67)	4 (11.11)	6 (16.67)	1 (2.78)	15 (41.46)	3 (8.33)	8 (22.22)
	Graduates	86	81 (94.19)	12 (13.95)	16 (18.60)	12 (13.95)	20 (23.26)	6 (6.98)	7 (8.14)	7 (8.14)	2 (2.33)	40 (46.51)	22 (25.58)	5 (5.81)
	Post Graduates	118	100 (84.75)	16 (13.56)	26 (22.03)	17 (14.41)	20 (16.95)	4 (3.39)	8 (6.78)	7 (5.93)	3 (2.54)	72 (61.02)	15 (12.71)	18 (15.25)
	Professionals	67	60 (89.55)	9 (13.43)	16 (23.88)	12 (17.91)	9 (13.43)	3 (4.48)	4 (5.97)	5 (7.46)	2 (2.99)	34 (50.75)	10 (14.93)	7 (10.45)
Smoking	Never	229	199 (86.90)	32 (13.97)	52 (22.71)	35 (15.28)	35 (15.28)	10 (4.37)	13 (5.68)	17 (7.42)	6 (2.62)	121 (52.84)	35 (15.28)	30 (13.10)
	Former	78	70 (89.74)	8 (10.26)	19 (24.36)	15 (19.23)	21 (26.92)	9 (11.54)	10 (12.82)	8 (10.26)	2 (2.56)	40 (51.28)	15 (19.23)	8 (10.26)

Table 2. Association of EHS to individual's age group (n = 307).

	Individual's group	No of participants	No of individuals Associated to EHS	headache	ringing delusion	forgetfulness	increase in carelessness	dizziness	extreme irritation	stammering	neurophysiologic discomfort	Warmth on ear	tremor	no symptoms
Age	<20	15	15 (100)	2 (13.33)	2 (13.33)	1 (6.67)	1 (6.67)	3 (20.00)	0 (0.00)	2 (13.33)	0 (0.00)	10 (66.67)	4 (26.67)	0 (0.00)
	20-23	77	73 (94.81)	16 (20.78)	24 (31.17)	17 (22.08)	13 (16.88)	4 (5.19)	5 (6.49)	8 (10.39)	1 (1.30)	48 (62.34)	14 (18.18)	4 (5.19)
	24-27	111	100 (90.09)	13 (11.71)	24 (21.62)	19 (17.12)	26 (23.42)	5 (4.50)	8 (7.21)	9 (8.11)	2 (1.80)	54 (48.65)	22 (19.82)	11 (9.91)
	28-31	56	51 (91.07)	5 (8.93)	10 (17.86)	5 (8.93)	8 (14.29)	5 (8.93)	4 (7.14)	3 (5.36)	2 (3.57)	31 (55.36)	8 (14.29)	5 (8.93)
	>31	48	30 (62.5)	4 (8.33)	11 (22.92)	8 (16.67)	8 (16.67)	2 (4.17)	6 (12.50)	3 (6.25)	3 (6.25)	18 (37.50)	2 (4.17)	18 (37.50)

Table 3. Association of EHS to individual’s gender charecteristics (n = 307)

	Individual’s group	headache	ringing delusion	forgetfulness	increase in carelessness	dizziness	extreme irritation	stammering	neurophysiologic discomfort	warmth on ear	tremor	no symptoms
Sex	Female (71/64)	14 (19.72)	14 (19.72)	10 (14.08)	10 (14.08)	3 (4.23)	4 (5.63)	3 (4.23)	1 (1.41)	45 (63.38)	16 (22.54)	7 (9.86)
	Male (236/205)	26 (11.02)	57 (24.15)	40 (16.95)	46 (19.49)	16 (6.78)	19 (8.05)	22 (9.32)	7 (2.97)	116 (49.15)	34 (14.41)	31 (13.14)

3.4. Individual’s association of symptoms and sensations

Hardly (12%) individuals were not associated to EHS, they did not report any complain regarding the possibility to be associated with symptoms and sensation during *calling* or just after *calling* on CP but Incredible about 88% individuals were associated to symptoms or sensations.

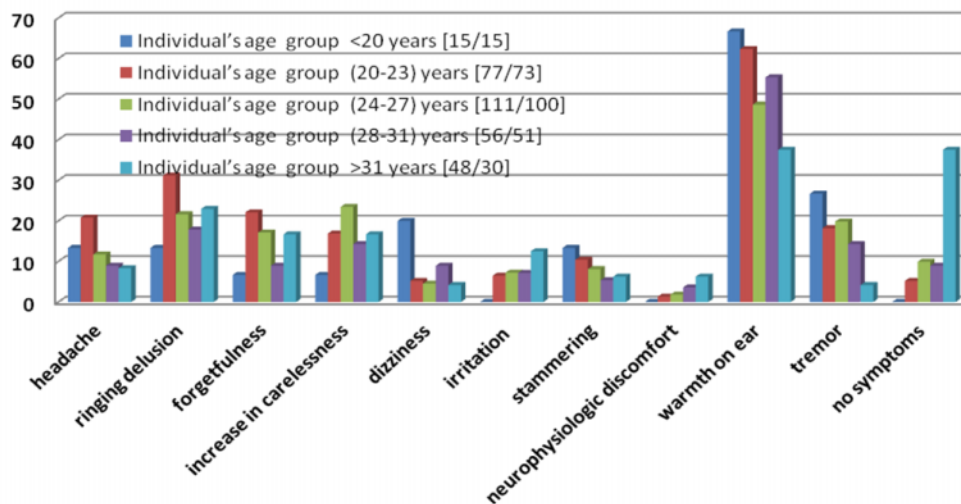


Figure-1: Association of EHS to individual’s age group

The prevalence of overall link of EHS to individuals was found above 87%. They were associated to at least one or more symptoms and sensations but above the half CP users were reported ‘warmth on ear’. Second most frequent symptom was observed ‘Ringing delusion’ (52.4%). The symptom ‘Ringing delusion’ is basically a confusion of ringing voice of cellphone realized by the CP user, though in reality there is no ringing voice at that moment. ‘Ringing delusion’ may consider as psychological sensitivity in which suddenly, a cellular phone user feels ringing voice of the device but in actually there is no ringing of the device. The associations of ‘increase in carelessness’ ‘forgetfulness’, and ‘headache’, symptoms was observed 18.2% 16.3%, and 13.0% respectively and rest of the symptoms like dizziness (6.19%), extreme irritation (7.49%) and neurophysiologic discomfort (2.61%) were minutely linked to individuals.

The possibilities of prevalence of EHS among the CP users were usually analogous to all age groups except the users of 31 years and above age. They were found in the reduced rate of possibility. Almost CP user's link of EHS to CP usage did not support on the basis of participant's gender but it was significant higher ($p < 0.05$) in females (63.4%) than the male (49.2%) users individually. No significance link of EHS to CP users could be detected on the basis of literacy and smoking habits.

3.5. Switch on/off

EHS were found to be significantly higher ($p < 0.001$) in individuals, they were keeping their device 'switched on' mode in the night (88%) than the 'switched off' mode. Particularly they were found significantly associated ($p < 0.001$) to symptoms 'warmth on ear'.

4. DISCUSSIONS

In the world wide a no of studies have been conducted over the possibilities of the symptoms and their association with usage of cell phone. In Indian scenario this is the first study with particular relevance to subjective symptoms and sensation through usage of cell phone.

A cross-sectional community study in Singapore [1] have carried out to determine the prevalence of specific central nervous system (CNS) symptoms among handheld cellular telephone (HP) users compared to nonusers and to study the association of risk factors and CNS symptoms among HP users. A total of 808 men and women between 12 and 70 years of age, who lived in one community, were selected using one-stage cluster random sampling and responses to a structured questionnaire. The prevalence of HP users was 44.8%. Headache was the most prevalent symptom among HP users compared to non-HP users, with an adjusted prevalence rate ratio of 1.31 [95% confidence interval, 1.00–1.70]. There is a significant increase in the prevalence of headache with increasing duration of usage (in minutes per day). Prevalence of headache was reduced by more than 20% among those who used hand-free equipment for their cellular telephones as compared to those who never use the equipment. Study concluded that the use of HPs is not associated with a significant increase of CNS symptoms other than headache.

A survey study has been conducted in Elazig, Turkey [18] among the cell phone users and cell phone non users. A total of 695 attendants (193 females and 502 males) were randomly selected from different ages, educations, earnings, locations and occupations. Among female, 157 women were mobile phone users whereas 36 were non-mobile phone users. 502 were consisting of 392 mobile phone users and 110 non-mobile phone users. They reported the symptoms and sensation after the cell phone use and resulted as Headache 313 (72.1%), Dizziness 29 (55.8%), Extreme irritation (71.8%;140), Tremor (61.0%; 25), Stammering (73.3%; 11), Forgetfulness (67.6%; 75), Neuro-psychological discomfort (81.5%; 53), Increase in the carelessness (86.9%; 186), Decrease of the reflex (97.3% 71), Clicking sound in the ears (72.1%; 80).

5. CONCLUSION

In this study, we found a small number of individuals were associated to EHS but significantly it could not be establish a link between the EHS to CP users. The vast statistics of participants may conclude better such a concern. Finally, the need-based cautious use of the scientific technologies must be accepted but the same technology may turn to be negative due to overuse. The Cell phones are required to be fabricated and to be used as per the guidelines of the regulatory organizations.

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