

Evaluation of self reported health effects in children mobile phone users using Information Gathering Chronological Model

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Abstract— Children are in their growing phase and they have thinner skin than adults, therefore they are at risk for the increased absorption of electromagnetic radiation emitted by mobile-phone. The aim of this study was to evaluate the mobile-phone utilization pattern and the potential self reported health effects among students of North India. We have included 455 students of age ranging from 10-29 years. An “Information Gathering Chronological (IGC) model” was used for the collection and evaluation of information. We observed that the incidence of “warmth-on-ear” was 38.24% among mobile-phone users. Prevalence of “warmth-on-ear” symptoms among overall mobile-phone users was 34.50%, 39.68%, 43.42% and 56.25% in low (LU), normal (NU), moderate (MU) and heavy (HU) users respectively. Nearly two fold increased risk for “warmth-on-ear” was found among HU as compared to LU in overall mobile-phone users. The risk association for “warmth-on-ear” ranges almost 2-5 folds among HU as compared to LU in different group (i.e. male, children and urban mobile-phone users). No substantial difference for “warmth-on-ear” was found in other categories (i.e. female, adult and rural mobile-phone users). These results suggested that the incidence of “warmth-on-ear” among male children from urban mobile-phone users were significantly increased.

Keywords-mobile-phone; electromagnetic hypersensitivity (EHS); electromagnetic radiation; self reported symptom; ‘warmth-on-ear’

I. Introduction

Mobile-phone is one of the ultimate inventions of the world. The mobile communication gives a comfort level to humans worldwide. Due to its expediency, the mass of people in developed as well as developing countries usage mobile-phones[1]. Rapid advancement and well-known usage of mobile-phones have their enormous effect on communication and exchange of views [1]. It is important to study possible adverse health effects of mobile-phones. Mobile-phones are really eye-catching tool for communication and exchanging views, however, an increased health risk was prevalent among mobile-phone users [1]. Mobile-phones are minute power radio gadgets that broadcast and obtain radio frequency rays

at frequencies of 900-1800 MHz. Mainly youth and kids are more captivated to make usage of the mobile-phones [2]. It emits radiofrequency radiation (RFR) from their antennas and from path elements inside [3]. Mobile-phone user feels “warmth-on-ear” that are some temperature when the user put their mobile-phones nearby the same ear while communicating for a long time. A study, which was held in Italy suggest that 96% of 14-18 years old children hold as a minimum one mobile-phones; even as 22% of them had more than one mobile-phones [4]. It has been recorded that 79.1% of 7-14 years old children had access to mobile-phones, and 57.7% had passed details that they bear their own mobile-phones [5]. Children’s are in their growing phase and they have thinner skin than adults. Therefore, they are at risk for increased absorption of electromagnetic (EM) radiation, which can be absorbed through the skin [refer.].

Previously a significant association between calling time/number of calls per day and the occurrence of ‘warmth-on-ear’, fatigue and headaches were observed [6]. People who are addicted tend to feel low, vanished and help less when they lack there mobile-phones. Their social and professional lives are occasionally bothered by numerous calling and messaging. Wide focus has been on experience to electromagnetic fields (EMF) emitted by mobile-phone. Recently, scientists have been making an effort to understand whether symptoms such “warmth-on-ear” can be triggered exclusively by the radio frequency electromagnetic fields (REFs) produced by mobile-phones [7]. Children are likely to use mobile-phones more frequently than the adults [8, 9].

The growing attractiveness of mobile-phone users has caused a concern over its possible detrimental effects on the human health. Recently, it has been shown that the rays emitted by a mobile-phone can relate with brain activity and behavior of human being [10-12].

Radiofrequency radiations emitted by mobile-phone are absorbed by the skin and it will cause much adverse effect in the biological system. The epidermis of children is thinner and under-keratinized as compared to adults. Therefore, they are at risk for increased absorption of agents that can be engrossed through the skin. Children may also respond more rapidly to agents such as EM radiation. Signs and symptoms in children may be an “early warning” of a radiological incident. The aim of the present study was to investigate the extent of mobile-phone use and the potential self reported health effects among North Indian students age ranges from 10-29 years (mean \pm SD = 15.94 \pm 2.92).

II. Materials and methods

A. Subjects

A total number of 455 students [Male = 238 (52.3%), Female = 217 (47.6%)] from the North Indian region were randomly selected for inclusion in this study. A well designed study proforma was used to evaluate the pattern of mobile-phone usage and the potential self reported health effects. In this study, the majority of subjects were children and young students. The most of the participants included in this study were from primary, secondary or higher secondary education programs, while few participants were registered in UG or PG programs (Table 1). An “Information Gathering Chronological (IGC) model” was used for collection and evaluation of the information [13]. Being cost effective, sequential steps and efficient independent assessment qualities of this model tends us to recommend IGC model for this study.

B. Data Collection

For each subject, the information was collected for various factors, including some basic information such as name, age, mobile-phone model, service operators, utilization pattern and the common health of users. Subsequently, in the section of general health, self reported complaints of symptoms “warmth-on-ear” were also collected from mobile-phone subscribers. . All subjects involved gave their consent prior to the inclusion in the study.

C. Foremost Parameters

In this study four major parameters were included in the assessment of various confounding factors in order to get concise information from subjects. These parameters were namely (i) Demographic and social characteristics [Table 2], (ii) Mobile-phone utilization patterns [Table 3], (iii) Grievance of the “warmth on ear” symptom to the subjects, and (iv) Awareness about the safety measures [Table 4].

III. Risk Assessment and Variables

The emphasis of this study was basically to evaluate the self reported symptoms “warmth-on-ear” of electromagnetic hypersensitivity among mobile-phone users in school going students. On the basis of mobile-phone utilization pattern subjects were stratified into low users (LU), normal users (NU), moderate users (MU) and heavy users (HU), for the assessment of self reported symptoms i.e. “warmth-on-ear”. We have evaluated the prevalence of “warmth-on-ear” symptom in NU, MU and HU as compared to LU in different groups such as overall, male, female, children, adult, urban and rural area mobile-phone users.

IV. Statistical analysis

The information for each subject from the questionnaire was transformed into a Microsoft Excel 2007 spreadsheet, to compute the prevalence of signs and symptoms in relation to age, sex and duration of usage of mobile-phone. Qualitative data are expressed as frequency and percentage. Numerical data are represented as mean \pm SD. Tests of group differences were conducted using Mann-Whitney tests for nonparametric continuous data and χ^2 or Fisher exact test for categorical data. Odds ratios (OR) with 95% confidence intervals (CI) were calculated to estimate the relative risk. A p-value of ≤ 0.05 was considered as statistically significant. These analysis were performed by using SPSS version 20.0 for Windows (Statistical Package for Social Sciences, SPSS Inc., USA) and GraphPad InStat 3.06 (GraphPad Software, Inc., USA).

V. Results

The prevalence of self reported symptom “warmth-on-ear” was analyzed among various group, namely overall, male, female, children, adult, urban and rural mobile-phone users (Figure.1). The number of mobile-phone users belonging to LU, NU, MU and HU were 284 (62.41%), 63 (13.84%), 76 (16.70%) and 32 (7.03%) respectively. The prevalence of overall “warmth-on-ear” symptoms was 34.50% in LU, 39.68% in NU, 43.42% in MU while 56.25% in HU (Figure.2). Nearly two fold increased risk of “warmth-on-ear” (OR = 2.44, CI = 1.16-5.11, p = 0.0200) symptoms were found among HU as compared to LU in overall users. We were keen to see the prevalence of “warmth-on-ear” symptoms among different groups such as male, female, children, adult, urban and rural area mobile-phone users (Table 5). Almost three fold increased risk was seen for the “warmth-on-ear” (OR = 2.60, CI = 1.09-6.19, p = 0.0405) in male users, while no-

significant difference was found in female users (Table 5), among HU as compared to LU. The prevalence of “warmth-on-ear” ranges nearly two to four fold among MU (OR = 1.87, CI = 1.06-3.30, $p = 0.0368$) and HU (OR = 4.14, CI = 1.50-11.41, $p = 0.0048$) as compared to LU in children mobile users, revealing considerable increase in usages of mobile-phone among children. Approximately five fold increased risk was observed for the incidence of “warmth-on-ear” (OR = 4.56, CI = 1.55-13.35, $p = 0.0040$) among HU as compared to LU in Urban area mobile users. No substantial difference in the prevalence of “warmth-on-ear” symptom was found among HU, while comparing to LU in adult and rural area mobile-phone users (Table 5).

VI. DISCUSSION

Mobile-phones emit signals through radio waves, which are comprised of radio-frequency (RF) energy, a form of electromagnetic radiation[4]. The antenna of mobile-phone propagates the radio waves, which transmit the encoded signal that are made up of EM radiation. There are the studies which have shown the increasing trend of mobile-phone usage in children [4]. Children are more likely to accumulate many years of exposure to EM radiation during their entire life span. They are more prone to EM radiation that affects rapidly growing tissue than adults. Keeping these facts in the mind the present study was designed to investigate the pattern of mobile-phone usage and the potential self reported health effects among North Indian students.

We have observed that the frequency of self reported symptoms “warmth-on-ear” was significantly higher ($p = 0.0200$) among HU as compared to LU in overall mobile-phone users. A significant increased risk for “warmth-on-ear” symptom was seen among HU in individual, group of male ($p = 0.0405$), children ($p = 0.0048$) and urban ($p = 0.0040$) mobile-phone users, revealing significant increase in usages of mobile-phone among male children from urban areas. However, no significant differences ($p \geq 0.05$) for the occurrence of “warmth-on-ear” symptoms were found in other categories (i.e. female, adult and rural mobile-phone users). Signs and symptoms of self reported health effects in children may be an “early warning” of a radiological incident of electromagnetic hypersensitivity. It is anticipated that the identification of vulnerable group determined on the basis of extent of mobile-phone usage may accentuate some light on understanding of EM hypersensitivity among children mobile-phone users. These results are in concordance with a recent report which suggested that the mobile-phone usage was associated with changes in cognitive function among young adolescents [14]. A correlation between calling time/number of calls per day and the occurrence of warmth-on-ear, fatigue and headaches were observed, which further strengthen, our finding among self reported symptoms “warmth-on-ear” in

North Indian students [6]. Previous report confirmed the more often complain of burning or heating sensation within the auricle area among mobile-phone users [15]. The self reported symptom “warmth-on-ear” during mobile-phone usage may be due to the extent of radio frequency (RF) exposure and electric power dissipation [15]. The epidemiological [16], cellular [17] and animal studies [18], have been performed for the assessment of EM radiation and its hazardous effect, but none of them have reached definite conclusions. Radio-frequency energy emitted by mobile-phone is considered as non-ionizing radiation. Usually it causes a heating effect but extensive usage of mobile-phone may have a hazardous effect among children due to lack of awareness.

Although we cannot urge children to stop using mobile-phones, but there are the few simple steps they can take to protect their health. Our study has certain limitations. First, the reported symptoms “warmth-on-ear” is the self declared ones; therefore, the reported frequency may not reflect their exact incidence among North Indians. Second, since most of the students participated in this study are in the age of 12-18 years (65.9%), their understandings about the exact definitions of the self reported symptoms “warmth-on-ear” might have affected their answers to the questions given in the study proforma. Both of these limitations might have affected the outcome of this study.

VII. CONCLUSION

To conclude, our results revealed, that the incidence of warmth-on-ear among male children from urban mobile-phone users are significantly increased. The outcome of this study should be viewed in the light of the nature of symptom measurement (self-report) and the knowledge as well as the understandings of subjects about the symptom. Moreover, in future, more studies in an independent cohort should be included to evaluate the impact of EM hypersensitivity among children mobile-phone users.

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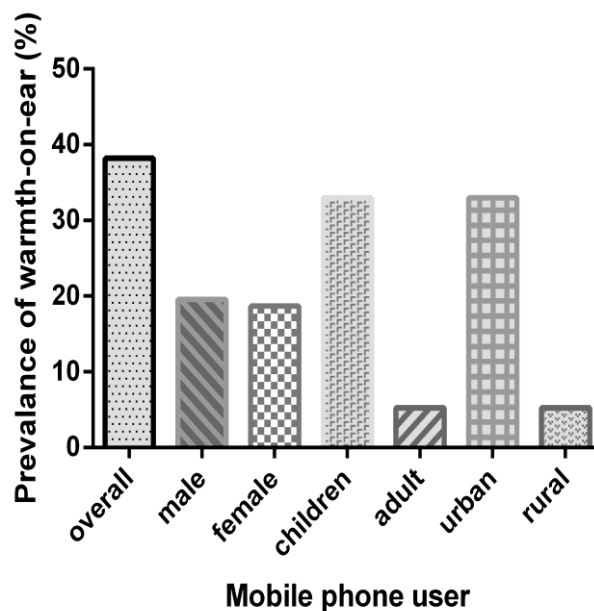


Figure 1. Prevalence of "warmth-on-ear" (%) among overall, male, female, children, adult, urban and rural mobile-phone users

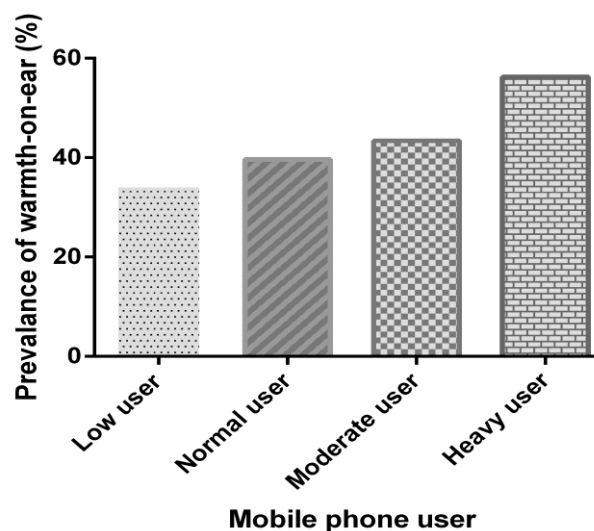


Figure 2. Prevalence of self reported symptom "warmth-on-ear" (%) in LU, NU, MU and HU among over all mobile-phone users

TABLE 1. DISTRIBUTION OF PARTICIPANTS IN REFERENCE TO DISTINGUISH FACTORS

User Factor	Category	Subject (n= 455)
<i>Age</i>	<i>12 to 18</i>	<i>300(65.9%)</i>
	<i>18 to 24</i>	<i>146(32.0%)</i>
	<i>above 24</i>	<i>9(1.9%)</i>
<i>Gender</i>	<i>Male</i>	<i>238(52.3%)</i>
	<i>Female</i>	<i>217(47.6%)</i>
<i>Ethnicity</i>	<i>Urban</i>	<i>396(87.0%)</i>
	<i>Rural</i>	<i>59(12.9%)</i>
<i>Education</i>	<i>Below UG</i>	<i>361(79.3%)</i>
	<i>UG</i>	<i>79(17.3%)</i>
	<i>PG</i>	<i>15(3.2%)</i>
<i>Safety</i>	<i>Ear Phone user</i>	<i>100(21.9%)</i>
	<i>Switch off in night</i>	<i>74(16.2%)</i>
	<i>Put cell phone near the head during sleeping</i>	<i>180(39.5%)</i>
	<i>Left ear side user</i>	<i>96(21.0%)</i>
	<i>Right ear side</i>	<i>359(78.9%)</i>
	<i>Mobile-phone utilization range in hours</i>	
<i>Exposure</i>	<i>Group 1; LU* (< 500)</i>	<i>284(62.4%)</i>
	<i>Group 2; NU *(500-1000)</i>	<i>63(13.8%)</i>
	<i>Group 3;MU*(1000-5000)</i>	<i>76(16.7%)</i>
	<i>Group 4; HU *(< 5000)</i>	<i>32(7.03%)</i>
<i>Mobile-phone use- Yearly</i>	<i>1 Year User</i>	<i>162(35.6%)</i>
	<i>2 Year User</i>	<i>93(20.4%)</i>
	<i>3 Year User</i>	<i>73(16.0%)</i>
	<i>4 Year User</i>	<i>66(14.5%)</i>
	<i>≤5 Year User</i>	<i>61(13.5%)</i>
<i>Association of Symptoms and Sensation</i>	<i>Self Reported symptom</i>	<i>440(96.7%)</i>
	<i>No Self Reported Symptom</i>	<i>15(3.2%)</i>
<i>Mobile-phone holds on</i>	<i>Right side pant pocket</i>	<i>206(45.2%)</i>
	<i>Bag</i>	<i>156(34.2%)</i>
	<i>Left side pant pocket</i>	<i>63(13.8%)</i>
	<i>Left side shirt pocket</i>	<i>20(4.3%)</i>
	<i>Right side shirt pocket</i>	<i>10(2.1%)</i>

TABLE 2: DEMOGRAPHIC AND SOCIAL CHARACTERISTICS

S. No.	Characteristics	Classifications
1.	<i>Gender</i>	<i>Male</i> <i>Female</i>
2.	<i>Educational Level</i>	<i>Primary School</i> <i>Secondary School</i> <i>Higher Secondary School</i> <i>UG or PG</i>
3.	<i>Family Detail</i>	<i>No of Family Members</i> <i>No of Mobile phone user</i> <i>No of Children Below 16 yr</i>

TABLE 3: MOBILE PHONES UTILIZATION PATTERNS

S. No.	Characteristics	Classifications
1.	<i>Frequency of use</i>	<i>Non-regular use (<1.5 years)</i> <i>Regular use (>1.5 years)</i>
2.	<i>Life-time years of use</i>	<i>≤1 Years - 3 years></i> <i>≤3 years - 5 years></i> <i>≥5 years</i>
3.	<i>Number of calls per day</i>	<i>Dialed calls</i> <i>Received calls</i>
4.	<i>Hours of use per day</i>	<i>≥1 hours</i> <i><1.5 hours - 3 hours></i> <i>≤3hours-5 hours></i>
5.	<i>Mode of use</i>	<i>Ringing mode</i> <i>Vibration mode</i> <i>Both (Ringing + Vibration)</i>

TABLE 4: ADOPTED SAFETY MEASURES

S. No.	Characteristics	Classifications
1.	<i>Which ear side user holds their cell phone during call?</i>	<i>Left ear side</i> <i>Right ear side</i>
2.	<i>Do you use safety device during talking on mobile phone?</i>	<i>Ear phone</i> <i>Blue tooth</i> <i>Speaker mode</i> <i>No device</i>
3.	<i>Generally where you hold you're mobile phone?</i>	<i>Pant pocket(left or right)</i> <i>Shirt pocket (left or right)</i> <i>Hanging in neck</i> <i>Mobile holder in belt</i> <i>In bag</i>
4.	<i>Do you switch off your mobile phone in nights?</i>	<i>Yes</i> <i>No</i>
5.	<i>Do you keep your mobile phone near head during sleep?</i>	<i>Yes</i> <i>No</i>

Table 5. Prevalence of 'warmth-on-ear' symptom among mobile-phone users

Participants		Low User	Normal User	Moderate User	Heavy User
A Overall	CP users (455)	284 (62.41%)	63 (13.84%)	76 (16.70%)	32 (7.03%)
	Cases of warmth on ear (174)	98 (34.50%)	25 (39.68%)	33 (43.42%)	18 (56.25%)
	P-value	-	0.4680	0.1794	0.0200*
	OR (95%CI)	Reference	1.24 (0.71-2.18)	1.45 (0.86-2.43)	2.44 (1.16-5.11)
B Male	CP users (238)	137 (57.56%)	33 (13.86%)	43 (18.06%)	25 (10.50%)
	Cases of warmth on ear (89)	45 (32.84%)	13 (39.39%)	17 (39.53%)	14 (56.00%)
	P-value	-	0.5408	0.4639	0.0405*
	OR (95%CI)	Reference	1.32 (0.60-2.91)	1.33 (0.65-2.71)	2.60 (1.09-6.19)
C Female	CP users (217)	147 (67.74%)	30 (13.82%)	33 (15.20%)	7 (3.22%)
	Cases of warmth on ear (85)	53 (36.05%)	12 (40.00%)	16 (48.48%)	4 (57.14%)
	P-value	-	0.6830	0.2346	0.4246
	OR (95%CI)	Reference	1.18 (0.52-2.64)	1.66 (0.77-3.57)	2.36 (0.50-10.97)
D Children	CP users (398)	261 (65.57%)	58 (14.57%)	61 (15.32%)	18 (4.52%)
	Cases of warmth on ear (150)	85 (32.56%)	24 (41.37%)	29 (47.54%)	12 (66.66%)
	P-value	-	0.2220	0.0368*	0.0048*
	OR (95%CI)	Reference	1.46 (0.81-2.61)	1.87 (1.06-3.30)	4.14 (1.50-11.41)
E Adult	CP users (57)	23 (40.35%)	5 (8.77%)	15 (26.31%)	14 (24.56%)
	Cases of warmth on ear (24)	13 (56.52%)	1 (20.00%)	4 (26.66%)	6 (42.85%)
	P-value	-	0.3259	0.1000	0.5077
	OR (95%CI)	Reference	0.19 (0.01-2.00)	0.27 (0.06-1.14)	0.57 (0.15-2.20)
F Urban	CP users (396)	261 (65.90%)	58 (14.64%)	60 (15.15%)	17 (4.29%)
	Cases of warmth on ear (150)	90 (34.48%)	23 (39.65%)	25 (41.66%)	12 (70.58%)
	P-value	-	0.4527	0.2999	0.0040*
	OR (95%CI)	Reference	1.24 (0.69-2.24)	1.35 (0.76-2.40)	4.56 (1.55-13.35)
G Rural	CP users (59)	23 (38.98%)	5 (8.47%)	16 (27.11%)	15 (25.42%)
	Cases of warmth on ear (24)	8 (34.78%)	2 (40.00%)	8 (50.00%)	6 (40.00%)
	P-value	-	1.0000	0.5092	1.0000
	OR (95%CI)	Reference	1.25 (0.17-9.09)	1.87 (0.50-6.90)	1.25 (0.32-4.78)

Prevalence of "warmth-on-ear" symptom among mobile-phone users
 LU: Low User (≤ 500 hours); NU: Normal User (> 500 and ≤ 1000 Hours); MU: Moderate User (> 1000 and ≤ 5000 Hours); HU: Heavy User (> 5000 Hours); MP: Mobile-phone.
 Fisher Exact Test was performed to obtain the p-value; OR: odds ratio; CI: confidence interval; p-value ≤ 0.05 was considered as significant;
 *statistically significant increased prevalence of warmth on ear symptoms among mobile-phone users.