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Symptomatic health issues of using mobile phones for extended periods: study with young adults

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Abstract
Mobile phone, which is today considered to be a necessity by most people is supposed to be harmful to health. In this study we investigated the association between the duration and quantity of cell phone use with visual disturbance, tingling sensation of the face, dizziness, headache, burning sensation to the face, burning sensation to the ear, sense of warmth around /behind the ear, unusual drowsiness, loss of memory and difficulty in concentration in young adults pursuing medical, nursing and engineering studies in Mangalore. A total of 518 volunteers consisting of 455 health care students and 63 engineering students enrolled willingly and filled the questionnaire the study. The participants indicated the presence of at least one symptom associated with the number of years ($p < 0.003$) and between the length of conversation with headache ($p< 0.03$) and sense of warmth around the ear ($p < 0.02$). Based on these results we conclude that long term or excessive use of mobile phones should be avoided.

Keywords: Cellular phone, child, electromagnetic frequency, environmental exposure, migraine, mobile phone, pain, radiofrequency

Introduction
Hand held mobile phones were introduced for the first time in Sweden in late 1980's and since then their use has increased tremendously all over the world due to the convenience they offer over other modes of telecommunication [1]. Mobile phones operate using the radiofrequency radiation and more than 80% of these mobile phones are GSM (Global System for Mobile Communications) 900 system dependent, while 12% are reported to use the GSM 1800 system [2]. In the digital systems, the information is sent via pulse modulated signals of frequency between 870 and 995 MHz (megahertz). Within this frequency band, the wave is non-ionizing [2].

The maximum output power during a pulse from GSM phone is higher than the maximum output power from NMT (Nordisk Mobil Telefoni or Nordiska Mobil Telefoni-gruppen, Nordic Mobile Telephony) phones, whereas mean power from GSM phones is lower and because of regulation systems, under most condition the GSM phones operate at much lower levels than the NMT phones [3]. Although useful, the use of mobile phones is presumed to cause/increase health risk and this is attributed to the electromagnetic radiation (EMR) emitting from it [4, 5]. As mobile phones are held close to the body, in most cases near the ears it is speculated to inflict deleterious effects on the brain and auditory apparatus [6]. Mobile phones emit radiations that are intercepted in the proximity of the brain and cranial nerves and preclinical studies have shown that the low level of radiofrequency radiations can alter the blood brain barrier in mice [6]. Wister Albino rats exposed to mobile phone radiation for longer than 15 min a day for a total period of 3 months had significantly higher fasting blood glucose, indicating that the exposure to the emitting electromagnetic radiation may increase the chances of diabetes [7].

Similarly in humans also, these radiations cause a potential and reports indicate that people who have been occupationally exposed to low level radiofrequency fields have complained of heaviness in head, headaches, fatigue, and poor memory more often than people who have not been exposed [8]. Although inconclusive, epidemiological data also indicate an increase for development of brain tumours (glioma, acoustic neuroma, meningioma), parotid gland tumor, seminoma in long-term users of mobile phone [9].

Based on the results of the Interphone study (2010) and Swedish study by Hardell and colleagues (2011), the International Agency for Research on Cancer (IARC) has classified Radio Frequency (RF) fields as 2B (possible) carcinogen [10]. Additionally, the effects of cell phones on cardiovascular system, sleep and cognitive function have also been the areas of recent attention [11, 12].

The use of mobile phones by men is associated with a decrease in semen quality and the decrease in sperm count, motility, viability, and normal morphology is related to the duration of exposure to mobile phones [13]. The number of reports of symptoms experienced by mobile phone users around the world is increasing and the symptoms include headaches, dizziness, warmth or tingling around the ear and face, and difficulty in concentrating [8, 14]. The objectives of our study therefore are to evaluate the frequency of use of mobile phones among students and also to asses any complication consequent to the use. Since the mobile phone use is present everywhere and as youth form a large group of the users, its negative effect, immediate or long term, could also be widespread.

Methods

Study design and subjects

We conducted this study in Mangalore, a coastal region in southern Karnataka (Figure 1) from July 2010 to September 2010. The study location was chosen because of the educational hub. A mini cross section of India is available as student population is present here, which serves the aim of the study being evaluating the problems associated with the use of mobile phones among students. The subjects included for the study belonged to two categories, one being the Health care professionals and other being the engineering students. This was done to compare the frequency of usage of mobile phones and its associated symptoms.

The study was anonymous and largely done in Father Muller Charitable Institutions, as it has both medical college and nursing college. The students of both medical and nursing college were included in the study. The engineering students were selected from the St Joseph's Engineering College, Mangalore. The students selected for the study were between the ages 17 and 23 years. The students included were both local residents of Mangalore and those from out of Mangalore living in the institute's hostels/dorms. The participation rate was 100%, giving an effective sample of 518 respondents.

Questionnaire

The questionnaire was indigenously compiled and validated. A well-structured questionnaire was distributed among the subjects, with English translation only (language comfortable to all). The questionnaire included personal information about the student (age, sex, and address), questions on usage of mobile phones and health queries, and the symptoms experienced by them. We used a two-tier approach in our questionnaire to minimize recall bias. The questionnaire was structured in such a way that before asking the individuals about the use of mobile phones, presence of headache was asked first. Because headache is a common public health concern and is a topic of interest among the public, the topic would engage the subject in the survey but would mask the actual survey goal of determining the relationship of the symptoms with mobile phone use. Headache was the main symptom which was focused during the preparation of the questionnaire. Other symptoms like visual disturbances, tingling sensation of the face, dizziness, burning sensation to the face, burning sensation to the ear, sense of warmth around the ear, unusual drowsiness, loss of memory, difficulty in concentration. The symptoms included in the study were based on the previous study of Chia and co-workers [2]. The subjects were requested about the incidence of any of the listed symptoms.

Statistical analysis

The students's *t* and chi-square test were applied for comparison between the groups and incidence. The correlation for various health disturbances with time and length of mobile phone use was performed using the Spearman's correlation coefficient analysis. A p value of 0.05 was considered to be statistically significant.

Results

A total of 518 questionnaires were distributed to willing participants, 455 health care students and 63 by engineering students. Health care students included both medical students and nursing students. Table 1 represents the various questions present in the questionnaire and the responses of health care professionals and engineering students. The sex distribution among health care students and engineering students is also shown in Table 1. A total of 378 girls (83%) and 77 boys (17%) were considered from Health care (medical/ nursing) and 52 girls (83%) and 11 boys (17%) were considered from Engineering course.

The duration of conversation lasted less than 10 minutes for 56.04% of the health care professionals and 30.15% of engineering students. It was more than 10 minutes for 43.95% health care professionals and 69.84% of engineering students. In our study, 44.61% of health care professionals and 49.2% of engineering students are of the view that mobile phones are indispensable to them. 46.15% of Health care professionals and 60.31% of engineering students viewed that they get agitated without mobile phones. A total of 275 respondents stayed away from their families and an association of cell phone usage (duration of conversation) was observed to be significant ($p < 0.02$).

The number of years of usage of mobile phones was seen and accordingly Table 1 shows the distribution. 31% of the total respondents are using mobile since 1-2 years, 35% of them are using mobile since 2-4 years and 34% of them are using mobile from more than 4 years. Different aspects were charted down from the responses in the questionnaire. In the study, the frequency of symptoms were categorized as visual disturbance, face tingling, dizziness, headache, burning sensation to the face, burning sensation to the ear, sensation of warmth around the ear, drowsiness, memory loss, loss of concentration and is represented in Figure 2.

Association of duration of conversation with symptoms like headache and sense of warmth around the ear were evaluated and observed as follows. Out of total 518 participants, 460 had headache ($p < 0.03$), 409 had sense of warmth around the ear ($p< 0.02$). We also found association between numbers of years of usage of cell phones with sense of warmth around the ear ($p < 0.02$). The students of both the streams indicate that there is presence of at least one symptom associated with the number of years of usage ($p < 0.02$). Of all the symptoms sensation of warmth around the ear showed a high correlation with the years of use and was significant ($p < 0.03$).

Discussion

Mobile phone use has pervaded into every aspect of the community and it has a special presence in the lives of young, college going students. However, its excessive use and its health effects are relatively new issues that have come forth only in the recent years. Mobile phone growth in India has been fast and it has reached all segments of society, especially the young Planning Commission Government of India, 2002 [15]. There have been situations where the mobile phone usage among the young has been deemed as problematic [16, 17]. According to IARC, the number of mobile phone subscriptions is estimated to be 5 billion globally. Over few years, there has been increased concern about the possibility of adverse health effects resulting from exposure to radiofrequency electromagnetic fields (IARC, WHO). In recent years "Ringxiety", a psychological problem which results from the excessive use of mobile phones have been reported [17]. It is a condition where individuals hear the phone ringing when it actually hasn't, which is also called "phantom ringing" [18]. It has been estimated that 25% of the mobile phone users in India could be suffering from this disorder [19].

Excessive mobile phone use has been found to be associated with headache, stress, sleep disturbances and depression [3, 14, 20]. It was also found to be a risk factor for the development of the mental health outcomes in a study with one year follow up, which was done among young adults in Sweden [20]. Since the mobile phone use is ubiquitous and as youth form a large group of the users, its negative effect, immediate or long term, could also be widespread. The literature search has revealed no such studies in India, though the potential impact of the mobile phone use on various body systems has been elaborated [17, 21]. A significant increase was found in some self-reported symptoms among users of mobile phones. These findings are in line with what is widely believed regarding the higher vulnerability of children to exhibit symptoms from using mobile phones [21].

Our study ventured to see the frequency of use of mobile phones and associated problems among health care professionals and engineering students. A total of 518 students were included in the study. The mean age was 21.21±2.67 and 20.18±2.4 of the health care and engineering students, respectively. Engineering and health care professionals of relatively similar age group were considered as these courses are opted after a basic pre university grade. A total of 188 girls (75%) and 64 boys (25%) were considered from MBBS course, 190 girls (94%) and 13 boys (6%) were considered from Nursing course and 52 girls (83%) and 11 boys (17%) were considered from Engineering course. In both health care professionals and engineering courses female respondents are more amenable to fill up the questionnaire and hence the discrepancy.

The present study which was done among engineering and health care professionals revealed that the use of mobile phones was almost universal. As regards to the people with whom the students communicated the most with their mobiles, a majority of them were found to do so with their parents. This was similar to the findings of a study which was done among Malaysian college students, where 51% of the students said that they talked most often to either parent [22]. The reason for this in our study could be that a large proportion of the students in our institution were from other places outside dakshina karnataka district, and that their parents found it easier to keep in contact with their wards through mobile phones [17]. Here a total of 275 students stay away from their family. The association of cell phone usage (duration of conversation) and families staying away was significant ($p< 0.02$).

The duration of conversation lasted less than 10 minutes for 56.04% of the health care professionals and 30.15% of engineering students. It was more than 10 minutes for 43.95% health care professionals and 69.84% of engineering students. This increased duration of conversation in engineering students may be one of the reasons for the medical problems associated with mobile phones in them. We would also conjuncture that medical career being vast preempts the long duration of calls. This contradicts to a study done in a medical college where median call duration was 45 minutes and also the Malaysian study was also the call duration was 45 minutes [17].

In a study which was done on adolescents in Hong Kong, 27.4% of them were classified as mobile phone addicts [16]. A British study showed that 40% of the subjects had admitted that they could not do without their cell phones and that 7% had admitted to either losing a relationship or a job due to their cell phone usage [23]. In a study in Sweden, 13% of the males and 22% of the females said they were using mobile phones too much [20]. In a younger sample of Spanish adolescents, 20% admitted to having cell phone dependence [24]. In our study, 44.61% of Health care professionals and 49.2% of engineering students are of the view that mobile phones are indispensable to them. 46.15% of Health care professionals and 60.31% of engineering students viewed that they get agitated without mobile phones. In both the cases engineering students were found to be more addicted to mobile phones than the health care professionals

The issue of mobile phone addiction is definitely present among the student community. The usages of mobile phone lead to both physical and psychological withdrawal symptoms when they stop using it, like anxiety, restlessness, nervousness and irritability. The symptoms disappear when they start using the phones again [25]. In the study, the frequency of symptoms were charted down, symptoms such as visual disturbance, face tingling, dizziness, headache, burning sensation to the face, burning sensation to the ear, sensation of warmth around the ear, drowsiness, memory loss, loss of concentration. Specifically sensation of warmth around the ear, visual disturbance, and head ache were seen to be present in a larger number of students. This was in congruence with the findings of other studies that have shown that headache to be the consequence of excessive mobile phone [2, 26, 27]. A study in Iran on mobile phone usage in high school students also show similar results were in headache is predominantly seen [26].

Similarly in our study also there was association of cell phone usage (duration of conversation) with a lot of variable symptoms. Out of total 518 participants, 460 had headache ($p< 0.03$), 409 had sense of warmth around the ear ($p< 0.02$), 312 had any one of the symptom mentioned in questionnaire ($p< 0.04$). We also found association between numbers of years of usage of cell phones with sense of warmth around the ear ($p< 0.02$). The students of both the streams indicate that there is presence of at least one symptom associated with the number of years ($p< 0.03$). The number of years of usage was not associated with headache. The frequency of headache, as we find it is not related to number of years of mobile usage rather the

duration of conversation (duration of conversation > 10 minutes). Persistent strong headache was associated with sensation of warmth around the ear ($p< 0.003$) and are in agreement to previous observations [2, 26, 27].

Table 1: Demographic and various aspects associated with the use of mobile phones in Health care and engineering students

Questions		Health care	Engineering
Years of usage	1-2 years	160 (35.16%)	3 (4.76%)
	2-4year	158 (34.72%)	24 (38.09%)
	More than 4 years	137 (30.1%)	36 (57.14%)
Indispensability	Yes	203 (44.61%)	31 (49.2%)
	No	252 (55.38%)	32 (50.79%)
Domicile (away from parents)	Yes	355 (78.02%)	16 (25.39%)
	No	100 (21.97%)	47 (74.6%)
Persistent strong head aches	Yes	53 (11.64%)	17 (26.98%)
	No	402 (88.35%)	46 (73.01%)
Headaches occurring on the side adjacent to phone and aerial	Yes	48 (10.54%)	14 (22.22%)
	No	407 (89.45%)	49 (77.77%)
Holding of the phone	Right ear	331 (72.74%)	35 (55.55%)
	Left ear	124 (27.25%)	28 (44.44%)
Hand held telephones or hand free	Yes	302 (66.37%)	39 (61.9%)
	No	153 (33.62%)	24 (38.09%)
How often do you get phone calls	Less than 10 times	352 (77.36%)	51 (80.95%)
	10-20	60 (13.18%)	8 (12.69%)
	21-30	5 (1.09%)	2 (3.17%)
	More than 30	38 (8.35%)	2 (3.17%)
How often do you call others?	Less than 10 times	367 (80.65%)	52 (82.53%)
	10-20	47 (10.32%)	9 (14.28%)
	21-30	8 (1.75%)	1 (1.58%)
	More than 30	33 (7.25%)	1 (1.58%)
How long does each conversation last?	Less than 10 min	255 (56.04%)	19 (30.15%)
	More than 10 min	200 (43.95%)	44 (69.84%)
How many hours in week do you talk on phone?	Less than 6 h	348 (76.48%)	49 (77.77%)
	More than 6 and Less than 10 h	65 (14.28%)	7 (11.11%)
	More than 10 h	39 (8.57%)	6 (9.52%)
How many messages do you send every day	Less than 75	341 (74.94%)	38 (60.31%)
	More than 75Less than 150	92 (20.21%)	23 (36.5%)
	More than 150	22 (4.83%)	2 (3.17%)
How long do you listen to songs every day on mobile?	Less than 60 min	364 (80%)	54 (85.71%)
	More than 60 min and Less than 3 h	70 (15.38%)	6 (1.31%)
	More than 3 h	19 (4.17%)	3 (0.65%)
How long do play with mobile games?	Less than 60 min	410 (90.1%)	63 (100%)
	More than 60 min and Less than 3 h	17 (3.73%)	0
	More than 3 h	4 (0.87%)	0

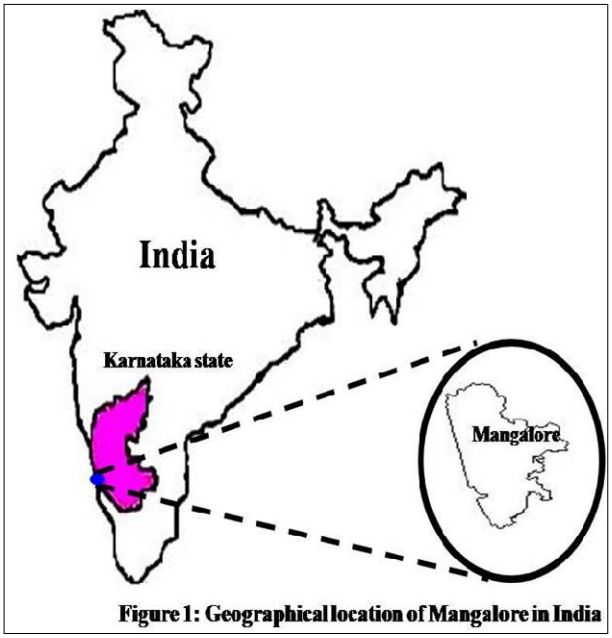

Figure 1: Geographical location of Mangalore in India

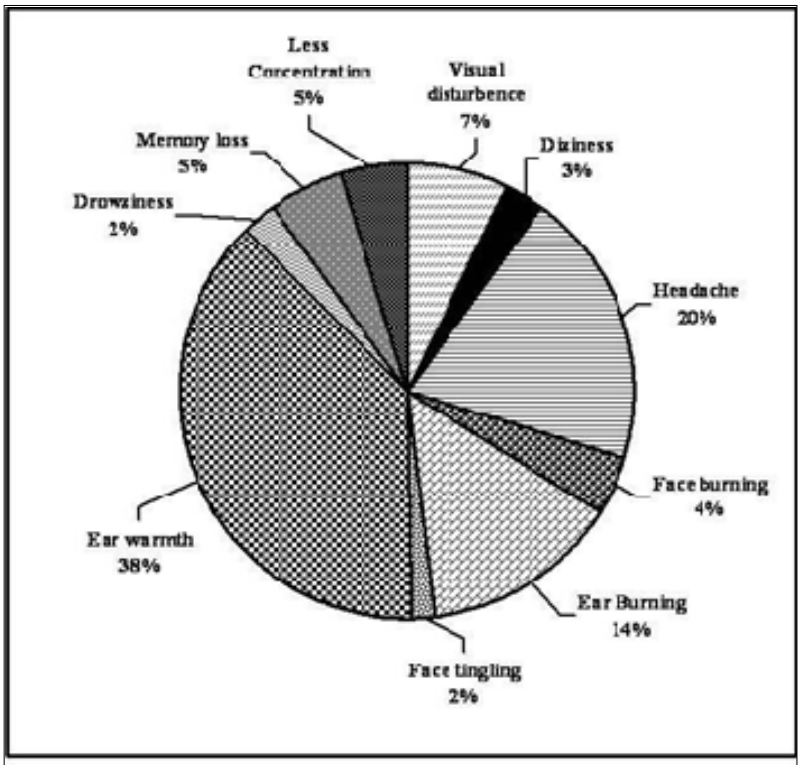

Figure 2: Incidence of various ill effects after use of mobile phones

Conclusion

This study evaluated the frequency of mobile phone usage and health related problems. It was noted that South Indian that is Mangalore and student for health care (medical/nursing) and engineering show a rampant usage of mobile phones. The usage differs among two student population under consideration. Health related symptoms most commonly encountered are sensation of warmth around the ear, visual disturbance, and head ache. The association of headache was surprisingly not associated with period of mobile phone usage but to the duration of conversation. This study has some limitations; its results may not be representative of the whole community of college goers, as it was done among a specific group of students of a medical, nursing and engineering college of Mangalore. The results are also dependent on the assumption that the students gave honest responses to the questionnaire, as it was self- administered and anonymous. This study indicated that high mobile phone usage is associated with certain health disturbances and needs to be validated in a larger cross-sectional population.

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