ASSOCIATION OF CELL PHONE RADIATIONS WITH VARIOUS DISEASE SYMPTOMS AMONG 370 SUBJECTS RESIDING IN PESHAWAR

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Abstract: A study to investigate various health hazards due to cell phone radiations was conducted from October, 2007 to February, 2008 among cell phone users residing in Peshawar district. A total of 370 subjects (271 female and 89 male) having age ranging from 16 to 60 years were subjected to in person interviews, and blood samples were taken from 100 most extensive users to examine any deviant effect of radiations on blood cell morphology. Among 370 subjects interviewed, the most commonly occurring symptom was warming of ears (57.03%). The prevalence of headache (29.41%) was highest among females, who kept their cell phones under pillow. Among male subjects, palpitation (53.33%) was reported to be the highest symptom due to keeping their cell phones in front pocket. The symptom felt in frequent episodes among the inspected subjects was palpitation (44.95%) and the symptom felt in infrequent episodes was migraine (72.72%). Change in behavior or irritation during receiving the call was documented in 38.92% of the people interviewed. Elevated level of anger was noticed in 29.46% of the subjects after their exposure to cell phone radiations. Stress/depression (40.45%) due to unknown reasons was found to occur more frequently among male subjects. On the basis of occupation, the businessmen were extensive users having most of the symptoms associated with electromagnetic radiation of cell phone. The data was also analyzed using Chi-square test, where occurrences of the symptoms were dependent on call duration. No relationship between abnormal blood cells morphology and radiations was observed. In addition to above symptoms, high and low blood pressure, loss in hearing capacity, nausea, heavy feelings in head and ear, laziness, & loss of appetite in mild degrees were also reported. This study suggested that extensive use of cell phone may be associated with chronic diseases or disorders.

Key Words: Cell phone, radiation, stress, businessmen, blood smear

Introduction

Microwaves are very short waves of electromagnetic energy that travel at the speed of light. Mobile phones and telephone towers emit microwave radiation, which is in the radiofrequency (RF) radiation part of the spectrum of electromagnetic waves. Microwave radiation borders on the optical part of the non-ionizing electromagnetic spectrum, ranging in wavelength between 1mm and 1meter (Barnett, 1994). Research conducted in various regions has indicated great concern about the possible adverse
effects of RF radiation on human health. An enormous increase of mobile telephones and other telecommunication devices throughout the world may be the main cause of possible genetic effects (Verschaeve, 2009). There have been suggestions; based on some epidemiological studies at low frequencies that chronic exposure to Electromagnetic fields (EMF) may increase the risk of developing certain types of cancer. Although there has been no epidemiological study completed specifically addressing the higher frequency range used for telecommunications but there have been some reports of increased tumors in animals exposed to microwaves together with a known carcinogen. However, there was a report of increased breast cancer in a very small group of female radio-operators on Norwegian ships that were exposed to a combination of Extremely Low Frequency (ELF) and RF radiations (Barnett, 1994).

There have been very few studies on this subject in Pakistan but various researches worldwide have undertaken studies on various adverse aspects of microwaves emitted from cell phones. Cossarizza, et al., (1993) studied stress level in humans and associated it with microwave exposure. The results showed that microwaves increased the production of interleukin-1 and IL-6 in human peripheral blood which is the indicator of increase in stress level in humans. Mann & Roschkle, (1996), and Borbely, et al., (1999) worked on sleep patterns in humans and found that cell phone radiations disturb sleep. Hocking, (1998) conducted a study on microwave sickness and in his result showed that headache, discomort and nausea are associated with microwave radiations. Miled, et al., (1998) conducted a some what similar study and concluded that cell phone radiation was involved in the increase of symptoms such as memory loss, concentration difficulties, fatigue and headache. Santini, (2001) conducted a survey study, using questionnaire, on 161 students & workers in a French engineering school on symptoms experienced during use of digital cellular phones. In his study women significantly complained more often of sleep disturbance than men. The users also had significant complains of discomfort, warmth & picking on the ear during phone conversation. Al-Khaliwi and Meo, (2004) investigated headache, sleep disturbance, tension, fatigue & dizziness and associated them with the effect of cell phone radiations in humans and concluded that the use of cell phone might be a risk factor and its long term use should be avoided by health promotion activities. Another similar study was conducted in Iran by Mortazvi, et al., (2007). Headache, fatigue, difficulties in concentration, vertigo/dizziness, attention disorders, nervousness, palpitation, low back pain, myalgia and tinnitus were the self-reported symptoms. Al-Dousary, (2007) investigated a 42 year old male, businessman, in King Abdul-Aziz University Hospital, Riyadh, Kingdom of Saudi Arabia. The chief complaint of the subject was diminished hearing in the right ear. The patient gave history of burning sensation and dull ache, in and around the right ear, associated with mobile phone use. Rubin, et al., (2007) deduced in his experiment that there is no significant association between the psychiatric disorders and only small percentage of people were sensitive to Cell phone signals. Rezk, et al., (2008) studied fetal and neonatal heart rate (HR) and cardiac output (COP), following acute maternal exposure to EMF emitted by mobile phones. The main outcome was a significant increase in
fetal and neonatal HR and statistical significant decrease in stroke volume and COP before and after use of Mobile phone. All these changes were attenuated with an increase in gestational age.

The purpose of present study is to investigate various health hazards due to Cell phone radiations among cell phone users residing in Peshawar district.

Materials and Methods

In order to conduct the survey in an organized and effective manner a questionnaire was prepared. Also blood smears of 100 most extensive users of cell phone were made to examine any abnormal effect of radiations on blood cell morphology.

The questionnaire were filled by in-person interviews using a well-structured synopsis that included collecting information regarding their age, gender, occupation, duration of possession of cell phone, duration of in coming and outgoing calls, where they kept their cell phone, and the different chronic symptoms body disorders they felt.

During interviews, blood samples were collected by pricking the individual's finger with sterilized blood lancet and blood smears were made. The blood smears were fixed with methanol, and were later stained with Geimsa's stain. Blood smears were examined under Nikon Binocular microscope, (Model E-200, Instech Co. LTD, Japan), at Biodiversity Department, University of Peshawar. To conduct a better research in this field, pictures of blood smears were also taken with camera DCM-35 using software USB-2.0. Statistical analysis of the data was carried out by Chi-square tests. As errors are expected in manual calculations, statistical software called "MINITAB 15" was used to compute the Chi-square values. Whereas values in some of the tables were analyzed through percentages.

Results and Discussion

This research was conducted by using a questionnaire and taking blood samples from the subjects work/live in different departments, hostels and banks in the University of Peshawar and houses situated in Peshawar city from October 2007 to February, 2008 to find out various health hazards due to cell phone radiations among 370 cell phone users. After assessing the population, data was calculated and analyzed statistically using percentages and Chi-square tests.

Fig. I. shows 29.46% out of 370 subjects experienced an increase in their level of anger while 70.54% of the subjects had normal episodes of anger as they used to experience it before their exposure to cell phone radiations. While 38.92% of the people observed irritation in their behavior after being exposed to cell phone radiations. They mostly felt irritation during or immediately after talking on cell phone.

Fig. 1. Impact of microwave radiations on anger level, irritation & warming of ears.
To unearth the relation of warming of ears with radiations of cell phone, subjects were pored over during in person interviews and it was established statistically that the major symptom of being exposed to cellular radiations was warming of the ears, found in 57.03%. The after effect of warming of ear has yet to be brought in light in future research. Similar symptoms of warming of ear after prolonged exposure to cellular radiations were reported by Santini, et al., (2001).

Table I shows that the total number of males in the sample size was 89 and 40.45% of which, the most frequent symptom felt was depression which had no evident reason. About 32.58% of the people were recorded under the symptom of their changed irritating behavior during talking on cell phone. The least symptom recorded were frequent episodes of migraine up to 11.24%.

While warming of ear (62.99%) was the most prevalent symptom amongst females after using cell phone, Santini, et al., (2001) also concluded similar result in his study and stated that his experimental subjects complained more often of ear warmth, discomfort and picking of the ear during phone conversation. The least felt symptoms due to microwave radiations were episodes of migraine (8.19%). The ratio of females experiencing irritating behavior during receiving the call was 40.93% which was higher than the value tabulated for males.

<table>
<thead>
<tr>
<th>Diseases</th>
<th>No of ♂’s affected &amp; their %age</th>
<th>No of ♀’s affected &amp; their %age</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stress/Depression</td>
<td>36/89 40.45%</td>
<td>100/281 35.59%</td>
</tr>
<tr>
<td>Palpitation</td>
<td>35/89 39.32%</td>
<td>74/281 26.33%</td>
</tr>
<tr>
<td>Warming of ears</td>
<td>34/89 38.20%</td>
<td>177/281 62.99%</td>
</tr>
<tr>
<td>Tinnitus</td>
<td>32/89 36%</td>
<td>83/281 29.54%</td>
</tr>
<tr>
<td>Fatigue</td>
<td>31/89 34.83%</td>
<td>68/281 24.20%</td>
</tr>
<tr>
<td>Sleep Disturbance</td>
<td>31/89 34.83%</td>
<td>88/281 31.32%</td>
</tr>
<tr>
<td>Irritation</td>
<td>29/89 32.58%</td>
<td>115/281 40.93%</td>
</tr>
<tr>
<td>Headache</td>
<td>25/89 28.1%</td>
<td>95/281 33.81%</td>
</tr>
<tr>
<td>Anger</td>
<td>22/89 24.72%</td>
<td>87/281 30.96%</td>
</tr>
<tr>
<td>Myalgia</td>
<td>21/89 23.60%</td>
<td>281/99 35.32%</td>
</tr>
<tr>
<td>Vertigo</td>
<td>15/89 16.85%</td>
<td>50/281 17.79%</td>
</tr>
<tr>
<td>Migraine</td>
<td>10/89 11.24%</td>
<td>23/281 8.19%</td>
</tr>
</tbody>
</table>

After much consideration, the data in Table 2 was divided into 3 categories viz. students, teachers, businessmen and others. The category others included servicemen, computer operators, doctors, engineers, bankers, housewives and librarians.

As can be seen from the Table 2, the highest symptom felt in students category was warmth (59.68%) and the least felt symptom was migraine (8.89%). Similarly, the symptom at its peak in the teacher’s
category was sleep disturbance which was 68.18% and the least disease felt by them were the episodes of migraine (18.18%). Warming of ears which was 66.67% was the symptom at its highest occurrence in businessmen, contrary to that migraine and vertigo (8.33%) was at its lowest rate amongst them.

Change in behavior or irritation (61.90%) was the symptom which occurred at its utmost incidence in others category. About 9.52% people had episodes of vertigo which occurred very rarely in others category.

Overall analyzing Table 2, the percentages & occurrences of each & every chronic disease in each & every category can be known. Startlingly migraine be falls in the least felt symptom in the first three categories viz. students, teachers & businessmen, while no case of migraine was recorded in others category & it’s clear that businessmen are overall more prone to diseases because they use cell phones most extensively.

To investigate the relation of call duration with chronic diseases symptoms, chi-square test was applied to the data acquired from male and female subjects. After much probing and examining the values of Chi-square, it came to be known that the values of all chronic diseases symptoms exceeded from the Chi-square value (5.991) so, it means that the diseases viz. vertigo, stress/depression, headache and migraine depends on the duration of call or in other words if the duration of call increases, the chances to have the disease will proportionately increase.

The symptoms like fatigue & myalgia may not be due to radiations but these symptoms, however, are due to prolonged holding of cell phones & are thus mechanical. But still the microwave radiations can harm the body, if they are kept close to the body, for example in the case of men who usually keep their cell phones in their pant’s or front pocket of the shirt.

The symptoms like palpitations, tinnitus, sleep disturbance, warmth anger and irritation are also due to long calls. However, the exact causal effect of radiations on all these symptoms will be worked out in future studies.

Table 2. Relation of diseases with occupation of investigated subjects

<table>
<thead>
<tr>
<th>Occupation</th>
<th>Overall</th>
<th>Vertigo</th>
<th>Fatigue</th>
<th>Myalgia</th>
<th>Palpitation</th>
<th>Tinnitus</th>
<th>Stress</th>
<th>Sleep Disturbance</th>
<th>Headache</th>
<th>Migraine</th>
<th>Warmth</th>
<th>Anger</th>
<th>Irritation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students</td>
<td>315</td>
<td>54 (17.14%)</td>
<td>81 (25.71%)</td>
<td>102 (32.39%)</td>
<td>95 (30.16%)</td>
<td>103 (32.70%)</td>
<td>121 (38.41%)</td>
<td>107 (33.97%)</td>
<td>100 (31.75%)</td>
<td>28 (8.89%)</td>
<td>188 (59.68%)</td>
<td>89 (28.25%)</td>
<td>124 (39.37%)</td>
</tr>
<tr>
<td>Teacher</td>
<td>22</td>
<td>7 (31.82%)</td>
<td>7 (31.82%)</td>
<td>5 (22.73%)</td>
<td>5 (22.73%)</td>
<td>6 (27.27%)</td>
<td>8 (36.36%)</td>
<td>15 (68.18%)</td>
<td>7 (31.82%)</td>
<td>4 (18.18%)</td>
<td>7 (31.82%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Businessman</td>
<td>12</td>
<td>1 (8.33%)</td>
<td>2 (16.67%)</td>
<td>5 (41.67%)</td>
<td>4 (33.33%)</td>
<td>6 (50%)</td>
<td>5 (41.67%)</td>
<td>3 (25%)</td>
<td>6 (50%)</td>
<td>1 (8.33%)</td>
<td>8 (66.67%)</td>
<td>3 (25%)</td>
<td>7 (58.33%)</td>
</tr>
<tr>
<td>Other</td>
<td>21</td>
<td>2 (9.52%)</td>
<td>7 (33.33%)</td>
<td>4 (19.05%)</td>
<td>5 (23.81%)</td>
<td>4 (19.05%)</td>
<td>8 (38.10%)</td>
<td>3 (14.29%)</td>
<td>6 (28.57%)</td>
<td>0 (0%)</td>
<td>11 (52.38%)</td>
<td>8 (38.10%)</td>
<td>13 (61.90%)</td>
</tr>
</tbody>
</table>
During in person interviews, the subjects were asked about their cell brand & model number to analyze the information given about the Specific Energy React (SAR) value of the cell phone, in turn knowing how much radiations the subjects were absorbing into their heads while using the cell phone.

After matching the cell phone brands & model no’s, it came to be known that 42.36% users of 1st brand cell phone used high SAR value models. The users of 2nd brand falling into the category of high SAR value model were 29.79%.

About 28.89% users of 3rd brand be falled in the category of high SAR value. Analyzing the data of 4th brand, it came to be known that 79.41% of the users were utilizing cell model having SAR value greater than 1.6W/kg.

The users of cell phone in others category included 73.33% which were having model number greater than 1.6W/kg.
Other symptoms felt in the inspected subjects

During the whole survey, some subjects also reported to have experienced symptoms other than the diseases mentioned in the questions. The symptoms felt were pain in ear while prolonged talk, loss in hearing capacity, low & high blood pressure symptoms, episodes of pain in neck & shoulder, pain in eyes due to typing of SMS & feelings of irritation, watering & soreness of eyes while looking at the display screen for a prolonged time (the later may be due to brightness of the screen but radiations are not involved in it because screen doesn’t emit radiations). Besides these some other symptoms were also recorded.

Analysis of the data shows that 11.351% of the subjects experienced pain in the ear while talking on cellular phone, 6.76% felt pain, irritation, distortion, watering & soreness of the eyes while gazing at the screen for extended period of time or while typing SMS. Symptoms of pain in neck & shoulder met up to 4.59% & 2.97%, respectively.

While conducting the research, some people reported a loss in their hearing capacity to some extent, although which were only 0.81% but interestingly they were all males. The conclusion of Al-Dousary. (2001) also favor our results. Al-Dousary, while investigating on a businessman came up with the result that microwave radiations are high risk factor & may cause loss of hearing when the ear is exposed for too long to cellular phone radiations.

Similarly, 0.54% & 0.27% people reported symptoms of high blood pressure & low blood pressure, respectively. The results of the present study regarding lowering of hearing capacity & high & low blood pressure were identical both in almost equal percentages & being exposed in males only, which was an astonishing harmony. However, it was concluded that these symptoms are very rare & occur approximately 1 in 100’s.

Besides these some other symptoms were also documented in persons using cellular phones viz. nausea, weakness, sleepiness, heavy feelings in head & ear, a lot of disturbance, numbness in ear & hand, laziness, loss of appetite, an increase or rapid decrease in breath, dryness of mouth, stretching of head muscles & restlessness but these symptoms were very rare which were overall calculated to be 4.59%.

Examination of blood smears

While conducting the research, blood smears of 100 most extensive users were taken to find out any effect of radiations on blood cells morphology, because skin & blood cells are more prone to radiations at first hand since cell phone is held close to human body (the ear). Figs. 2 & 3 show that no effect of radiations on blood cells morphology has been taken place up till now & the users of cell phone have normal blood cells just like other controlled population.

Fig. 2. Blood smear at 40x X 10 magnification shows normal red and white blood cells.
Conclusion

The study concluded that cell phone radiations in association with time of call may cause symptoms like vertigo, fatigue, myalgia, palpitations, tinnitus, stress/depression, sleep disturbance, headache, and migraine, warming of ears, rise in anger & an irritating behavior. Conversely, the overall high value obtained through percentages was of warming the ear, it means that microwave radiations may cause heating of the body tissues when exposed for long.

Most of the disease symptoms were in high ratio amongst businessmen since they used cell phone excessively. Some subjects also reported to have experienced other symptoms like loss in hearing capacity, high & low blood pressure, stretching of head muscles if exposed to cell phone radiations for long. None of any subjects had abnormal blood cells morphology.

Universal scientific consensus is that cell phones have not yet been shown to pose a risk to human health, but further research is needed. Some developed countries have imposed safety guidelines on manufacturers, based on the amount of radiations absorbed by the brain in normal cell phone use, but a level of uncertainty about the risk remains. However, the long-term effects of cell phone use can not be known for a number of years. In the short-term, no serious harmful effect has been known up till now. However, further detailed research has to be done in this subject in order to unravel other hazards regarding the excessive use of mobile phones, the exact causal mechanism causing temporary or permanent or both & hearing loss in the susceptible mobile phone users & other symptoms discussed in whole research. For the time being, their excessive use should be discouraged by educating the general public.

Recommendations

Although not clear long term harmful effects have been known up till now but it is hypothesized that cellular phone radiations may cause harm when used for long time. Here the authors would like to make some recommendations which would be of some assistance.

1. Cell phones should be kept away from the body while not in use because as the distance of cell phone from the body is increased, the frequency of radiations reaching to human body also decreases, which will in turn render less radiations from being absorbed by the body.

2. Use of ear phones (which does not transmit microwave radiations to the ear but converts them into mechanical waves) of hands free mode must be implicated in order to minimize exposure.

3. Use land line phones for longer conversations.
4. Choose the cell phone with lowest SAR rating.

**Future Research**

Future research & action is required around health hazards due to cell phone radiations. Future projects could include complete body examination & follow up for some years. Technical training & proper equipments should be provided to those who are willing to under take this project in Pakistan, still backward in technology. In current study, scientific equipment was limited & therefore did not show any substantial influence on blood cell morphology. The clear picture of these & further more relationships could be seen if the future studies are performed on larger scale with better equipments & including comparatively a larger sample size.

**References**


