

MOBILE PHONE RELATED-HAZARDS AND SUBJECTIVE HEARING AND VISION SYMPTOMS IN THE SAUDI POPULATION

SULTAN A. MEO¹ and ABDUL M. AL-DREES²

Department of Physiology
College of Medicine
King Khalid University Hospital
King Saud University
Riyadh, K.S.A.

Abstract

Objectives: Over the past decade utilization of mobile phones has dramatically increased. They are now an essential part of business, commerce, and communication, however, their use may lead to health problems. Therefore, the present study was designed to investigate a link between the use of mobile phones and hearing and vision symptoms in the Saudi population and also to contribute to the increase in social awareness of health problems associated with the use of these devices. **Materials and Methods:** A total of 873 (57.04% of males and 39.86% of females) subjects using mobile phones were invited to participate in the presented study. A structured questionnaire was distributed among them to collect a detailed medical history. The Chi-square test was employed to observe the relationship between duration of calls and hearing and vision complaints. **Results:** The present study showed an association between the use of mobile phones and hearing and vision complaints. About 34.59% of problems were related with impaired hearing, ear ache and/or warmth on the ear, and 5.04% of complaints with the decreased and/or blurred vision. **Conclusions:** It is concluded that the use of mobile phone is a health risk factor, and thus it is suggested that excessive use of mobile phones should be avoided and social awareness increased through health promotion activities, such as group discussions or public presentations and via electronic and printed media sources.

Key words:

Mobile phone, Decreased hearing, Ear ache, Warmth on the ear, Vision problems

INTRODUCTION

The use of mobile phones has dramatically increased all over the world during the 1990s [1]. Mobile phones have become a more and more widespread means of communication. They have become a part of everyday life with a growing number of people enjoying the service and extra freedom they provide. The advent of third generation systems will extend the use of most novel forms of communication technologies, including fax, e-mail and the In-

ternet access. Mobile phones are low power radio devices that transmit and receive radio frequency radiation at frequencies in the microwave range of 900–1800 MHz. Despite repeated horror stories about mobile phones in the media, nearly 500 million people worldwide use them [2]. The extensive use of mobile phones has been accompanied by public debates on their possible adverse effects on the human health. The main concerns are about emissions of radio frequency (RF) radiation from mobile phones and base stations that receive and transmit signals. There are

Received: October 20, 2004. Accepted: December 25, 2004.

Address reprint requests to Prof. S.A. Meo, Department of Physiology, College of Medicine, King Saud University, P.O. Box 2925, Riyadh 11461, K.S.A. (e-mail: sultanmeo@hotmail.com or smeo@edu.ksu.sa).

two direct ways by which health could be affected as a result of exposure to RF radiation: thermal (heating) effects caused mainly by holding mobile phones close to the body, and possibly non-thermal [3]. Among mobile phone users, the following health problems may be noted: headache, sleep disturbance, lack of concentration, impairment of short-term memory, dizziness, getting a worm ear, burning skin, brain tumors and high blood pressure [4]. In addition, mobile phones can cause discomfort, fatigue, general ill-being, nausea and muscular pain [5]. Although their effects on different organs of the body have been observed in a number of countries, no reports putting special emphasis on hearing and vision problems in the population of Saudi Arabia have been published yet, however, mobile phones are excessively used in this country. Therefore, the aim of this study was to investigate the association between the use of mobile phones and hearing and vision complaints in this population.

MATERIALS AND METHODS

Study design. The present study was conducted in the Department of Physiology, College of Medicine, King Khalid University Hospital, King Saud University, Riyadh, Kingdom of Saudi Arabia.

Subjects. The sample consisted of 873 volunteer subjects recruited from the College of Medicine, King Saud University and also from different areas of Riyadh. The study group comprised 57.04% of males and 39.86% of females, aged 18–46 years. The mean age was 25.56 ± 0.6 years (mean \pm SEM) for males and 26.32 ± 0.82 (mean \pm SEM) for females.

Methods. A structured questionnaire was developed particularly for the purpose of this study in the Arabic language and also translated into English. The questionnaire was designed so that it could be used in a structured interview context or self-completed. It provided information about general physical characteristics and occupation of the participants, medical history and different data on the type of mobile phones, the number and average duration of incoming and outgoing calls per day, and the period for how long (years) the respondents have used mobile phone.

Exclusion criteria. Subjects with known history of anemia, diabetes mellitus, arterial hypertension, central or peripheral nerve diseases, congenital hearing and vision disorders, and those using any medication or computer professionals were excluded from the study.

Statistical analysis. The analysis was primarily descriptive in nature and was performed using SPSS version 10.0 program for Windows. Comparison of clinical findings was based on the mean percentage; the Chi-square test was employed to observe the relationship between duration of calls and hearing and vision complaints. In the present study, the numbers of male and female participants were not equal therefore, the comparison of results between gender groups was not performed.

RESULTS

Table 1 presents the distribution of male and female respondents as a percentage of their total numbers. In the study group men outnumbered women: 498 (57.04%) vs. 348 (39.86%), and the age range was 18–46 years. The mean age was 25.56 ± 0.6 years (mean \pm SEM) for males and 26.32 ± 0.82 (mean \pm SEM) for females.

Table 2 demonstrates the duration of incoming and/or outgoing calls among respondents as a percentage of their total number. The association between duration of calls and frequency was: less than 5 min (17.86%); 5–10 min

Table 1. Distribution of male and female respondents as a percentage of their total number

Parameters	Number of respondents (%)
Male	498 (57.04)
Female	348 (39.86)
Sub total	846 (96.91)
Missing system	27 (3.09)
Total	873 (100)

Missing system – non-respondents.

Table 2. Distribution of duration of calls (min/day) among respondents as a percentage of their total number

Duration of calls (min)	Number of respondents (%)
Less than 5	156 (17.86)
5–10	388 (44.44)
11–20	115 (13.17)
21–30	87 (9.96)
More than 30	100 (11.45)
Sub total	846 (96.90)
Missing system	27 (3.09)
Total	873 (100)

Missing system – non-respondents.

(44.44 %); 11–20 minutes (13.17%); 21–30 min (9.96%), and more than 30 min (11.45%).

Table 3 summarizes the health problems associated with duration of incoming and/or outgoing calls as a percentage of the total number of respondents. The percentages of complaints of impaired hearing, ear ache and/or warmth on the ear were: 32.05% with duration of calls less than 5 minutes per day; 33.24% with 5–10 min; 40.0% with 11–20 min; 40.22% with 21–30 min; and 42.00% with more than 30 min per day. Similarly the percentage of complaints of decreased vision and/or blurred vision were: 2.56% with

Table 3. Distribution of hearing and vision problems associated with duration of calls (min/day) for respondents as a percentage of their total number

Duration of calls (min)	Hearing complaints	Vision complaints
Less than 5	50 (32.05%)	4 (2.56%)
5–10	129 (33.24%)	24 (6.18%)
11–20	46 (40.00%)	8 (6.95%)
21–30	35 (40.22%)	3 (3.44%)
More than 30	42 (42.00%)	5 (5.00%)
Total	302 (34.59 %)	44 (5.04%)

Hearing complaints: $X^2 = 5.355$, $df = 4$, $p = 0.253$; Vision complaints: $X^2 = 4.232$, $df = 4$, $p = 0.373$.

duration of calls less than 5 min per day; 6.18% with 5–10 min; 6.95% with 11–20 min; 3.44% with 21–30 min; and 5.0% with more than 30 min per day. The overall percentage of hearing complaints was 34.59% and vision complaints 5.04%. However, the differences between the duration of calls and hearing and vision complaints were not statistically significant; $p < 0.23$ for hearing complaints and $p < 0.37$ for visual complaints were observed.

DISCUSSION AND CONCLUSIONS

The operation of sensitive electronic devices such as mobile phones is prohibited in many places, including aircrafts and hospitals because it is thought that their emissions might adversely interfere with the operation of sensitive electronic equipment and exert possible deleterious effects. The well-liked belief is that adverse health effects can be induced by the heating effect of the Global system of mobile communication (GSM) radiation. Mobile phones are low power radio devices that transmit and receive radio frequency radiation at frequencies in the microwave range of 900–1800 MHz through an antenna used close to the user's head. The reported adverse health effects and the extensive portfolio of non-thermal effects, published in the scientific literature over the last few years, indicates that the kind of radiation now used in GSM phone can and does affect alive organisms in various non-thermal ways [3].

The results of the present study showed that the longer summative time of exposure to electromagnetic fields emitted by a mobile phone may be associated with more intensified subjective neurological symptoms, although an increase is observable, it is not statistically significant.

Eulitz et al. [6] suggested that a mobile phone emits a pulsed high-frequency electromagnetic field (PEMF), which may penetrate the scalp and the skull and showed that these electromagnetic fields alter distinct aspects of the brain's electrical response to acoustic stimuli. Reiser et al. [7] demonstrated that the extensive exposure to microwave radiation has been found to affect a wide variety of brain functions, such as electrical activity (EEG), electrochemistry [8–9], permeability of the blood/brain

barrier [10], and degraded immune system [11]. Khudnitskii et al. [12] studied the influence of ultra high frequency radiation caused by cellular phones on the functional state of the central nervous system and reported that the head area near the phone antenna appeared to be under the most intensive heating. Kellenyi et al. [13] found that exposure to GSM phone radiation caused an increase in auditory brainstem response in the exposed side of human subjects and also showed a hearing deficiency in high frequency range. These findings are supported by the results of the present study. Oftedal et al. [14] observed sensation of warmth on the ear, behind or around the ear and burning sensations in the facial skin in connection with the use of a mobile phone. Our findings are in conformity with these results. Ozturan et al. [15] demonstrated that the ear is in close proximity to the mobile telephone during its use and none of the subjects reported deterioration in the hearing level. Our results are in contradiction with this observation. A probable reason for this difference is that the authors exposed 30 subjects for the period of only 10 min and the size of the sample was also rather small. Hocking [16] described unpleasant sensations, such as a burning feeling or a dull ache mainly occurring in the auricular areas. These symptoms often developed few minutes after beginning a call but could also occur later during the day. Santini et al. [17] showed that female users of cellular phones significantly more often complained of warmth and picking on the ear during phone conversation, depending on the duration and number of calls per day. Our findings are in accordance with these results. Similarly, Sandstrom et al. [18] reported symptoms such as feelings of discomfort and warmth behind and/or around the ear while using mobile phones.

In addition, Wilen et al. [19] studied the subjective symptoms among mobile phone users and showed an association between calling time/number of calls per day and the prevalence of subjective symptoms, including warmth behind/around the ear. They also reported that the specific absorption rate of radio frequency field might be an important factor for the prevalence of these symptoms. Our results also confirm the observations of these authors.

Nakamura [20] demonstrated that exposure to high-density microwaves can cause detrimental effects on the eyes or other tissues and induce significant biologic changes through thermal actions.

Moreover, it was also reported that two Swedish subjects who had extensively used mobile phone for many years, went blind in one eye, on the side of the head they had used their phone. In one case, symptoms began with intense pain in one eye, which was eventually diagnosed as cornea ulceration. When his vision suddenly became blurred a blood clot was discovered and the eye could not be saved. There are two other people in the same town who attribute the loss of sight in one eye on the same side of the head they use their mobile phone [21]. In addition, we observed a significant positive correlation between duration of exposure to mobile phone and frequency of hearing complaints. But we failed to find out such correlation between the duration of exposure to mobile phones and vision complaints.

The present study demonstrated a relationship between hearing and vision complaints in subjects exposed to mobile phone emissions. Bearing in mind the findings of the present study and those reported in the literature, our results are of importance in that they demonstrate the need of taking preventive measures. Therefore, it is advisable to admit that the use of mobile phone is a health risk factor and suggest that excessive use of mobile phones should be avoided by increasing social awareness through health promotion activities, such as group discussions, public presentations and using electronic and printed media sources. In addition, further studies with a much larger sample along with a detailed clinical examination are needed to study the long-term affects of mobile phone use and related hearing and vision disorders.

ACKNOWLEDGEMENTS

Our thanks are due to Dr. Nazir Ahmed Khan, Assistant Professor of biomedical statistics, College of Dentistry, King Saud University, for his assistance in statistical analysis.

REFERENCES

1. Hardell L, Nasman A, Pahlson A, Hallquist A, Hansson-Mild K. *Use of cellular telephones and the risk for brain tumors: A case-control study.* Int J Oncol 1999; 5(1):113–6.
2. Editorial. *The health hazards of mobile phones.* Br Med J 2000; 320:1288–9.
3. Hyland GJ. *Physics and biology of mobile telephony.* Lancet 2000 Nov 25;356(9244):1833–6.
4. Michael M, Colin B, Mika K. *The health hazards of mobile phones.* Br Med J 2000; 20:1288–9.
5. Bortkiewicz A. *A study on the biological effects of exposure to mobile phone frequency EMF.* Med Pr 2001;52(2):101–6.
6. Eulitz C, Ullsperger P, Freude G, Elbert T. *Mobile phones modulate response patterns of human brain activity.* Neuroreport 1998;9(14):3229–32.
7. Reiser H, Dimpfel W, Schober F. *The influence of electromagnetic fields on human brain activity.* Eur J Med Res 1995;1(1):27–32.
8. Dutta SK, Subramoniam A, Ghosh B, Parshad R. *Microwave radiation-induced calcium ion efflux from human neuroblastoma cells in culture.* Bioelectromagnetics 1984;5(1):71–8.
9. Frey AH. *Electromagnetic field interactions with biological systems.* FASEB J 1993;7(2):272–81.
10. Salford LG, Brun A, Stureson K, Eberhardt JL, Persson BR. *Permeability of the blood-brain barrier induced by 915 MHz electromagnetic radiation, continuous wave and modulated at 8, 16, 50, and 200 Hz.* Microsc Res Tech 1994;27(6):535–42.
11. Frhlich H. *Advances in electronics and electron.* Physics 1980;53:85–152.
12. Khudnitskii SS, Moshkarev EA, Fomenko TV. *On the evaluation of the influence of cellular phones on their users.* Med Tr Prom Ekol 1999;9:20–4.
13. Kellenyi L, Thuroczy G, Faludy B, Lenard L. *Effects of mobile GSM radiotelephone exposure on the auditory brainstem response (ABR).* Neurobiology 1999;7:79–81.
14. Oftedal G, Wilen J, Sandstrom M, Mild KH. *Symptoms experienced in connection with mobile phone use.* Occup Med 2000;50(4): 237–45.
15. Ozturan O, Erdem T, Miman MC, Kalcioğlu MT, Oncel S. *Effects of the electromagnetic field of mobile telephones on hearing.* Acta Otolaryngol 2002;122(3):289–93.
16. Hocking B. *Preliminary report: symptoms associated with mobile phone use.* Occup Med 1998;48:357–60.
17. Santini R, Seigne M, Bonhomme-Faivre L, Bouffet S, Defrasne E, Sage M. *Symptoms reported by mobile cellular telephone users.* Pathol Biol 2001;49(3):222–6.
18. Sandstrom M, Wilen J, Oftedal G, Hansson Mild K. *Mobile phone use and subjective symptoms. Comparison of symptoms experienced by users of analogue and digital mobile phones.* Occup Med 2001;51(1):25–35.
19. Wilen J, Sandstrom M, Hansson Mild K. *Subjective symptoms among mobile phone users – a consequence of absorption of radio frequency field.* Bioelectromagnetics 2003;24(3):152–9.
20. Nakamura H, Matsuzaki I, Hatta K, Nobukuni Y, Kambayashi Y, Ogino K. *Non-thermal effects of mobile-phone frequency microwaves on utero-placental functions in pregnant rats.* Reprod Toxicol 2003;17(3):321–6.
21. *Mobile phone blindness – 2 cases thought to be caused by mobile phones.* The Environmental-Health Trust, Scotland [cited 2003 Dec 14]. Available from: [http:// www.ehn.clara.net/mobilephones.html](http://www.ehn.clara.net/mobilephones.html).