

## The Impact of Medical Education on Saudi Medical Students' Awareness of Cell Phone Use and its Health Hazards

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**Abstract:** The data surrounding the effect of cell phones' electromagnetic radiation on human health, particularly on the auditory and vestibular systems, are controversial. This issue is of particular relevance since it may affect billions of people worldwide. The study aimed to highlight the impact of medical education on the awareness of cell phone use and its health hazards in students at King Abdulaziz University's Faculty of Medicine in Jeddah, Saudi Arabia. In this study, a mixed research design was adopted as a complementary approach. Closed ended questionnaires were distributed to 400 medical students to determine their knowledge and practices regarding the use of cell phones and their possible health risks. The questionnaires were followed by discussions with four focus groups to further analyze the studied area. Both the questionnaires and focus groups covered many points, including the most common health hazards associated with the use of cell phones. The results showed that most of the students were aware of the potential risks arising from the use of cell phones, and at least half of them reported experiencing some of the negative effects.

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### 1. Introduction

While the use of cell phones has become widespread, many users are unaware of the potential health risks associated with cell phone use. Concerns regarding the potential physiological effects of exposure to radio frequency (RF) radiation have been increased recently. These waves may have a negative impact on the tissues that are near the handset, such as the auditory nerve. These risks include tumors, acoustic neuromas, and other potential concerns [Lönn, 2004]. Audiologic disturbances may be increased with increases in cell phone usage. Other factors may be related to the duration of exposure to radiation or the condition of a person's central nervous system and immune system [Galeev, 2000]. Some medical studies have shown that the use of cell phones might result in health problems, including warmth behind or around the tissues of the ear, brain tumors, headaches, sleep disturbances, impairment of short-term memory, lack of concentration, and high blood pressure [Knave, 2001].

This research aims to improve the understanding of medical students regarding cell phone use risks, and to gain better knowledge on medical education and a better understanding of the possible health hazards related to cell phone use. We chose King Abdulaziz University because it has two medical education curriculums: traditional and a new hybrid.

### 2. Subjects and Methods:

#### Type of study:

This is a mixed methodology study, using both quantitative (cross-sectional descriptive study) and qualitative (focus group discussion) methods. The aim of this design is to triangulate and complement the evidence from both the qualitative and quantitative data. Four focus group discussions (two being with sixth-year students and two with interns) were conducted at the hospital auditorium during break time. Each focus group discussion lasted about thirty minutes. For each group discussion, the research team met with 10 to 12 students.

#### Target group:

Interns from the old curriculum and sixth-year medical students from the new hybrid curriculum.

#### Time period of the study:

From October 2011 to January 2012, during the free time of the interns and sixth-year students.

#### Pilot study:

A pilot study was done with 42 students, including sixth-year students (n=22) and interns (n=20), to enhance the validity of the questionnaire. Modification of the questionnaire was done to avoid the pitfalls of the study and to increase the internal validity of the research. Members from the Faculty of Engineering revised the questionnaire to ensure both the content and discriminant validity.

#### Tool of the study:

The questionnaire was designed to measure the knowledge, attitudes, and practices of medical students regarding the negative effects of using cell phones. The

questionnaire was divided into four variable parts: personal data, knowledge, attitudes, and practices. Each question had a unique code to ease entering and processing the data.

In the quantitative study, the tool was in English. Arabic translation of the questionnaire was carried out for data collection purposes. Those questionnaires were distributed to all medical students in their sixth year ( $n = 325$ ) and to all medical interns ( $n = 310$ ). The return rates of the questionnaires were 61% (198/325) and 63% (195/310) from sixth-year students and interns, respectively. The Cronbach's alpha of the questionnaire was 0.78 for the sixth-year students, 0.85 for the interns, and 0.82 for the whole sample. Open-ended questions were used in the focus groups discussions to help the students express their knowledge and practices regarding cell phone use.

#### Monitoring for the quality of data:

There were four groups responsible for quality control. Group 1 was responsible for checking if the data was complete or not; they reviewed the questions to ensure that nothing was missing. Group 2 was responsible for coding; they made sure that every code was relevant to the right question. Group 3 was responsible for data entry; they entered the data into the computers to be processed. Group 4 took random samples and reviewed them completely to ensure that there were no pitfalls.

#### Statistical analysis:

Statistical Package for the Social Sciences (SPSS), version 18, was used for statistical analysis. The

qualitative data was presented in the form of numbers and percentages. A chi-square test was used as a test of significance for qualitative data, and Yates correction was used when the expected cell was less than 5. The quantitative data was expressed as mean and standard deviation. Significance was considered at a  $P$ -value less than 0.05.

### 3. Results:

**Table 1:** This study included 393 participants: 50.4% were sixth year medical students and 49.6% were interns. Regarding nationality, in the first group, 91.9% were Saudis and 8.1% were non-Saudis. The second group consisted of 93.3% Saudis and 6.7% non-Saudis. The age of the participants was ranging from 22 to 26 years with a mean  $\pm$  SD of  $23.25 \pm .85$  in the first group and  $24.02 \pm .83$  in the second group. Participants were equally chosen between females and males. Regarding marital status, in the first group, 93.9% of these participants were single and 6.1% were married. However, in the second group, 67.2% of these participants were single and 32.8% were married. Most of the participants in the first group (86.9%) were born in the western region and in the second group, 86.2% were from the same region. Almost half of the participants in the first group (54.5%) make <1000 S.R monthly, 33.3% have a monthly income ranging from 1000–3000 S.R, and 12.1% make > 3000 S.R monthly. Regarding the second group, 93.8% make > 3000 S.R monthly and 6.2% have a monthly income ranging from 1000–3000S.R.

**Table (1) Demographic Characters of the Participants on the Research**

	6 <sup>th</sup> years		Intern		P-Value
<b>Nationality</b>	<b>93.3%</b>	182	91.9%	182	$P = 0.366$
Saudi					
Non Saudi	6.7%	13	8.1%	16	
<b>Gender</b>	<b>52.3%</b>	102	50.5%	100	$P = 0.399$
Male					
Female	47.7%	93	49.5%	98	
<b>Status</b>	<b>67.2%</b>	131	<b>93.9%</b>	186	$P = 0.000$
Single					
Married	32.8%	64	6.1%	12	
<b>Age</b>	23.25 (0.85)		24.02 (0.83)		$P < 0.001$
<b>Place of Birth</b>	<b>86.2%</b>	168	<b>86.9%</b>	172	$P < 0.001$
Western Re.					
Central Re.	1.5%	3	4%	8	
Eastern Re.	8.2%	16	4%	8	
Northern Re.	0%	0	1%	2	
Southern Re.	4.1%	8	3%	6	
Outside Country	0%	0	1%	2	
<b>Income</b>	<b>108</b>	<b>54.5%</b>	<b>0</b>	<b>0%</b>	$P < 0.001$
< 1000					
1-3000	66	33.3%	12	6.2%	
>3000	24	12.1%	183	93.8%	

**Table 2:** 87.9% of the participants in the first group and 88.2% in the second group have heard about the side effects of cell phones. More than half mentioned hotness, pain, headache, and tinnitus as side effects, with hotness being the most chosen (79.8% for first group and 90.3% for second group). Wax, brain tumors, and disturbances in brain functions were chosen by less than 50% of the participants as cell phone side effects, with significant differences as to whether wax is/should be regarded a side effect. Regarding the source of knowledge about these side effects, community discussions (71.7% for the first group and 73.3% for the second group), Internet, TV, and magazines were the most chosen sources, though

there was no significance regarding the source of knowledge. When asked about the best way to minimize these side effects, 39.4% from the first group and 47.2% from the second group chose turning the phone on speaker mode; 34.3% from the first group and 27.7% from the second group chose headphones; 5.6% from the first group and 8.2% from the second group chose using the phone directly; and 3.5% from the first group and 2.1% from the second group chose using a Bluetooth earpiece, while 17.2% from the first group and 14.9% from the second group answered "I don't know." Only 1.5% total reported that the side effects of cell phone use are included in their curriculum.

**Table (2) Knowledge of the participants towards the Health Hazards of Mobile Phone Magnetism**

	6th years n=198		Intern n=195		Total	%	P - Value
<b>Did you hear about Mobile Side effects "SE"</b>	174	87.9%	172	<b>88.2%</b>	346	88%	$P = 0.522$
<b>Source of Knowledge</b>							
Magazine	103	52 %	87	44.6%	190	48.3%	$P = 0.086$
Radio	72	36.4%	72	36.9%	144	36.8%	$P = 0.496$
TV	81	40.9%	73	37.4%	154	39.2%	$P = 0.274$
Community	142	71.7%	143	<b>73.3%</b>	285	72.5%	$P = 0.403$
Internet	139	<b>70.2 %</b>	120	61.5%	259	65.9%	$P = 0.044$
Advertisements	29	14.6%	34	17.4%	63	16%	$P = 0.269$
<b>The Side Effect "SE"</b>							
Hotness around the ears	158	79.8%	176	<b>90.3%</b>	334	85%	$P = 0.003$
Pain	141	71.2%	154	<b>79%</b>	295	75%	$P = 0.048$
Headache	109	55.1%	110	56.4%	219	55.7%	$P = 0.433$
Tinnitus	107	54%	104	53.3%	211	53.7%	$P = 0.484$
Disturbance in brain function	83	41.9%	82	42.1%	165	42%	$P = 0.530$
Brain Tumor	58	29.3%	69	35.4%	127	32.3%	$P = 0.118$
Wax	62	<b>31.3 %</b>	40	20.5%	102	26%	$P = 0.010$
<b>SE of mobile use &amp; Curriculum are include</b>	6	<b>3%</b>	0	0%	6	1.5%	$P = 0.016$
<b>Best way to minimize SE</b>							
Through Phone	11	5.6%	16	8.2%	27	6.9%	$P < 0.001$
Head Phone	68	34.3%	54	27.7%	122	31%	
Bluetooth	7	3.5%	4	2.1%	11	2.8%	
Speaker	78	39.4%	92	47.2%	170	43.3%	
I don't Know	34	17.2%	29	14.9%	63	16%	

**Table 3:** About 66.2% in the first group and 65.1% in the second group reported using their cell phones from 30 minutes to one hour daily. 70.7% in the first group reported having less than 10 calls per day and 65.1% in the second group reported having 10 to 20 calls per day, with the average call being from 15 to 30 minutes in about half of the participants (54% from the first group and 49.2% from the second group).

More than half of our participants (66.2% from the first group and 50.3% from the second group) have been using cell phones for 5–10 years. The commonest reason for using cell phones among the participants was communication (54% from first group and 51.3% from second group). Other reasons included study purposes, multipurpose, and work purposes, in descending order. More than two thirds of the

participants (89.9% from the first group and 89.7% from the second group) take their calls through the phone directly; 12.6% from the first group and 22.1% from the second group take calls through headphones; 16.2% from the first group and 13.3% from the second group take calls through the speaker; and 12.6% from the first group and 5.6% from the second group take calls through a Bluetooth earpiece.

Almost half of the participants (52.5% from first the group and 67.7% from the second group) reported having hotness as a result of using cell phones. Other side effects such as tinnitus, wax, dizziness, headache, and sleep disturbance were reported as follows: 19.2%, 22.2%, 8.1%, 32.3% and 21.2% for the first group and 34.4%, 24.1%, 21.5%, 18.5% and 17.4% for the second group. From those who reported having side effects (144 and 151 participants in the first and second groups, respectively), 59.7% and 51.7% reported having these side effects after using a cell phone. 30.6% and 41.1% reported having them while using it, and 9.7% and 7.3% had them all the time.

### Result of the focus groups discussion:

The research team conducted four focus groups discussions: two for the sixth-year students of the new curriculum and two for the interns from the old curriculum. Both students of old and new curricula stated that they were not taught specifically about cell phone hazards. They might have obtained some scattered knowledge from their teachers during lectures, tutorials, and clinical sessions in community and family medicine clerkships. They used different brands of cell phones (iPhone, Nokia and Blackberry). About half had more than one brand. About a third from each group used Blackberry messenger, which is considered another source of exposure to RF. The interns stated that they are exposed to another source of RF, which is a pager that is used mostly during their on-call shifts. In conclusion, their knowledge about cell phone use risks is not considered a limiting factor.

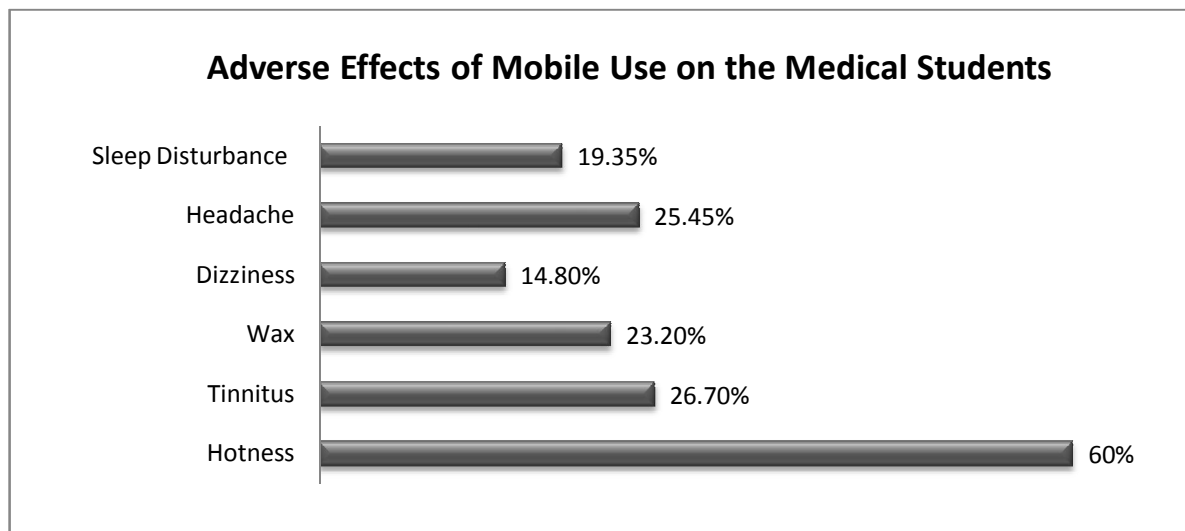
**Table (3) Practices of the participants towards the Health Hazards of Mobile Phone Magnetism**

	6th years n=198		Intern n=195		Total	%	P -Value
<b>Daily Usage time</b>							
<30 min	28	14.1%	14	7.2%	42	10.7%	$P < 0.001$
30 min - 1 hr	131	66.2%	127	65.1%	258	65.6%	
> 1 hr	39	19.7%	54	27.7%	93	23.7%	
<b>Min\Call</b>							
<15min	67	33.8%	66	33.8%	133	33.8%	$P < 0.001$
15 min - 30 min	93	47%	96	49.2%	189	48%	
> 30 min	38	19.2%	33	16.9%	71	18%	
<b>Reason for Mobile using</b>							
Work purpose	8	4%	22	11.3%	30	7.6%	$P < 0.001$
Study purpose	59	29.8%	16	8.2%	75	19%	
Communication	107	54%	100	51.3%	207	52.7%	
Multipurpose	24	12.1%	57	29.2%	81	20.6%	
<b>Duration of used mobile</b>							
< 5 years	7	3.5%	17	8.7%	24	6.1%	$P < 0.001$
5 to 10 years	131	66.2%	98	50.3%	229	58.3%	
> 10 years	60	30.3%	80	41%	140	35.6%	
<b>Call\ day</b>							
< 10 Calls	140	70.7%	52	26.7%	192	48.9%	$P < 0.001$
10 to 20 Calls	48	24.2%	127	65.1%	175	44.5%	
> 20 Calls	10	5.1%	16	8.2%	26	6.6%	
<b>Way of receive calls</b>							
Through Phone	178	89.9%	175	89.7%	353	89.8%	$P < 0.001$
Head Phone	25	12.6%	43	22.1%	68	17.3%	
Bluetooth	25	12.6%	11	5.6%	30	7.6%	
Speaker	32	16.2%	26	13.3%	58	14.8%	

#### 4. Discussion:

RF, an invisible electromagnetic radiation, is emitted by cell phones and is absorbed by the skin, inner ear, cochlear nerve, and the temporal lobe surface of cell phone users [Pereira, 2008]. A cross-sectional study was performed at King Abdul-Aziz University to estimate the potential health risks generated by RF electromagnetic waves of cell phones on the auditory function of medical students. Despite a lack of scientific proof regarding the association of the use of cell phones and thermal damage [Pereira, 2008], half of the participants from the first group and more than two thirds of the second group reported that they felt warmth in the tissue surrounding their ear. The thermal effect is caused by water molecule polarization in which electromagnetic waves produce heat. It has been reported that the temperature measured in the head is increased by not more than 0.11°C during the use of a cell phone [Wilén, 2003]. The other effects are non-thermal, and their impact requires further study to explain the conflicts and the controversial issues associated with them, since many studies have different results [Pereira, 2008]. The most controversial issues are related to the effects of cell phones and their risk for causing tumor development. Many studies have reported a link between analog handsets used for ten years or more and the risk of developing tumors [Lonn, 2004] [Hardell, 2005]. Other negative sensations and subjective symptoms, such as tinnitus, wax formation, dizziness, headache, and sleep disturbance, were reported in the range of 19.2–32.3% in the first group and 17.4–34.4% in the second group. It was found that the warmth of tissues, tinnitus, headaches, nervousness or distress, fatigue, concentration difficulties, and sleep disorders were the most common complaints. From those who participated in the study, 59.7% and 51.7% reported having these side effects after using their cell

time. These results indicate that cell phone use may have a temporary effect, which may increase in the future. The students' awareness has increased mostly via electronic sources, printed media sources, and through social communication in the community. Cell phone use is mainly for social communication, followed by study purposes and other reasons. It can be reported that most students take their calls through mobile phones directly, and only a small number of students use speakers and headphones. Education and raising awareness are the key factors for improving the behavior of people regarding the extensive use cell phones. The results indicated that the interns were more aware of the risks associated with the usage of cell phones than the sixth-year students; however, they were found to use their cell phones more frequently than the sixth-year students, and hence experienced more side effects. Our results are in agreement with a study Martha and Griffet (2007) in which the level of schooling was shown to have a constructive impact on social risk awareness; this aspect should be supported since the level of education has vital importance on the duration and the way cell phones are being used. However, other factors may have contributed to interns' need to use their cell phones, such as the need to answer more calls from the hospital when they are on duty. Moreover, they are paid more, and so they can afford to pay higher bills. In addition, the use of pagers may increase RF exposure. Furthermore, all anticipated high health risks connected with the exposure and use of cell phones should be available to the public so that they can take precautions [Hutter et al., 2004]. Some of these would include either using a headset or putting the caller on speaker while conversing and avoiding wearing a wireless or Bluetooth headset continuously in order to cut down the dose of radiation. Finally, the university's new medical curriculum should include



phone. 30.6% and 41.1% reported having them while using it, and 9.7% and 7.3% experience them all the

information about cell phone use that students may need, and should provide more tutorials and lectures

concerning the matter. We should also use the media to raise public awareness regarding the harmful side effects of cell phones.

#### Limitations:

The research team didn't measure the specific absorption rate, which is used to assess the amount of energy, in which the person can be exposed to RF, differs according to many aspects. These aspects include the distance, the spatial orientation of the place relative to the person, the cell phone handset model, the distance between a cell phone and its station, and the space between the user's head and the handset antenna. All these factors could affect the results of this study. For example, the Canadian government has restricted many models from entering the country because of the negative impact of some features on user health. In this study, it was difficult to classify the models of cell phones used as well as all the other parameters. These differences could be due to reasons such as cell phones' location, specific model, and exposure methodology. Inclusion of student from non-medical field might be considered in the future research.

#### Conclusion and Recommendation:

Some neurological symptoms and sensations caused by the daily use of cell phones were reported in this study. The use of cellular phones may affect the auditory system in the short term. We plan to continue monitoring these students in order to find out the possible negative effects and the appearance of any long-term hearing changes that may affect their auditory system. Therefore, it is advised that excessive use of cell phones should be avoided and health awareness must be increased through the new medical curriculum at King Abdul-Aziz University.

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