

ORIGINAL ARTICLE

Study of the Pattern of Cell Phone Usage Associated With Side Effects Among University Students: Case Study in a Malaysian University

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ABSTRACT

Introduction: Cell phone is a device that has been used almost every day for all age groups. It connects everyone and everything around the world as it provides various social platforms. However, not many people realized that cell phone is a source of non-ionizing electromagnetic waves that can be associated with various physical effects. Therefore, the aim of this research is to identify the physical side effects associated with exposure to the electromagnetic waves emitted by cell phone use and to detect if these effects are associated with specific pattern of use. **Methods:** A cross-sectional study was conducted on 166 participants randomly selected from university students. **Results:** showed that those suffering side effects associated with cell phone usage are usually using more than one cell phone (79%) since about 5 – 10 years (41.9%) for more than 5 hours daily (65.7%) for entertainment (34.3%) and making about 1-5 calls daily (41%) with average call duration 1 – 30 min (56.2%). 66.7% of them started using cell phone at age 7 – 12 years old, mostly handheld (61%), at their right side (40%), at all times of the day (64.8%). Most common side effects associated with cell phone usage include ear pain (52.4%), headache (79.5%), fatigue, anxiety or insomnia (57.8%), tremors and eye pain beside statistically significant ($P < 0.05$) complain of dry mouth (56.6%) and/or bad odor mouth (46.4%). **Conclusion:** There is a specific pattern associated with occurrence of side effects due to cell phone use.

Keywords: Cell phone, Electromagnetic waves, Management and Science University

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INTRODUCTION

A cell phone is definitely a must thing to have for each person throughout the world in this modern era. The population of people using this cell phone is increasing every day. Currently, there are about 6 billion people own cell phones and the youngest users of a cell phone can be estimated as early as 3 years old (1). Statistics show that 79% of Americans and more than 90% of European and Asian teens are using cell phones (2, 3). Recently students are showing an acceptance to adopt mobile learning (4). A survey conducted in 2014 stated that the sales of cell phones are rapidly increasing in Malaysia and it means that the cell phone has a great

opportunity in the future growth of the cell industry (5).

Despite better communication, these cell phones carry radiation exposure that may affect the health of individuals (6). Cell phones use electromagnetic, non-ionizing radiation to send and receive information specifically radio-frequency (RF) waves and microwaves (2, 7, 8). Previous study reported the relationship between the cell phone usage and various side effects to the body such as headaches, dizziness, fatigue, a burning sensation, dry mouth, ear pain, sleep disturbance, anxiety and insomnia (9). The aim of this study is to study the effects of cell phone's electromagnetic radiation on the physical body functions among the university students.

MATERIALS AND METHODS

A total of 166 students, including 56 male 110 female students from Management and Science University

are included in this research study. The total study participants are chosen by simple random sampling at the age between 18 to 35 years old. This research study involving those who are using cell phone in daily use. Those with history of systemic disorder or major head and neck trauma were excluded from this study. A questionnaire that has been constructed from previously used questionnaire (10) then distributed. Informed consents were given to the study participants before the study was carried out. The data was analyzed by using Statistical Package for Social Science (SPSS) version 23.

RESULTS

A total of 166 students from Management and Science University were participated on this study. The prevalence of cell phone usage among the Management and Science University students was 100%. The study participants' demographic data are summarized in Table I. Majority of the study participants were aware with the radiation emitted by a cell phone and aware with the side effects of prolonging use of cell phone towards the physical body functions. The general knowledge of the study participants towards the cell phone are summarized in Table II. The patterns of cell phone usage among all the study participants and those having side effects are presented in Table III. Those suffering side effects associated with cell phone usage are usually having more than one cell phone (79%), 66.7% of them started using cell phone at age 7 – 12 years old and using it since about 5 – 10 years (41.9%) for more than 5 hours daily (65.7%) for entertainment (34.3%) and making about 1-5 calls daily (41%) with average call duration 1 – 30 min (56.2%), using the cell phone mostly handheld (61%), at their right side (40%), at all times of the day (64.8%) (table 3). Most common side effects associated with cell phone usage include ear pain (52.4%), headache (79.5%), fatigue, anxiety or insomnia (57.8%), tremors and eye pain beside statistically significant ($P < 0.05$) complain of dry mouth (56.6%) and/or bad odor mouth (46.4%) (Table IV).

DISCUSSION

The prevalence of cell phone users among Management and Science University was 100% and it was quite similar to the previous study conducted in Malaysia (11). The present study showed that majority of the phone users were those ranging from 18 to 35 years old which is same as in a previous study (12). Another study revealed that the populations of cell phone users were balanced in both male and female (13).

Majority of students in present study were aware with the linking of cell phone and radiation exposure. Besides, most of them agreed with the side effects of prolonging using a cell phone. According to a previous study, it was found that majority of the study participants among

Table I : Demographic data of the study participants

	Characteristics	Frequency (%)
Gender	Male	56 (33.7%)
	Female	110 (66.3%)
Age	<20 years old	75 (45.2%)
	21-25 years old	77 (46.4%)
	26-30 years old	8 (4.8%)
	>31 years old	6 (3.6%)
Race	Malay	91 (54.8%)
	Indian	56 (33.7%)
	Chinese	9 (5.4%)
	Others	10 (6.0%)
Education level	Foundation	14 (8.4%)
	Diploma	67 (40.4%)
	Degree	83 (50.0%)
	Master	2 (1.2%)
Faculty	IMS	39 (23.5%)
	FHLS	11 (6.6%)
	FBMP	48 (28.9%)
	SCHA	17 (10.2%)
	SPH	7 (4.2%)
	FISE	19 (11.4%)
	SESS	25 (15.1%)
Living Area	Urban	142 (85.5%)
	Rural	24 (14.5%)

university students showed the addiction to a cell phone (5). In addition, some studies reported that most of their participants were aware about the radiation emitted by cell phone and the harmful effects of it (10).

According to the present study, the main reason for majority of the study participants using cell phone were for making or receiving call purposes. A previous study proved more than 90% of the study participants were using cell phone for the same reason (14). It has been said that younger ages spent most of their times playing with cell phone compared to older ages (13). Furthermore, the mode of cell phone usage may affect the body's health. This statement has been proved by a research study where majority study participants were complaining of side effects due to direct usage of cell phone (8).

The results from the research study revealed that the study participants who use cell phone had several problems with their physical body functions including sleep disturbance, difficulty breathing, memory changes, tired easily, ear pain, headache, eye pain, stress, tremors as well as anxiety or insomnia. Previous study also showed that a majority of the participants who use cell phone had several problems in their health (7, 15, 16).

In the previous studies, the majority of the participants were complaining of headache, nausea, anxiety and forgetfulness as compared to deaf participants (7). More recently, an experiment was carried out to study the effect of electromagnetic radiations of the cell phone

Table II : The general knowledge of the study participants towards the cell phone

Characteristics	Frequency (%)	
	Yes	No
Do you have a cell phone	166 (100%)	0
Do you feel a cell phone have impacted your life	151 (91%)	15 (9%)
Do you agree that using cell phone can increase effective communication with friends and family	159 (95.8%)	7 (4.2%)
Do you have the ability to leave cell phone for a long period of time	79 (47.6%)	87 (52.4%)
Are you using cell phone at night before sleeping on a dim light	138 (83.1%)	28 (16.9%)
Are you aware that cell phone carries radio-frequency radiation	148 (89.2%)	18 (10.8%)
Are you aware of any side effects of prolonging using a cell phone	144 (86.7%)	22 (13.3%)
Does the long time usage of cell phone affects your study	120 (72.3%)	46 (27.7%)
Do you use cell phone while driving	61 (36.7%)	105 (63.3%)
Do you comfortable on using cell phone for a long period of time	86 (51.8%)	80 (48.2%)
Do you think cell phone is the most important gadget for you	130 (78.3%)	36 (21.7%)
Are you aware of any linking of cell phone with any health conditions such as cancer/tumor	110 (66.3%)	56 (33.7%)
Do you have friend, colleague or family who does not use or own a cell phone	57 (34.3%)	109 (65.7%)
Do you think it is normal to not use a cell phone	85 (51.2%)	80 (48.2%)
Would you like to keep a relation with person who does not use a cell phone	121 (72.9%)	45 (27.1%)
Could you stop using your cell phone	48 (28.9%)	118 (71.1%)
Have you experienced any discomfort or pain in shoulder or hand after prolonging usage of cell phone	104 (62.7%)	62 (37.3%)
Have you experienced tangling sensation in your arm, shoulder, or hand after typing on cell phone	94 (56.6%)	72 (43.4%)
Are you a smoker	32 (19.3%)	134 (80.7%)
Are you checking your cell phone in-between sleep	101 (60.8%)	65 (39.2%)
Do you feel discomfort when your cell phone is running out of battery	122 (73.5%)	44 (26.5%)
Have you ever feel that you miss the normal social life without a cell phone	110 (66.3%)	56 (33.7%)
Do you feel anxious if you do not check your favorite application in a day (ex: Instagram, Twitter, Facebook, Snapchat, Youtube)	106 (63.9%)	60 (36.1%)
Have you ever missed planned work due to cell phone	75 (45.2%)	91 (54.8%)
Do you think you will be able to quit using your cell phone even though its affected your daily lifestyle	75 (45.2%)	91 (54.8%)
Do you aware on time spend in using a cell phone	118 (71.1%)	48 (28.9%)
Does the model type of cell phone is important to you	109 (65.7%)	57 (34.3%)
Do you get anxious when there is no signal on your cell phone	113 (68.1%)	53 (31.9%)
Do you experienced difficulties in regular day-to-day life	102 (61.4%)	64 (38.6%)
Do you feel dependent on the use of cell phone	113 (68.1%)	53 (31.9%)

base stations that was found to produce the side effects including nausea, depression, sleep disturbances, blurred vision and lack of appetite (17). On the other hand, another study found out there were no correlation of radiation exposure from cell phone base station with sleep quality, headache severity, psychometric complaints, and chronic stress, physical and mental

Table III : Patterns of cell phone usage among the study participants and participants having side effects

Characteristics		All the study participants No. (%)	participants having side effects No. (%)
How many cell phones do you have?	Only one	136 (81.9%)	83 (79.0%)
	More than one	30 (18.1%)	22 (21.0%)
At what age did you started using a cell phone?	< 7years old	19 (11.4%)	11 (10.5%)
	7-12 years old	103 (62.0%)	70 (66.7%)
	12-18 years old	44 (26.5%)	24 (22.9%)
What is the number of years are you using a cell phone?	< 5 years	43 (25.9%)	23 (21.9%)
	5 to 10 years	71 (42.8%)	44 (41.9%)
	10 to 15 years	43 (25.9%)	31 (29.5%)
	15 to 20 years	9 (5.4%)	7 (6.7%)
What is your main purpose of using a cell phone?	Communication	68 (41.0%)	41 (39.0%)
	Entertainment	55 (33.1%)	36 (34.3%)
	Study / work	43 (25.9%)	28 (26.7%)
How long is the usage of using a cell phone?	< 3 hours daily	21 (12.7%)	12 (11.4%)
	3 - 5 hours daily	60 (36.1%)	24 (22.9%)
	> 5 hours daily	85 (51.2%)	69 (65.7%)
Which side are you using cell phone as a dominant side?	Right side	73 (44.0%)	42 (40.0%)
	Left side	21 (12.7%)	15 (14.3%)
	Both sides	72 (43.4%)	48 (45.7%)
How many calls do you usually make in a day?	Only 1 call	25 (15.1%)	18 (17.1%)
	1-5	76 (45.8%)	43 (41.0%)
	5-10	48 (28.9%)	32 (30.5%)
	> 10	17 (10.2%)	12 (11.4%)
How many calls do you receive in a day?	Only 1 call	26 (15.7%)	16 (15.2%)
	1-5	81 (48.8%)	52 (49.5%)
	5-10	45 (27.1%)	28 (26.7%)
	> 10	14 (8.4%)	9 (8.6%)
How long is the time spent on making phone calls every day per minutes?	< 1 minute	18 (10.8%)	11 (10.5%)
	1- 30 minutes	89 (53.6%)	59 (56.2%)
	30-60 minutes	25 (15.1%)	18 (10.8%)
	> 1 hour	34 (20.5%)	17 (10.2%)
In which mode do you use a cell phone?	Handheld	105 (63.3%)	64 (61.0%)
	Bluetooth speaker	10 (6.0%)	10 (9.52%)
	Earphone	47 (28.3%)	28 (26.7%)
	Headset	4 (2.4%)	8 (7.6%)
When is the time that you frequently using a cell phone?	At all day	106 (63.9%)	68 (64.8%)
	At home	44 (26.5%)	28 (26.7%)
	At public places	16 (9.6%)	9 (8.60%)
What type of cell phone's model do you use?	iPhone	71 (42.8%)	49 (46.7%)
	Samsung	39 (23.5%)	25 (23.8%)
	Huawei	19 (11.4%)	12 (11.4%)
	Oppo	25 (15.1%)	11 (10.5%)
	Xiaomi	12 (7.2%)	8 (7.6%)

health (18). While another study observed that the most common side effects of cell phone's radiation were headache and sleep disorder (19). So, it can be concluded that there are many effects associated with use of cell phone but these effects differ from one user to another. The future researches should be more specific to correlate these effects with the specific indicators of exposure to the specific electromagnetic waves evoked from cell phone usage.

CONCLUSION

It is concluded that 100% of the university students are using a cell phone and about 62% of them were having side effects associated with cell phone usage that may be mostly due to exposure cell phone's electromagnetic radiations. The pattern usage that was associated with side effects including those that have used cell phone for about 5 to 10 years, more than 5 hours daily while

Table IV : The side effects of cell phone usage to the physical body functions

Side effects	Frequency (%)					x value	P value
	Rarely	Sometimes	Often	Very often	No		
Sleep disturbance	26 (15.7%)	47 (28.3%)	35 (21.1%)	18 (10.8%)	40 (24.1%)	3.432	0.488
Exercise regularly	23 (13.9%)	77 (46.4%)	28 (16.9%)	14 (8.4%)	24 (14.5%)	6.745	0.150
Difficulty in socializing	30 (18.1%)	50 (30.1%)	30 (18.1%)	8 (4.8%)	48 (28.9%)	5.682	0.224
Difficulty breathing	45 (27.1%)	28 (22.9%)	9 (5.4%)	4 (2.4%)	70 (42.2%)	0.711	0.950
Poor sleep quality	22 (13.3%)	51 (30.7%)	30 (18.1%)	17 (10.2%)	46 (27.7%)	0.977	0.913
Physical or mental health disturbance	30 (18.1%)	31 (18.7%)	14 (8.4%)	10 (6.0%)	81 (48.8%)	4.215	0.378
Depression	27 (16.3%)	39 (23.5%)	13 (7.8%)	7 (4.2%)	80 (48.2%)	5.543	0.236
Dry mouth	28 (16.9%)	39 (23.5%)	21 (12.7%)	6 (3.6%)	72 (43.4%)	11.218	0.024
Bad odor in mouth	44 (26.5%)	20 (12.0%)	8 (4.8%)	5 (3.0%)	89 (53.6%)	12.668	0.013
Ear pain	33 (19.9%)	33 (19.9%)	14 (8.4%)	7 (4.2%)	79 (47.6%)	6.299	0.178
Headache	20 (12.0%)	58 (34.9%)	37 (22.3%)	17 (10.2%)	34 (20.5%)	2.319	0.677
Eye pain	28 (16.9%)	56 (33.7%)	19 (11.4%)	14 (8.4%)	49 (29.5%)	4.321	0.364
Anxiety or insomnia	28 (16.9%)	38 (22.9%)	20 (12.0%)	10 (6.0%)	70 (42.2%)	2.438	0.656
Forgetfulness	33 (19.9%)	42 (25.3%)	25 (15.1%)	14 (8.4%)	52 (31.3%)	5.376	0.251
Stress	21 (12.7%)	51 (30.7%)	40 (24.1%)	22 (13.3%)	32 (19.3%)	3.077	0.545
Memory changes	28 (16.9%)	38 (22.9%)	29 (16.9%)	6 (3.6%)	65 (39.2%)	0.567	0.967
Tremors	36 (21.7%)	24 (14.5%)	12 (7.2%)	7 (4.2%)	87 (52.4%)	4.263	0.372
Limitations in doing physical activities	34 (20.5%)	29 (17.5%)	20 (12.0%)	6 (3.6%)	77 (46.4%)	3.013	0.556
Tired easily	28 (16.9%)	45 (27.1%)	30 (18.1%)	28 (16.9%)	35 (21.1%)	3.318	0.506

making or receiving phone calls for more than 1 but less than 5 and spent about more than half an hour in a phone call. Also, those were using handheld cell phone at all day were complained of having side effects. The most common encountered side effects including bad odor in the mouth, dry mouth, heat sensation, sleep disturbances, fatigue, memory loss, dizziness, headaches, tremors, anxiety or insomnia, eye pain and ear pain.

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