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Knowledge, Attitude, and Practices (KAP) Study and Antioxidant Status Among Mobile Phone Users

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Nowadays, there is marked increase in utilization of mobile phone technology. The aimed to evaluate knowledge, attitude and practice regarding mobile phone usage and antioxidant status among college students using mobile phones. Subjects and Methods: A sample of (150) nursing students were investigated for their knowledge about mobile phone hazards and their attitude and practices towards decreasing such effects. Also, Malondialdyde, Superoxide Dismutase and Catalase were measured. Results: Our results revealed that only (60.7%) had knowledge of mobile phone cancer hazards. Moreover, (81.3%) showed need to reduce calls duration. The Malondialdyde level was statistically significant higher in high mobile users than medium and low mobile phone users. There was more oxidative stress with increase both duration of mobile ownership and intensity of mobile usage. The studied group had deficient knowledge about how the mobile phone could affect them. Also, the oxidant-antioxidant status in subjects using mobile phones was affected. In conclusion, the degree of affection differs according to intensity of use and duration of mobile ownership.

Keywords: Mobile phone, Oxidative stress, Antioxidant enzymes.

INTRODUCTION

Recently, there was remarkable rise in the usage of wireless communication especially the mobile phones (Dixit et al., 2010). The smart phones technology and the continuous internet connection all over the day led to huge rise in number of users and intensity of their usage (Kumar et al., 2011).In Egypt, at the end of the year 2000, the total mobile phone subscriptions were 1.359.900 and the mobile phone subscriptions per 100 inhabitants were 2.06. There was great growth in number of subscription. So that by the end of the year 2015, the total mobile phone subscriptions became 94.016.152 and the mobile phone subscriptions per 100 inhabitants became 110.9 (Telecom Egypt, 2000, Ministry of Communications and Information Technology, 2015 and Vodafone Egypt, 2015).On exposure to EMF emitted from cell phones and cell towers, the human body absorbs it and that might be associated with several health hazards (Levitt and Lai, 2010).Studies revealed that there were not any apparent effects on healthy personnel on short term exposure to low levels of EMF while exposure to higher levels might pose harmful effects. Moreover, long term exposure to low levels of EMF raised the concerns about the possible health effects (WHO, 2006 a and WHO, 2006b).The awareness about the hazards of excessive use of mobile phones was assessed in previous studies (Kumar et al., 2011and Al-Muhayawi et al., 2012).

Normally, the reactive oxygen species (ROS) are produced during physiological processes and

they play a role in defence against pathogens (Ghanbari et al., 2013). Free radicals are unstable molecular species that can initiate chain reactions to form new free radicals .There are several mechanisms to neutralize them; including antioxidants which generally stop the production of free radicals and prevent oxidative stress and subsequent tissue damage (Kumar et al., 2011). Disturbance in the balance between the oxidants and the antioxidants can occur by increase in free radical production or reduction in the antioxidants. The *Malondialdyde (MDA)* results from oxidation of polyunsaturated fatty acids. It is considered as a marker of oxidative stress mediated lipid peroxidation (Awanti et al., 2010). The *Superoxide Dismutase (SOD)* is responsible for intracellular dismutation of superoxide radical, generating hydrogen peroxide which has marked cytotoxic effect. This leads to decrease of SOD levels. Then hydrogen peroxide is detoxified by catalase enzyme (Kesari et al., 2011). The radiofrequency radiations emitted from mobile phones increase free radicals which enhance lipid peroxidation and change the antioxidant activities in human blood, thus leading to oxidative stress which induces the possible harmful effects on human health (Agarwal et al., 2009, Ghanbari et al., 2013 and Iheme et al., 2018).

The present study aimed to evaluate knowledge, attitude and practice regarding mobile phone usage and antioxidant Status among college students using mobile phones.

MATERIALS AND METHODS

The present study is a simple random convenient study done on 150 college students, (98) subjects from the technical nursing institute and (52) subjects from Faculty of Nursing, Cairo University. A questionnaire was designed and filled by all participants by personal interview including sociodemographic data and description of details of mobile phone usage. Smokers were excluded from the study (Supriya et al, 2017). As the gas phase of the tobacco smoke contains free radicals and induces oxidative stress. A blood sample was collected to measure: Oxidative stress (Lipid peroxidation) marker; Malondialdyde *(MDA)* and Antioxidant enzymes *(Superoxide Dismutase and Catalase).*The *(MDA)* was estimated in serum by colorimetric end point procedure (Satoh, 1978 and Ohkawa et al., 1979). The *Superoxide Dismutase (SOD)* was estimated in erythrocytes by kinetic procedure (Nishikimi et al., 1972).The *Catalase* was estimated in plasma by colorimetric end point procedure according to (Aebi, 1984 and Fossati and Prencipe,1980). Statistical analysis: The collected questionnaires were revised for completeness and logical consistency. The data was analysed using the *Statistical Package for Social Sciences (SPSS)* version 20 for statistical analysis. Independent t-test was used for numerical variables between two independent groups and Analysis of Variance (ANOVA) test for numerical variables between more than two independent groups.

RESULTS

The age of the studied group ranged from (18 to 19 years) with mean (18.39±0.49), (68.6%) of them were male. Nearly (65%) of them were from nursing institute and (34.7%) were from Faculty of nursing, (73%) of them owned one mobile phone and (76%) had one SIM (Subscriber Identification Module) card in the phone. About (50%) of the students owned mobile for duration (1-5 years) and (52.7%) of them were high mobile users.

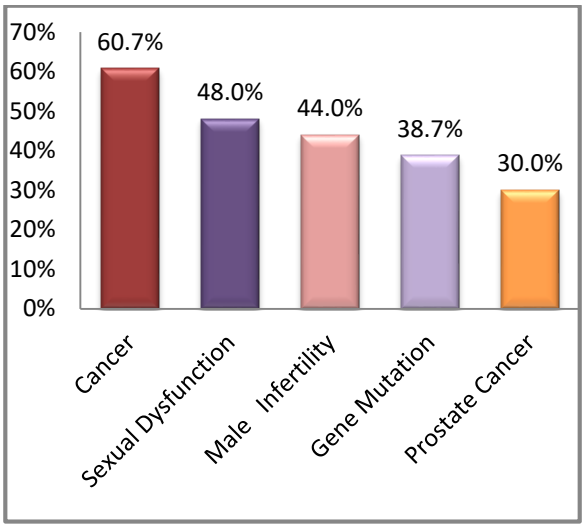

Figure (1): Knowledge about Effects of Mobile Phone among the studied Group

Figure (1) shows that (60.7%) of the studied group had knowledge about the potential cancerous hazards of mobile phone. About half of them knew about the sexual dysfunction and infertility hazards.

Figure (2) shows that (78%) had the knowledge that putting mobile phone away from the body minimizes unwanted effects followed by (76.3%) showed knowledge that reducing usage frequencies could minimize such effects.

Figure (3) shows that (81.3%) of the studied group showed a need to reduce talking duration and (65.3%) showed a need to increase using hand

free.

Table (1) shows that, *(MDA)* level was statistically significantly higher in high mobile users than the other two groups. Also, the antioxidant enzyme *(Catalase)* showed a statistical significant difference between medium mobile users and low mobile users (P-value<0.05). Meanwhile, the antioxidant enzyme (SOD) showed no statistical significant difference in relation to duration of mobile use per day.

Figure (2): Knowledge about methods of Minimization of Unwanted Effects of Mobile Phones

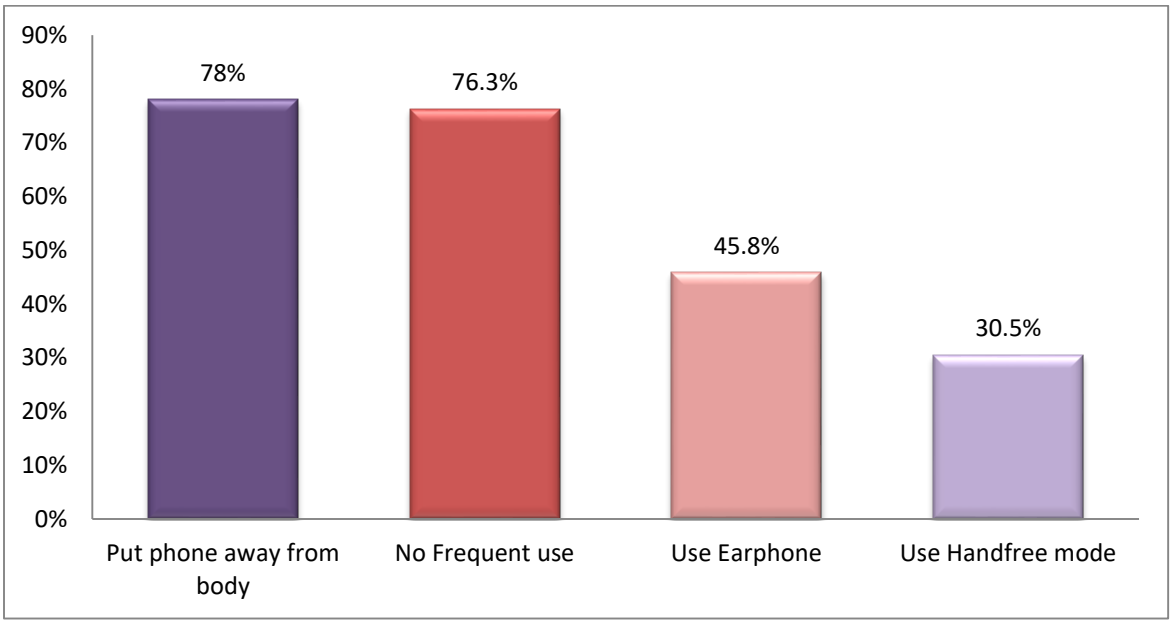

Figure (3): Attitude towards Decreasing Health Hazards

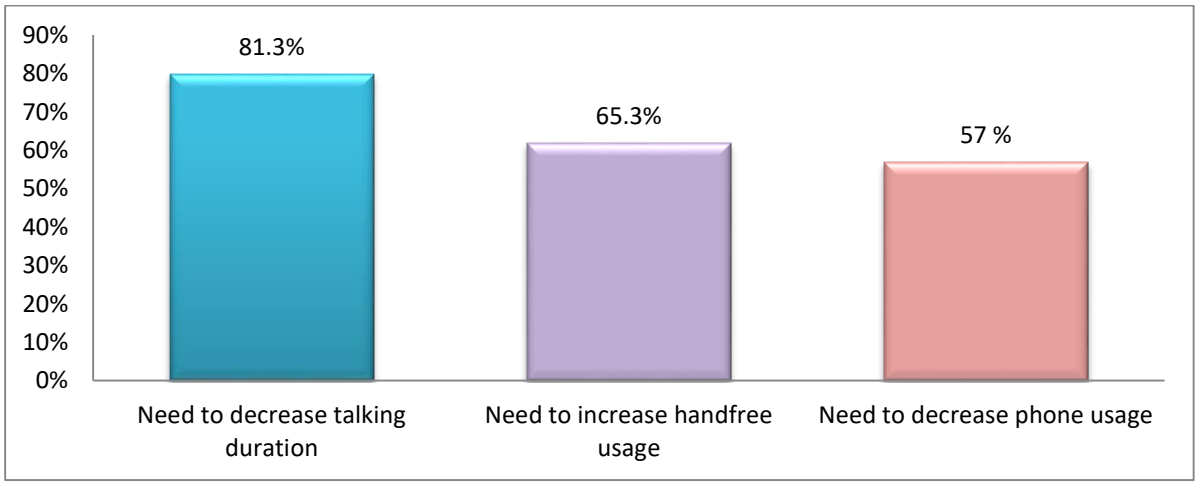

Table (1): Difference in Biomarkers Levels in Relation to Duration of Mobile Phone Use Per Day

	(Low users) < 30 minutes No= 24 Mean±SD	(Medium users) 30-60 minutes No= 47 Mean±SD	(High users) >60 minutes No=79 Mean±SD	ANOVA	P-value
MDA (U/L)	5.2±2.6	5.2±3.3	6.7±2.7[a.]	4.5	<0.05*
SOD (U/L)	52.2±24.1	49.7±25	55.3±21.1	0.9	>0.05
Catalase (U/L)	731.8±103.2	652.8±127.8[b.]	690±122.6	3.5	<0.05*

a. The *MDA* level is significantly higher than the other two groups LSD.
b. The *catalase* level showed high significant difference between those using mobile phone from (30-60 minutes) per day and those using mobile phone (<30 minutes) LSD. * P-value < 0.05 (significant)

Table (2): Biomarkers Levels According to Duration in Mobile Phone Ownership with Different Usage Duration

	Duration (1-5 years) Mean ±SD	Duration (>5years) Mean ±SD	Independent t-test	*P-value*
(Low Users) Using mobile < 30 minutes per day				
MDA (U/L)	4.8±2.4	5.5±3.6	0.27	>0.05
SOD (U/L)	52±24.8	52.7±27.4	0.05	>0.05
Catalase (U/L)	745.9±97.1	689.7±118.9	1.2	> 0.05
(Medium Users) Using mobile 30-60 minutes per day				
MDA (U/L)	4.2±2.9	6.8±3.3	2.8	<0.01**
SOD (U/L)	52.9±24.5	45.2±25.7	1.04	> 0.05
Catalase (U/L)	673.8±139.8	624.9±106.4	1.4	> 0.05
(High Users) Using mobile >60 minutes per day				
MDA (U/L)	5.5±2.6	7.4±2.5	3.2	<0.01**
SOD (U/L)	61.4±17.9	51.5±22.2	2.1	<0.05*
Catalase (U/L)	719.2±101.9	672.2±131.5	1.8	> 0.05

* P-value < 0.05 (significant) ** P-value < 0.01 (highly significant)

DISCUSSION:

Most of the studies on the mobile hazards were based on short exposure and related to mobile phone thermal effects. Meanwhile, there is little knowledge on long term effects of exposure. So, those concerns interested some authors to evaluate the effect of long term exposure to mobile phones (Hardelland Carlberg, 2015).

The present study showed that about 60.7% reported their knowledge of cancer hazards, about half of them knew about the sexual dysfunction and infertility problems and only about one third of them knew about gene mutation hazards. Those findings suggest the deficient knowledge of the studied group about the potential health hazards of the mobile phone. Concerning their knowledge about methods to minimize the potential unwanted health effects, the first method was putting mobile away from the body (78%), then decrease mobile using frequency (76.3%), the third method was using earphones and finally increasing the usage of hand free mode (45.8% and 30.5%). Similar studies were conducted in many countries about the knowledge of the college students about the hazards of mobile phone and their attitude towards mobile phone usage. Kumar et al., (2011) conducted a study in India on the awareness of mobile phone hazards among two hundred university students with a mean age of 22 years old. In their study, concerning the knowledge of mobile phone hazards, they reported similar results to ours as 62% of the studied group showed awareness about the mobile phone health hazards. In accordance with our findings, concerning methods to minimize such hazards, their study subjects reported that the first method was putting away from body, then using hand free mode, third using earphones and finally decrease using frequencies. Another study carried out on four hundred Saudi final year medical students and medical interns found that less than 50% of their study group reported their knowledge about the cancer hazards of mobile phones. Regarding methods to minimize mobile phone hazards, the students reported that using loudspeaker mode was the first method followed by using earphones as the second method (Al-Muhayawi et al., 2012). Also, similar results were reported by Pendse and

Zagade (2014), in their study which was done on 120 Indian students. About 72% of studied group reported average knowledge about physical hazards related to mobile phone usage; meanwhile, they reported poor knowledge about psychological hazards. Moreover, they had good attitude towards reduction of mobile phone usage. Furthermore, a study conducted by Gautam and Shakya (2016) on 145 college students in Nepal to evaluate their knowledge on the mobile phone health hazards found that about half of the participants showed poor knowledge on the mobile phone hazards in general while about 75% reported knowledge of cancer hazards of mobile phones. Considering the attitude towards decreasing hazards of mobile phone usage in the present study, 81.3% reported that there was a need to decrease talking duration followed by a need to increase using hand free mode and finally a need to decrease phone usage in general either talking or other applications. Although the students showed a high attitude to mobile phone usage, they did not practice methods to minimize hazardous effects. The reasons of not practicing such methods, first 27.7% of them thought that there were no side effects of mobile usage, second 17% of them considered it difficult. The last reasons, that they were either busy or lazy as shown in figure (4). Kumar et al., (2011) in their study reported results on the contrary of our findings. They found that only 15% of their study population reported no need to minimize its usage. Also, the reasons for non-practicing such methods were opposite to our findings, as the main reasons in their study were being busy or lazy, then not caring and the last reason was they did not experience side effects.

Regarding the effect of EMF emitted from mobile phones on oxidant-antioxidant status in different tissues, numerous investigators attributed that to biochemical, anatomical and physiological properties of those tissues. Some studies revealed the development of oxidative stress via increased level of *(MDA)* or decreased antioxidant enzymes (in order to scavenge the free radicals) (Oktem et al., 2005; Oral et al., 2006; Balci et al., 2007; Narayanan et al., 2014 and Shehu et al., 2016). In the present study, *(MDA)* level was statistically significant higher in high mobile users group than the other two groups. The *Catalase* level was statistically significant lower in medium users group than the other two groups. Iheme et al., (2018) reported increase in lipid peroxidation and *MDA* level on exposure to mobile phone and the higher the mobile frequency of usage, the more the degree of affection. In contrary to our results, Arbabi et al., (2014) found increase *(MDA)* level but significant decrease in salivary total antioxidants in group with high mobile usage (talking in mobile phone> 60 minutes/day) compared to other two groups with medium and low users (group talking <20 minutes/day and group talking from 20 – 60 minutes/day). Our findings regarding the lower catalase level in medium mobile phone users might be owed to that students owned mobiles with dual SIM cards more than the other two groups. Shehu et al., (2016) cleared in their study that people prefer phones with dual SIM because such phones cost less and have extra SIM capacity. But those phones have two built in transceivers, so they emit higher radiation and have peak power up to 5 watts. So according to their findings, there are more emissions with dual SIM mobiles. Moreover, Abu Khadra et al., (2014) found increase in free radicals concentration in the saliva of mobile phone users. Also, Agarwal et al., (2009) evaluated the effects of chronic exposure to EMF emitted from mobile phones. They found increase free radicals production and decrease antioxidant enzymes *(SOD and catalase)* activities that led to reduction in their levels.

We also compared the measured parameters in users owned mobiles for duration (1-5 years) and other owned mobile for duration (>5years) within each group (high, medium and low users group). Our findings revealed that the measured parameters did not show any significant difference in low users group. Meanwhile, in medium and high users group *(MDA)* was statistically significantly higher in subjects owned mobile phones for (duration>5 years) than those owned phones for lesser duration. Moreover, in high users group the subjects owned mobile phones for longer duration had significantly lower levels of *(SOD)* as shown in table (2). Those findings indicate more oxidative stress with increase the duration of ownership of mobile phones. We suggest that those owned mobile for longer duration increase free radicals production and decrease antioxidant level which would lead to oxidative stress (which was expressed by elevation of *MDA* level). This is clear in our findings as the level of *(SOD)* was reduced in those with longer duration (although the difference was not significant). The reduction of the *(SOD)* level would lead to reduction of free radicals dismutation. This led to consumption to catalase level (to transform the accumulated radicals to

oxygen and water) resulting in reducing its level. This came in accordance to Shivashankara et al., (2015), who found in their study that the salivary *MDA* level was significantly higher in heavy mobile phone users (owned mobile ≥ 4 years and talking for duration ≥ 2 hours/ week) than in less mobile phone users (owned mobile < 4 years and talking for duration< 2 hours/ week).

CONCLUSION

This study concluded that the electromagnetic field emitted from mobile phones affect the oxidant-antioxidant status in subjects using them and led to oxidative stress. The degree of affection differs according to both duration of mobile ownership and intensity of mobile usage.

Ethical Consideration:

Ethical considerations: the study was conducted after explaining to the participants the study objectives then insight consent was obtained from all the participants with assured confidentiality. The study was reviewed and approved by the Ethical Committee at the National Research Centre and the Ethical Committee at Faculty of Nursing, Cairo University, to obtain the approval to carry up our study on the nursing students.

CONFLICT OF INTEREST

The authors declared that present study was performed in absence of any conflict of interest.

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AUTHOR CONTRIBUTIONS

Nasser S., Ghobashi M. and Amer N. designed the study and reviewed the manuscript. Hafez S. Shaheen W. collected data, clinical part and wrote the manuscript. Morcos G. samples collection and biochemical analysis. Helmy M. performed data analysis and wrote the manuscript. All authors read and approved the final version.

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