EFFECTS OF SHORT-TERM CELL PHONE EXPOSURE ON EEG, ECG AND BLOOD PRESSURE IN MALES AND FEMALES OF HUMAN

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Abstract

Mobile phones have become important devices of modern communication. As a result of the widespread increase in use of this technology, concerns have been raised regarding the potential impact on human health, particularly on the CNS. The aim of the present study is to investigate the effect of cell phone on EEG, ECG, blood pressure and in both sexes of human. Thirty two volunteers (16 males, 16 females) who had participated in the original study. During mobile exposure for a period of 30 minutes , EEG, ECG and some hemodynamic were measured . The mobile phone which used in the study was a Nokia model .Statistical analysis revealed that alpha and beta amplitude during closed eye were increased after cell phone exposure for 30 minutes. Alpha amplitude was also significantly elevated during opened eye. The result of present study shown that cell phone exposure for (30)minutes didn't statistically change hemodynamic parameters ,however diastolic blood presser (DBP)and heart rate were slightly increased . ECG waves and amplitude are also not changed with exception of QT inter vale. In conclusion, the results suggested that cell phone exposure for 30 minutes affect alpha amplitude rather than beta amplitude values especially during closed eye. These changes of alpha waves represents the change in parieto-occiptal region of the brain.

Keyword*: Cell phone , EEG, ECG, Blood pressure*

Introduction

Mobile phones have become important devices of modern communication. As a result of the widespread increase in use of this technology, concerns have been raised regarding the potential impact on human health, particularly on the CNS

Third generation mobile phones currently in the market offer additional services to the users (such as fax, e-mail and Internet access). For both analogue and digital mobile phones, the signals transmitted and received are in the form of waves in the radio frequency (RF)(analogue) and microwave parts of the electromagnetic spectrum. RFs are non-ionizing radiation with, wavelengths that range from 3 kHz to 300 MHz, and microwaves range from 300 MHz to 300 GHz .

The frequencies that mobile phones and telecommunication networks use range from 900 MHz to1.8 GHz and up to 2.1 GHz, although it should be noted that the wavelength of the different types of mobile phones varies. This applies to both mobile phones and their base stations, which send and receive calls(National Radiological Protection Board).

Electroencephalogram (EEG) to denote the record of the variations in brain potential. The EEG can be recorded with scalp electrodes through the unopened skull or with electrodes on or in the brain. The term electrocardiogram (ECG) is used for the record obtained with electrodes on the pial surface of the cortex. The EEG recorded from the scalp is a measure of the summation of dendritic postsynaptic potentials rather than action potentials (Barret*et al*., 2010)

The brain is a very sensitive electromagnetic organ. It has been shown that the brain resonantly detects and reacts to an extremely small, natural, globally available electromagnetic signal(Cherry,2002).Several experiments have revealed short-term changes in electroencephalographic (EEG) spectral power during both waking(Croft *et al* ,2010, Regel *et al* ,2007 a) and sleep (Loughran*et al*, 2005 and Regel *et al* , 2007 b)in conjunction with exposures to mobile phone-like RF EMF. Previous research has shown that the EEG is affected by exposure to RF EMF, with the most consistent findings being an increase in EEG spectral power within the 8 - 14 Hz frequency range in both awake and sleep states during and/or following exposure (Croft *et al* 2002 and Regel *et al* , 2007c).

Because the body fluids are good conductors and because the body is a volume conductor), fluctuations in potential that represent the algebraic sum of the action potentials of myocardial fibers can be recorded extracellular. The record of these potential fluctuations during the cardiac cycle is the electrocardiogram (ECG). The P wave represents depolarization of the atria. .PR interval. The PR interval is the time from initial depolarization of the atria to

initial depolarization of the ventricles. The QRS complex consists of three waves: Q, R, and S. Collectively, these waves represent depolarization of the ventricles. The T wave represents repolarization of the ventricles. ST interval (QT minus QRS)IS Ventricular repolarization (during T wave)(Barret *et al*.,2010).

During the 30 min of RF/EMF exposure no difference in heart rate between the three conditions was observed. Heart rate in waking and stage 1 of the entire sleep episode was reduced after exposure of the right and left hemispheres and before sleep onset after right hemisphere exposure. Heart rate variability (spectra of RR intervals) was altered during the 3 h sleep episode but not during the first half hour of non REM sleep. Some cardiac pacemakers are susceptible to active cell phone signals, recommending keeping cell phones away from hearts and pacemakers (Reto*et al*., 2003).

Blood pressure is the force of blood against the walls of arteries. Differences in several cardiovascular parameters between exposed and non-exposed adolescents (systolic and diastolic blood pressures, heart rate, respiration rate, and skin impedance), except for a brief decrease in skin impedance (Nam *et al*., 2006).

It is logical, with the very high exposure of the cell phone user's head, that neurological effects will occur early in some users from acute and repeated exposures. On the other hand, Cancer, Cardiac, Reproductive and Neurological disease and mortality rates (CCRN), being chronic effects, are likely to take decades to be detectable in cell phone users by their rates being higher than the background rates radiation . Brain cortex interaction as shown by significantly altered human EEG by cell phone, during a 15min (Lebedeva *et al* ., 2000). The aim of the present study is to investigate the effect of cell phone on EEG, ECG, blood pressure and in both sexes of human.

Material and methods

Thirty two volunteers (16 males, 16 females) who had participated in the original study. During mobile exposure for a period of 30 minutes , EEG, ECG, some hemodynamic and blood glucose were measured . The mobile phone which used in the study was a Nokia model .

EEG recording

The frontal and occipital leads of three EEG flat electrodes to Earth, channal1 negative and positive, on the Bio Amp cable on the power lab(AD instrument)was used to recording alpha and beta waves.

ECG recording

The positive electrode to the left wrist, the negative to the right wrist, and the ground to the right leg were attached. Then, on the power lab(AD instrument) were connected for recording and analyzing ECG waves.

Blood pressure measurement

Systolic blood pressure (SBP) and diastolic blood pressure (DBP) were measured by mercuric sphygmomanometer .Pulse pressure (PP) and mean arterial pressure (MAP) were calculated from SBP and DBP as the following:

Pulse pressure = SBP –DBP

MAP= DBP-1/3 PP

Statistical analysis

Analysis of data was performed by using SPSS (Version 11.5). Results are expressed as mean ± S.E. Statistical differences were determined by paired student t -test .p value < 0.05 was considered statistically significant.

Results

People keep the mobile phone near their body. That cause penetrates electromagnetic wave after skin to the blood. The cell phone communicate with base station using (RF) radiation ,it has a thermal effect, which means it raises body temperature. A total thirty two student participants for thirty minuets used cell phone. The result of present study shown that cell phone exposure for 30 minutes did not statistically change hemodynamic parameters, however diastolic blood presser (dbp) and heart rate were slightly increased as seen in table (2,3). ECG waves and amplitude are also not changed with exception of QT inter vale as seen in (table 3).

Alpha and beta amplitudes were significantly increased during closed eyes after 30 minutes of cell phone exposure, while only Alpha amplitude was changed by this exposure opened eye (Figure 1, 2,3). In both opened and closed eye, alpha and beta frequencies were not changed by cell phone exposure as seen in Table (1).

Table 1: Short –term effect of mobile phone on EEG amplitude and frequencies in both males and females.

EEG waves and frequencies		Before mobile	After mobile	Statistical evaluation
closed eye	Alpha amplitude	6.6960 ±1.86718	22.1490±5.62912	P<0.037
	Alpha frequency	9.3470 ±.32284	9.5860±.262	N.S
	Beta amplitude	4.5570±.69639	11.5230±2.54734	P<0.028
	Beta frequency	21.8190±1.16066	22.4990±.94420	N.S
Open eye	Alpha amplitude	5.5400±.80312	18.4080±4.43324	P<0.020
	Alpha frequency	9.1080±.39340	9.4290±.39340	N.S
	Beta amplitude	4.5400±.80367	11.8860±4.50542	N.S
	Beta frequency	21.0870±21.0870	22.2070±.44431	N.S

Table 2: Short –term effect of mobile phone on and hemodynamic parameters in both males and females.

Hemodynamic parameters	Before mobile	After mobile	Statistical evaluation
SBP(mmHg)	112.9167±1.75276	112.5000±1.92711	N.S
DBP(mmHg)	71.6667±1.87147	74.1667±2.32478	N.S
PP (mmHg)	41.2500±2.50452	38.3333±2.73641	N.S
MAP(mmHg)	85.4167±1.40181	86.9444±1.78241	N.S

Table 3: Short –term effect of mobile phone on ECG waves in males and females.

ECG	Before mobile	After mobile	Statistical evaluation
RR Interval (s)	0.6848±.01750	0.6617±.01390	N.S
Heart Rate (BPM)	89.1000±2.08242	91.7857±2.02357	N.S
QRS Interval (s)	0.0735±..00324	0.0700±.00333	N.S
QT interval	0.3117±.00502	0.2961±.00381	P<0.016
Q Amplitude (mV)	-0.0513±.01549	-0.0439±.01537	N.S
R Amplitude (mV)	0.7822±.08052	0.8943±.09107	N.S
S Amplitude (mV)	-0.1526±..03024	-0.1404±..03189	N.S
ST Height (mV)	0.0317±.00746	0.0296±.00895	N.S
T Amplitude (mV)	0.2196±..01824	0.2178±..01890	N.S

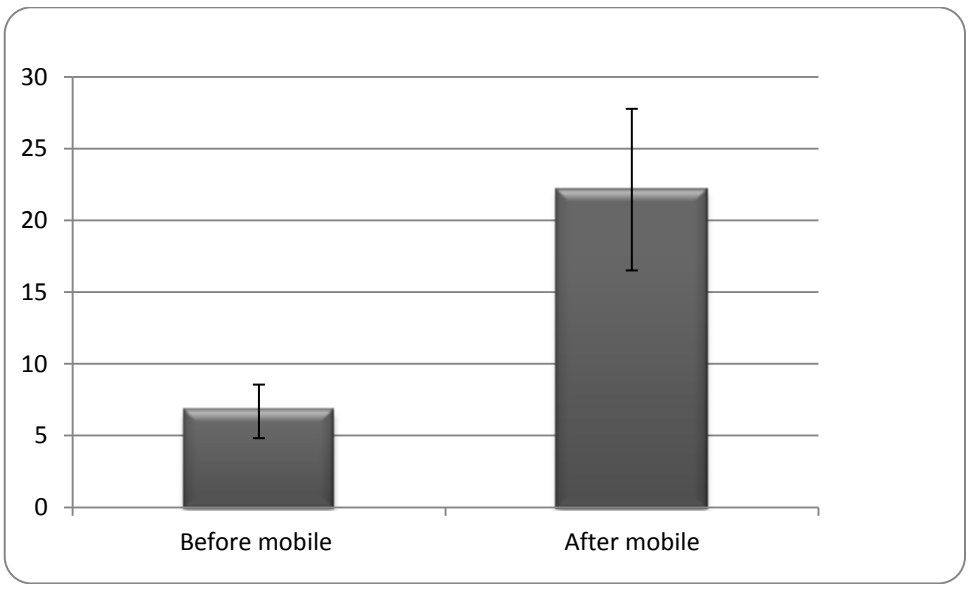

Figure 1: Short –term effect of mobile phone on alpha amplitude (closed eye) in males and females

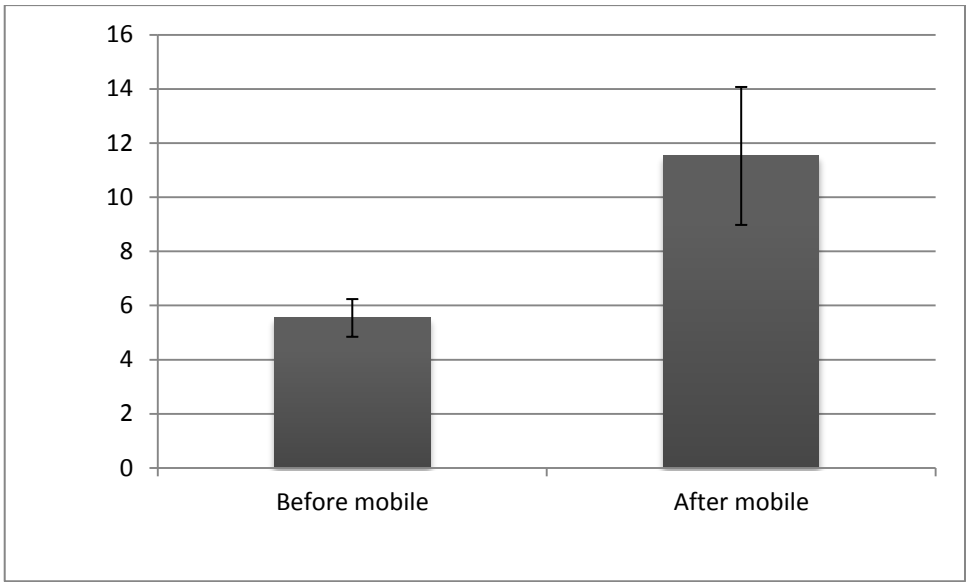

Figure 2: Short –term effect of mobile phone on beta amplitude (closed eye) in both males and females

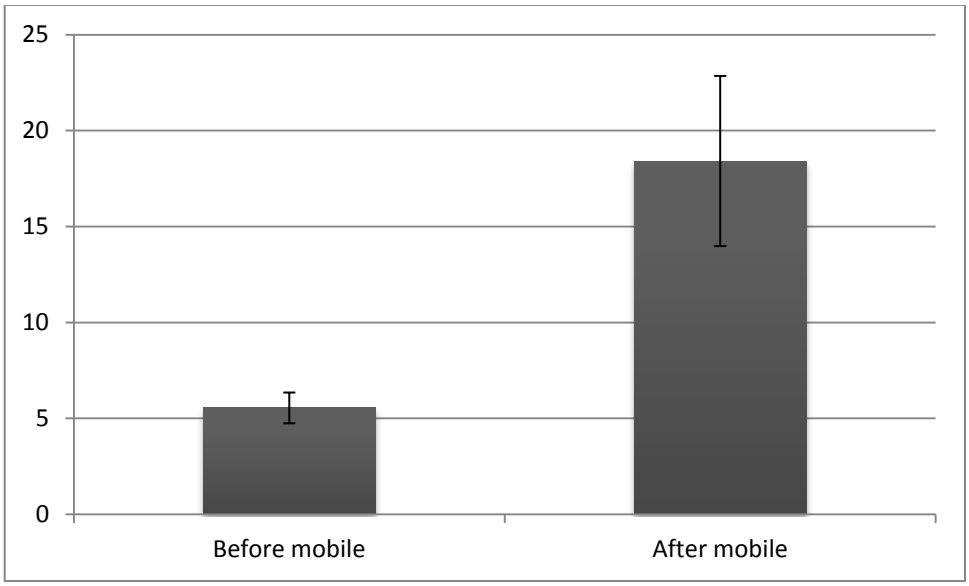

Figure 3: Short –term effect of mobile phone on alpha amplitude (Opened eye) in both males and females

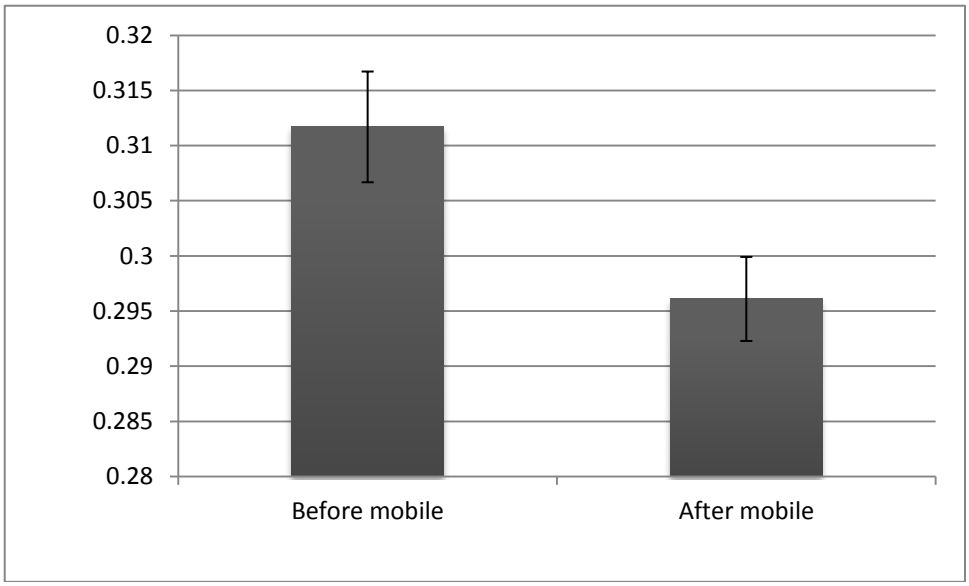

Figure 4: Short –term effect of mobile phone on QT intervals in both men and women

Discussion

Statistical analysis revealed that alpha and beta amplitude during closed eye were increased after cell phone exposure for 30 minutes. Alpha amplitude was also significantly elevated during opened eye as shown in table 1 and figure(1,2,and 3). The exact mechanism by which how cell phone affect brain waves is not fully explained ,however there is now evidence that the brain is very sensitive to radiofrequency and electromagnetic field (Cherry,2002) which produce during espousing by the mobile phone.Several experiments have revealed short-term changes in electroencephalographic (EEG) spectral power during both waking(Croft *et al* ,2010, Regel *et al* ,2007 a) and sleep (Loughran *et al*, 2005 and Regel *et al* , 2007 b)in conjunction with exposures to mobile phone-like RF EMF. Alpha waves have a frequency of 8 to 13 Hz and are recorded especially in the parieto-occipital area. They occur when a person is awake and resting, with the eyes closed and the mind wandering.(Saladin,2003).

Previous research has shown that the EEG is affected by exposure to RF EMF, with the most consistent findings being an increase in EEG spectral power within the 8 - 14 Hz frequency range in both awake and sleep states during and/or following exposure (Croft *et al* 2002 and Regel *et al*, 2007c). Brain cortex interaction as shown by significantly altered human EEG by cell phone, during a 15min (Lebedeva *et al* ., 2000).

The result of present study shown that cell phone exposure for 30 minutes did not statistically change hemodynamic parameters, however diastolic blood presser (dbp)and heart rate were slightly increased as seen in table. (Croft *et al*, 2010, Regel *et al*, *2007* a).

ECG waves and amplitude are also not changed with exception of QT inter vale as seen in figure (4) .The slight change of heart rate after cell phone exposure may be due to the reduce QT interval,this change in QT interval which is represent depolarization and repolarization of the heart ventricles(Barret *et al*.,2010) may be due to that sympathetic neuron activation from brain ,which send signals to the heart .On other hand, there is evidence that cell phone may affect heart pacemaker, as a result ,the QT intervals may be reduces in its value.

In conclusion, the results suggested that cell phone exposure for 30 minutes affect alpha amplitude rather than beta amplitude values especially during closed eye. These changes of alpha waves represent the change in parieto-occiptal region of the brain.

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کاریگەری ماوەی کورتی بەکارهێنانی مۆبایل لەسەر هێلکاری کارەبای دڵ و مێشك وە پاڵەپەستۆی خوێن لە مرۆڤی نێرو مێ دا

پوختە

بەکارهێنانی مۆبایل ئامێرێکی سەردەمیانەیە بۆ گەیاندنی دەنگی. لەئەنجامی زۆر بەکارهێنانی ئەم تەکنەلۆژیایە، گرنگی زیاد بەکاریگەرەکانی لەسەر تەندروستی مرۆڤ بەتایبەتی ناوەندە کۆئەندامی دەمار دراوە.مەبەست لەم لێکۆڵینەوە بەدەرخستنی کاریگەری مۆبایل لەسەر هێلکاری کارەبای دڵ و هێلکاری کارەبای مێشك و پاڵەپەستۆی خوێن لەهەردوو ڕەگەزی مرۆڤدا. سی و دوو مرۆڤ (16نێر و 16مێ) لەم لێکۆڵینەوەیەدا بەکارهاتن. لەبەرکەوتنی مۆبایل بۆ ماوەی نیو کاتژمێر هەریەك لە هێلکاری کارەبای دڵ و هێلکاری کارەبای مێشك و هەندێك پارامیتەری داینەمیکی دڵ پێوەر کران.جۆری مۆبایلەکە نۆکیا بوو. شیکەرەوەی ژمێریاری دەری خست کە شەپۆلی ئەلفا و بێتا لەکاتی چاو نووقاندا بەرز بۆوە بەهۆی بەرکەوتنی مۆبایل بۆ ماوەی 30 خولەك.بەڵام هیچ گۆڕانکاریەك لەپاڵەپەستۆی خوێن بەدی نەکرا. هەرچەندە پاڵەپەستۆی خاوبونەوە بەڕێژەیەکی کەم بەرز بۆوە. هێلکاری دڵ هیچ گۆڕانکاریەکی بەسەردا نەهات ، تەنها درێژی نێوان کیو-تی نەبێت. لەدەرەنجامدا ئەنجامەکان پێشنیار دەکەن کە شەپۆلی ئەلفا زیاتر لەشەپۆلی بێتا کاریگەرتر کاری تێ کراوە بەتایبەتی لەکاتی چاو نوقاندا بەهۆی بەرکەوتنی مۆبایل بۆماوەی 30 خولەکدا. ئەم گۆڕانکارانە لەشەپۆلی ئەلفا گۆڕانکاری لەبەشی پلی پشتەوەو دیواری مێشك دەردەخەن.

تأثيد المدى القصير لتعرض الموبايل على تخطيط الدماغ والقلب و ضغط الدم في كلا الاناث و الذكور البشري

الخلاصة

ان استخدام الموبايل هو وسيلة العصر للاتصال. و ان الاهتمام العلمي جاءت لنتيجة الاستخدام الهائل لهذه التقنيات و تأثيراته الصحية وبالاخص على الجهاز العصبي المركزي . الهدف من الدراسة الحالية هو كشف تأثيرات تعرض الموبايل على الكهربائية الدماغ و كهربائية القلب و ضغط الدم. اثنا وثلاثون (16 ذكور،16 اناث) شاركت في الدراسة الحالية. خلال التعرض لمدة 30 دقائق قيست كل من تخطيط الدماغ والقلب و بعض مقايس الهيموداينميك. و ان نوع الموبايل هو في نوع النوكيا. كشفت التحليل الاحصائي بان الموجة الفا و بيتا قد ارتفعت خلال غلق العيون عندما تعرض الاشخاص لمدة 30 دقائق. واضهرت من النتائج بان القياسات ارتفعت ولكن بشكل غير المعنوي. و ان تخطيط القلب لم تغيرت باستثناء قيمة (كيو-تي). و يستنتيج من النتائج الحالية بان قيمة الفا ارتفعت بشكل اكبر من موجه البيتا خاصة في غلق العيون عندما تعرض لموجات الموبايل لمدة 30 دقائق. و يدل هذه التغيرات الى التغيرات في الفص الامامي- الجداري للدماغ.