Research Article

Effect of mobile phone radiofrequency on Cognitive function among children users.

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Abstract
Background : Mobile phone use is increased worldwide, most of mobile phone users are from the young age, Our study is carried out to explore negative effects of mobile phone radiofrequency (MPRF) on IQ grades of the children. **Methods:** our study is a (case-control) pilot study on 30 children as users (cases) 12-18 years old, and 30 age matched nonusers (controls). We used Stanford Binet intelligence scale for assessment of the IQ and its grades. **Results:** there were significant differences between nonusers and users in the full scale IQ p=0.02, grading of the full scale IQ p=0.01, nonverbal IQ p=0.03, and verbal IQ p=0.01, but no significant differences in the distribution of grades between non users and users. **Conclusions:** We found negative effects of MPRF on IQ distribution between MP non users and users which predict harmful effects in the teens who are frequently using mobile phones for calling.
Keywords: Mobile phone, radiofrequency, young age

Introduction
There are 5.11 billion unique mobile users in the world today, up 100 million (2 percent) in the past year [1] and youth represent a large sector of this quantity [2]. This worldwide use of radiofrequency (RF) generating devices raised the concerns about possible hazardous health effects from exposure to RF radiation. Given the fact that children and adolescents are still in the developmental process, there is concern over the question of whether children are more sensitive to electromagnetic fields (EMF) than adults.[3] Neurological functions are of special concern given that the brain is heavily exposed while calling with a mobile or cordless phone[4]. Present-day adolescents will likely have higher cumulative life time exposure to RF-EMF, and the developing brain might be particularly susceptible to RF-EMF–induced alterations up to15y of age.[5] In the present study we aimed to explore whether the exposure to mobile phone radiofrequency is associated with changes in intelligence quotient in adolescents.

Subjects and methods
This pilot (case-control) study was conducted in pediatrics outpatient clinic at Minia university hospital, Egypt, during the period from June 2016 to July 2017 on 60 children of different socioeconomic status, 30 users (cases) and 30 nonusers (controls) aged from 12–18 years.

Exclusion Criteria
Children with psychiatric disorders, or Children suffering from any chronic illness or receiving any medicine known to affect cognitive function. All children were subjected to the following: Detailed history taking, with fulfillment of the questionnaire that includes RF-EMF exposure measures which was answered by the children and their parents, those measures were categorized in to duration of calls per minutes, frequency of calls per day, total number of voice calls weekly and duration of mobile phone usage by years and Laterality of putting the phone on which side of the head during active call operation either RT, LF or both sides.

Intelligence quotient assessment
The participating children were subjected to the Stanford Binet Intelligence Scales–Fifth Edition (SB5) and Scoring was done by Windows-based software SB5 Scoring Program [6].

Results

The users were negatively affected than nonusers and users in the full scale IQ p=0.02, grading of the full scale IQ p=0.01, it was noticed that where they nearly have the same distribution within the average intelligence where 56.7% and 60% in nonusers and users respectively, 26.7% versus 3.3% in the high average grade respectively, and 6.7% versus 23.3% in the low average grade respectively. However 13.3% were in the superior group in the users versus 3.3% in the nonusers.

Also there were significant differences in the nonverbal IQ p=0.03, and verbal IQ p=0.01in this age group, but no significant differences in the distribution of grades between non users and users.

Table (1) Demographic and clinical data of the studied children:

Age group (12-18 years)		Control	Cases	P value
		N=30	N=30	
Age	Mean±SD Range	13.9 ±1.3 (12-17.9)	14.7 ±2 (12-17.9)	0.09
Sex	Male Female	15(50%) 15(50%)	14(46.7%) 16(53.3%)	0.796
Residence	Urban Rural	25(83.3%) 5(16.7%)	28(93.3%) 2(6.7%)	0.424
School	Governmental Private	27(90%) 3(10%)	24(80%) 6(20%)	0.472

Significant difference at P value < 0.05

Table (2): prevalence of use of mobile phone among cases

Age group (12-18 years)		Cases
		N=30
Number of call/day	Mean ±SD (Range)	5.067±2.7 (5-15)
Number of call/week	Mean ±SD (Range)	31±17.4 (10-100)
Duration of call by minutes/ day	Mean ±SD (Range)	5.3±4.3 (1-15)
Duration of use/years	Mean ±SD (Range)	3±1.2 (1.5-5)
Laterality	RT LT Both	97% 3% 0%

Table (3): comparison between IQ grades between non users and users in adolescents groups

Age group (12-18 years)		Controls	Cases	P value
		N=30	N=30	
Full scale IQ	**Mean ±SD (Range)**	106.3±11.6/ (87-134)	99.9±12.4/ (84-128)	0.02*
Full scale IQ	**Moderately impaired**	0(0%)	0(0%)	0.01*
	Mildly impaired	0(0%)	0(0%)	
	Borderline impaired	0(0%)	0(0%)	
	Low average	2(6.7%)	7(23.3%)	
	Average	17(56.7%)	18(60%)	
	High average	8(26.7%)	1(3.3%)	
	Superior	1(3.3%)	4(13.3%)	
	Gifted	2(6.7%)	0(0%)	
	Very gifted	0(0%)	0(0%)	
Nonverbal IQ	**Mean ±SD (Range)**	105.4±12.7/ (85-137)	98.4±13.7/ (80-130)	0.03*
Nonverbal IQ	**Moderately impaired**	0(0%)	0(0%)	0.224
	Mildly impaired	0(0%)	0(0%)	
	Borderline impaired	0(0%)	0(0%)	
	Low average	3(10%)	9(30%)	
	Average	18(60%)	14(46.7%)	
	High average	6(20%)	5(16.7%)	
	Superior	0(0%)	1(3.3%)	
	Gifted	3(10%)	1(3.3%)	
	Very gifted	0(0%)	0(0%)	
Verbal IQ	**Mean ±SD (Range)**	104.5±10.6/ (84-1125)	98.9±10.6/ (84-125)	0.04*
Verbal IQ	**Moderately impaired**	0(0%)	0(0%)	0.147
	Mildly impaired	00%)	0(0%)	
	Borderline impaired	00%)	0(0%)	
	Low average	26.7%)	7(23.3%)	
	Average	1860%)	18(60%)	
	High average	826.7%)	3(10%)	
	Superior	26.7%)	1(3.3%)	
	Gifted	00%)	1(3.3%)	
	Very gifted	00%)	0(0%)	

Significant difference at P value < 0.05

Discussion

This is a case-control study to demonstrate effects of MPRF on IQ and cognitive abilities of adolescent users. Our study found that, MPRF exposure has negative effects on full scale IQ, verbal IQ and NVIQ.

Our results was in agree with a study by Leung (2011) who provided support for an effect of acute 2G and 3G exposure on human cognitive functions, especially in adolescents.[7] Thomas (2010) in their study found 7% of children and 5% of adolescents using mobile phones showed behavioral problems. The higher the exposure, the higher the risk of problems.[8] Also, Children living near a radio transmitter were found to have reduced memory and attention as well as slower reaction times [9].

Lai (2004) [10] also found an intriguing effect with other environmental EMFs, in that exposure to a specific form of magnetic fields blocked the learning and memory deficits. Abramson et al., (2009) found that in children reporting more mobile phone voice calls, the accuracy of working memory was poorer, reaction time for a simple learning task shorter, associative learning response time shorter and accuracy poorer. [11]

The radiofrequency microwave radiation thus has the potential to be far more disruptive to the biological processes going on in the child's growing and developing brain and nervous system. Dark neuron degenerative changes were found in the brains of rats exposed pre- and postnatally to 900 MHz radiation. [12]

Another proposed mechanism by which EMF may affect the brain is by increasing the permeability of the blood-brain barrier (BBB). The BBB protects the brain from exposure to substances in circulating blood that could be toxic or disrupt the homeostasis of the brain microenvironment. Exposure to an electromagnetic pulse may increase the permeability of the BBB and perturb proteins that form the tight junctions that maintain its integrity. [13]

References:

1. Simon kimp 2019: DIGITAL 2019: Global internet use accelerates. We are social. 30 January 2019. https://wearesocial.com/blog/2019/01/digital-2019-global-internet-use-accelerates.Letstalk@wearesocial.com.

2. Goswami and Singh, 2016: Vandana Goswami and Divya Rani Singh, 2016: Impact of mobile phone addiction on adolescent's life: A literature review, International Journal of Home Science 2016; 2(1): 69-74.

3. Kheifets L, Repacholi M, Saunders R, van Deventer E 2005. The sensitivity of children to electromagnetic fields. Pediatrics; 116:e303e13.

4. Joseph W, Frei P, Roösli M, Thuróczy G, Gajsek P, Trcek T. 2010. Comparison of personal radiofrequency electromagnetic field exposure in different urban areas across Europe.EnvironRes110(7):658–663.

5. Kheifets L, Repacholi M, Saunders R, van Deventer E. 2005. The sensitivity of children to electromagnetic fields. Pediatrics116(2):e303–e313

6. Roid, G. H. 2003. Stanford -Binet Intelligence Scales, Fifth Edition, Technical Manual, Itasca, IL: Riverside Publishing.

7. Leung S, Croft RJ, McKenzie RJ, Iskra S, Silber B, Cooper NR, O'Neill B, Cropley V, Diaz-Trujillo A, Hamblin D, Simpson D 2011. Effects of 2G and 3G mobile phones on performance and electrophysiology in adolescents, young adults and older adults. Clin Neurophysiol.;122(11):2203-16.

8. Thomas S, Heinrich S, von Kries R, Radon K 2010. Exposure to radio-frequency electromagnetic fields and behavioural problems in Bavarian children and adolescents. Eur J Epidemiol.;25(2):135-41.

9. Kolodynski and Kolodynska. 1996. Motor and psychological functions of school children living in the area of the Skrunda Radio Location Station in Latvia. Sci Total Environ. 180: 87-93.

10. Lai H. 2004. Interaction of microwaves and a temporally incoherent magnetic field on spatial learning in the rat. Physiol Behav. 15;82(5):785-9.

11. Abramson MJ, Benke GP, Dimitriadis C, Inyang IO, Sim MR, Wolfe RS, Croft RJ 2009. Mobile telephone use is associated with changes in cognitive function in young adolescents. Bioelectro-magnetics.; 30(8):678-86.

12. Köktürk S1, Yardimoglu M, Celikozlu SD, Dolanbay EG, Cimbiz A 2013. Effect of Lycopersicon esculentum extract on apoptosis in the rat cerebellum, following prenatal and postnatal exposure to an electromagnetic field. Exp Ther Med. 2013 Jul;6(1):52-56. EpubMay 17.

13. Ding GR, Qiu LB, Wang XW, Li KC, Zhou YC, Zhou Y, Zhang J, Zhou JX, Li YR, Guo GZ.2010. EMP-induced alterations of tight junction protein expression and disruption of the bloodbrain barrier. Toxicol Lett 196(3): 154-60.