

The Effects of Mobile Phone Radiation on Memory in Male Rats

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Abstract—Studies show that there is association between noise pollution and Psychological and physiological diseases. The main aim of this study was to determine the effects of mobile phone radiation on memory in male rats. In our study male Wistar rats were randomly divided into control and mobile phone radiation receiving groups of 10 rats in each. The experiments were repeated for 3 times with a week interval. memory level was measured in animals using shuttle box. Data were statistically analyzed and compared between groups using ANOVA. The results indicated that memory level was decreased in rats exposed to mobile phone radiation compared to control rats ($P < 0.05$). Our findings show that mobile phone radiation have a significant role in reducing of memory level, according to which, it is required to avoid long term exposure to mobile phone radiation to keep healthy memory.

Keywords— Mobile Phone Radiation, Memory, Male Rat.

I. INTRODUCTION

MAGNETIC waves, waves in vacuum or matter have been expanded and including electric and magnetic fields that oscillate in phase and perpendicular to the direction of energy [1]. Sources manufacturer of magnetic wave, microwave and RF systems that exist in every environment and every individual can be exposed to electromagnetic waves are non-ionizing [2]. Identification of biological effects of microwave radiation is complex and controversial and there is evidence that shows these waves cause various biological effects on irradiated molecules according to intensity and frequency [3]. Studies show that a relationship between cell phone use and glioma or meningioma [4]. On the other hand studies show that current mobile phones are not safe for long-term exposure [5]. Some studies show that cell phone use increases the risk of brain cancer [6]. However, some findings suggest no significant difference in heart rate and blood pressure in subjects exposed to cell phone radiation [7].

The reports coming from studies conducted to elucidate the effects of mobile phone radiation on memory function are still conflicting, so, the present study was carried out to show the effects of mobile phone radiation on memory in rats using shuttle box method.

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II. MATERIAL AND METHODS

A. Animals

Adult Wistar rats weighting 200 ± 30 g were purchased and raised in our colony from an original stock of Pasteur institute (Tehran, Iran). The temperature was at 23 ± 2 °C and animals kept under a schedule of 12h light:12h darkness (light on at: 08: 00 a.m.) with free access to water and standard laboratory chow. Care was taken to examine the animals for general pathological symptoms. Food was withheld for 12-14h before death. This study was performed according to ethical guidelines relating to working with laboratory animals [8].

B. Apparatus

The training apparatus was a shuttle box consisting of two similar $15 \times 6 \times 7$ in. compartments (A and B) separated by a motor-driven guillotine door. The sides and top were gray wood, while the front was clear Plexiglas..

C. Protocol of Study

Male Wistar rats were randomly divided into control animals and rats exposed to mobile phone radiation . Rats were placed in shuttle box. The test was performed for 300 sec for each rat and was repeated twice at 5-day interval. High levels of memory was measured by increased length of time for the animal to emerge into the lighted portion of the apparatus and lowered memory was in proportional to increased length of time for the animal to emerge into the dark portion of the apparatus.

D. Statistical Analysis

All values are presented as mean \pm S.E.M. Statistical significance was evaluated by one-way analysis of variance (ANOVA) using SPSS 19. Differences with $P < 0.05$ were considered significant.

III. RESULTS

Figure I shows the mean time spent by animals to stay in lighted portion of the apparatus. The mean time in lightened portion of rats exposed to mobile phone radiation was significantly decreased compared to control animals ($P < 0.05$); according to which, memory level decreased in rats exposed to mobile phone radiation.

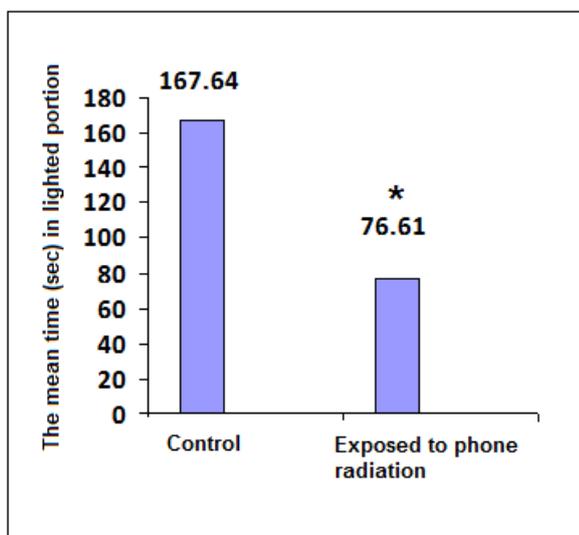


Fig 1 The mean time spent by animals to stay in lighted portion of the apparatus. * indicates significant difference compared to control group ($P < 0.001$).

IV. DISCUSSION

Our study indicated that mobile phone radiation results in decreased memory level. In line with this finding there are reports indicating that exposure of adult rats to electromagnetic radiation (EMR) may cause disturbances in monoamine neurotransmitters and this may underlie many of the adverse effects reported after EMR including memory, learning, and stress [10]. Studies also show the effects of mobile waves on hearing [11] activity and excitability of the brain [12,13], and on hormonal changes and cardiovascular system [14]. The destructive effects of microwave on muscle fibers and cell membranes have been also established [12,13]. However, in contrast to our finding some studies indicated that constant mobile phone users are not in a higher risk of brain tumor compared to the people who never or rarely use mobile phones [15-17].

V. CONCLUSION

We have shown that exposure to mobile waves can bring about decreased memory level, according to which, it is pivotal to avoid long term exposure to mobile waves to maintain good mental health and memory.

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REFERENCES

- [1] Serway RA, Ujewett JW. Physics for scientists and engineers (6th ed). BilalFarah ISBN. 2004; 534:40842-7.
- [2] Hossman Ka, Hermann DM. Effects of electromagnetic radiation of mobile phones on the central nervous system. *Bioelectromagnetics* 2003;24(1):49-62.
- [3] Baharara J., Oryan S., Asharaf A. The effects of microwave on the ovary and fertility of female balb/c mouse. *Journal of Science*; 2008; 7(3-4):931-940.
- [4] Muscat JE, Malkin MG, Thompson S, et al. Handheld cellular telephone use and risk of brain cancer. *JAMA* 2000; 284(23):3001-3007.
- [5] Hardell L, Carlberg M, Hansson Mild K. Pooled analysis of case-control studies on malignant brain tumours and the use of mobile

- and cordless phones including living and deceased subjects. *International Journal of Oncology* 2011; 38(5):1465-1474.
- [6] Howlander N, Noone AM, Krapcho M, et al. (eds.). (2013) SEER Cancer Statistics Review, 1975-2010. Bethesda, MD: National Cancer Institute. Retrieved June 24, 2013.
- [7] Colak C, Parlakpınar H, Ermis N, Tagluk ME, Sarihan E, Dilek OF, et al. Effects of electromagnetic radiation from 3G mobile phone on heart rate, blood pressure and ECG parameters in rats. *J Toxicol Ind Health*. 2011.
- [8] Stansfeld SA, Gallacher J, Babisch W, Shipley M. Road traffic noise and psychiatric disorder: Prospective findings from the Caerphilly Study. *BMJ* 1996; 313: 266-7.
- [9] Institute for Laboratory Animal Research (ILAR). Guide for the Care and Use of Laboratory Animals. Washington, D.C: National Academy Press; 1996. MENCH (2000); p 43-76.
- [10] Aboul Ezz HS, Khadrawy YA, Ahmed NA, Radwan NM, El Bakry MM. The effect of pulsed electromagnetic radiation from mobile phone on the levels of monoamine neurotransmitters in four different areas of rat brain. *Eur Rev Med Pharmacol Sci*. 2013 Jul;17(13):1782-8.
- [11] Hamblin, D.L., Wood, A.W. Effects of mobile phone emissions on human brain activity and sleep variables. *Int J Radiat Biol.*, 78: 659-690.
- [12] Radichera N. Effect of microwave electromagnetic field on skeletal muscle fiber activity. *Arch Physiol Biochem*. 2002;110(3):203-14.
- [13] Ozturan O, Erde T. Effects of the electromagnetic field of mobile telephones on hearing. *Acta Otolaryngol*. 2002;122(3):269-93.
- [14] Braune S, Riedel A, Schulte-Mönting J, Raczek J. Influence of a radiofrequency electromagnetic field on cardiovascular and hormonal parameters of the autonomic nervous system in healthy individuals. *Radiat Res*. 2002 Sep;158(3):352-6.
- [15] Ahlbom A, Feychting M, Green A, Kheifets L, Savitz DA, Swerdlow AJ. Epidemiologic evidence on mobile phones and tumor risk: a review. *Epidemiology*. 2009;20(5):639-52.
- [16] Ahamed VI, Karthick NG, Joseph PK. Effect of mobile phone radiation on heart rate variability. *Comput Biol Med*. 2008;38(6):709-12.
- [17] Kavvannejad R, Hadizade N, Mohammad Taghi R, Gharibi F. Effect of electromagnetic field of mobile phones on blood pressure, heart rate and