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Research Article

Effect of aerobic training on rate of total antioxidant capacity In ratsexposed to Wi-Fi radiation

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ABSTRACT

Electromagnetic radiation reduces total antioxidant capacity (TAC) and, on the other hand, regular aerobic exercise increase TAC. The purpose of this study was to investigate the effect of aerobic training on TAC in rats exposed to radiation emitted by the Wi-Fi router.24Wistar rats Divided into four groups: control group, Wi-Fi ,training and Wi-Fi+training. 8 weeks running on the treadmill for animals with 40 to 60% of maximum speed and radiation protocol was includes exposure to 2/45 GHz emitted by the Wi-Fi router.Before and 48 hours after the intervention, blood samples were taken.Plasma levels of TAC were measured and data were analyzed using one-way ANOVA, T-test and post hoc Tukey tests ($P \leq 0.05$).analysis of variance showed a significant difference between the study groups. Post-hoc test showed differences between all groups, except Wi-Fi+trainingwith training and control groups was significant.T-test results also showed a significant difference between pre-test and post-test was investigated.It It seems that aerobic exercise can have beneficial effects on the antioxidant system and cause TAC activity in people exposed to Wi-Fi radiation.

Keywords: Antioxidant capacity, Wi-Fi, aerobic training, electromagnetic radiation

INTRODUCTION

With the advent of science, the use of radio frequency technology and human-made electromagnetic radiation is increasing (1). Recently, low-frequency EMRs, including waves emitted from Wi-Fi routers, have been raised as new oxidizers and have raised concerns about their impact on human health (2). One of the consequences of exposure to EMR radiation is the increase in reactive oxygen species Cited (3). When ROS production exceeds the antioxidant defense, oxidative stress is said to be (2). However, EMR from different sources can produce different biochemical and physiological effects (4). Including that it can affect the cell membrane; simulate NADH oxidase in a plasmid membrane and produce superoxide superoxide(5). Several studies have examined the relationship between human health and exposure to EMR. Atasoy et al (2013) have shown that exposure to Wi-Fi with a frequency of 2.4 GHz reduces the activity of antioxidant enzymes (3). In the study of Megha et al (2015), 60 days (2 hours a day and 5 days a week), microwave radiation significantly increased levels of malondialdehyde as an indicator of lipid peroxidation and decreased levels of antioxidant enzymes (6). In a study by Turker et al (2011), the EMR radiation of 2.45 GHz caused an EMF reduction of antioxidant enzymes for 1 hour per day over a period of 28

days (7). Results from the results of Aynali et al (2013), Oksay et al (2014) and Nazıroğlu et al (2012) showed that exposure to the EMR of 45.2 GHz reduces glutathione peroxidase levels (8-10).

On the other hand, the human body has normal antioxidant systems and the function of this system increases with exercise. Sports activities as an external stimulant, by induction of antioxidant enzymes, reduce the amount of free radicals (11). Aerobic activity, if conducted with moderate to low levels, leads to a type of adaptation and protects the body against the effects of these stresses and increases the amount of antioxidant enzymes (12, 13). Some studies have shown that endurance training and adaptation to light and aerobic exercises lead to increased activity of antioxidant enzymes and increased total antioxidant capacity (14). In the study of Hejazi et al (2014), twelve weeks of aerobic training (3 sessions per week with an intensity of 65-75% of maximum heart rate reserve) showed a significant increase in total antioxidant capacity in the experimental group (15). AzamyanJazi et al (2017) showed that six weeks (three sessions per week), moderate-intensity continuous running, significantly increased serum levels of TAC in women who were rescued from breast cancer (16).Vezzoli et al (2014) by comparing the effect of eight weeks of moderate intensity training and severe periodic exercises on oxidative damage showed that the plasma relaxation TAC increased in moderate intensity training group, while there was no significant decrease in the intermediate training group with High intensity was not observed in this area (17). On the other hand, the results of Cardoso et al (2012) showed a negative relationship between injury indices and antioxidant defense immediately after exercise in both groups of severe and intermittent aerobic exercises (18).

Considering the results of previous studies have shown that exposure to EMR from Wi-Fi routers reduces the antioxidant capacity of the body and, on the other hand, regular aerobic exercises, by increasing the antioxidants, lead to some adaptation To deal with free radicals. And due to the different source and probably the mechanism of the effect of oxidative stress caused by emitted waves from Wi-Fi, and given that, according to authors, so far no studies have been done on the effect of exercise on the antioxidant capacity of EMR sources. Including Wi-Fi routers, inside or outside of the country, and all researches have merely examined the effect of one of the two subjects (radiation or exercise) on the index; for this purpose, the purpose of this study was " The effect of eight weeks of aerobic training on total antioxidant capacity in exposed Wi-Fi rats.

MATERIALS AND METHODS

Animals

The present study was carried out experimentally. 30 female two-month old female Wistar rats weighing 180-220 g at 22 ± 2 ° C under 12 hours of darkness and 12 hours of brightness and humidity of 45 ± 5% in an animal lab with free access to water and food And were maintained in accordance with NIH-Publication's Animal Care Principles. For the first week, animals were adapted to the laboratory environment. Then, to get familiar with running on a treadmill for animals, all experimental and control groups - to start the familiarization step effect on the variations of the research variables - for one week at a speed of 5 m / min, a 0 ° slope and a start time of 10 minutes (19). At the end of the week, a number of rats unable to adapt to running on treadmill were excluded from the study and the remaining 24 rats were randomly assigned to four groups of six controls, radiation, exercise, and radiation + exercise, and each group was placed in a separate cage Were given.

Practice protocol

The main training program consisted of 8 weeks (one hour per day, 5 days a week) running on treadmills for animals (20) for exercise groups (exercise and radiation + exercise), which in the first week with 40% of the maximum starting speed From the second to the fourth week, it ranged from 50 to 55 percent, and from the fifth to the eighth week, it reached 60 percent of the maximum speed. Maximum speed was measured using increasing exercise test. First, the rats started running at speeds of 11 meters and 6 tenths per minute. Then, speeds of 1 and 6

ths per minute rose to 20 meters per minute. After that, the speed rises to 3 and 2 tenths of a meter per minute, so that the rats get exhausted. The extinction was when the animal touched the canal 5 times in a minute (21). The length of each exercise session was one hour, with a warm-up program at the beginning of each training session, including a 5-minute running at 7 m Minutes and speeds up to reach the desired speed. The cooling operation was also performed at the end of the training by decreasing the speed step at the end of each training session (22). To minimize the difference in stress caused by manipulation, the control group was also placed on the treadmill for no more than 10 minutes daily (23).

Exposure protocol

The radiation protocol was that radiation and radiation groups + were exposed to radiation at a frequency of 45.2 GHz for a period of 1 hour per day, which was broadcast from a Wifi modem device (24). In order to minimize the interference and effect of the rest of the radiation on the results of the study, no other radiation device (even mobile researchers) during the study, in the laboratory, and up to 25 meters away.

Sampling

48 hours after the induction stage and 48 hours after the last session of the intervention (25)and after 10-12 hours of fasting, between 8:00 and 10:00 rats, using intraperitoneal injection of ketamine (60 mg/kg) and xylacin (5 mg/kg) were anesthetized (26)and 2.5 cc blood was taken directly from their heart (25). Samples were immediately poured into EDTA Acid anticoagulant dipped tubes and centrifuged at 1000 rpm for centrifuges and plasma separated in half-milliliter volumes and at -70° C until The test was maintained (26). TAC capacity was measured by ELISA using a valid kit of Assay Kit made by ZellBio GmbH in Germany. To implement the project blindly, biochemical measurements of variables and analysis of data were carried out by colleagues who did not know how to group the samples. In order to minimize the error of the test, all measurements for one variable were performed on a day. The methods and equipment used for all groups in both phases of blood sampling were the same.

STATISTICAL TESTS

Data were collected to compare the mean of changes using SPSS software version 23. After ensuring the natural distribution of the data collected by Shapiro-Wilk test, ANOVA was used for statistical analysis and comparison between the groups and Tukey's post hoc test was used to determine the difference between the groups. Also, t-test was used to evaluate the effect of intervention on the changes induced by use and values ($P \leq 0.05$) were considered significant. All statistical operations were performed using SPSS software version 23.

RESULTS

The results of one-way analysis of variance and dependent t-test for the analysis of intergroup and intragroup variations are presented in Table 1. Based on this test, there was a significant difference between the different groups in the levels of TAC in the post-test ($P < 0.05$). The results of Tukey's post hoc test (Table 2) showed a significant difference in the TAC variable between the different groups of research except for the group of radiation + exercise with exercise and control groups, although there was no significant difference. Based on the results of t-test, there were significant differences in intra-group variables

Table1. One-way analysis of variance analysis in different groups of research

		Sum of Squares	Df	Mean Square	F	Sig
preTAC	Between Groups	.002	3	.001	.142	.934
	Within Groups	.090	20	.004		
	Total	.092	23			
postTAC	Between Groups	1.024	3	.341	23.542	.000
	Within Groups	.290	20	.014		
	Total	1.314	23			

Table2. Tukey's post hoc test results to determine the location of the variable in the groups

Variable	groups	Groups	Mean Difference	p
TAC(Mm)	Cotrol	EMR	.32	.001
		Training	-.21	.026
		EMR+ Training	-.14	.202
	EMR	Training	.53	.000
		EMR+ Training	-.46	.000
TAC	Training	EMR+ Training	.073	.717

Table3. The results of t-test for comparing pre-test and post-test in different groups

groups	Mean ± Std. Deviation		df	T	p
	Pre	post			
Cotrol	1.035±0.10	1.036±0.03	5	-0.242	0.818
EMR	1.025±0.03	.717±0.19	5	4.378	0.007
Training	1.023±0.07	1.25±0.08	5	-15.558	0.007
EMR+ Training	1.010±0.03	1.179±0.03	5	-10.097	0.000

DISCUSSION

In terms of total antioxidant capacity, as with MDA, the results of one-way ANOVA showed a significant difference between the two groups. The results of Tukey's test showed that the difference between all groups except in the group of radiation+training with training groups and Control was meaningful (Table 2). The fact that the eight week exposure to Wi-Fi 45.2GHz exposure reduced TAC and the other side had eight weeks of aerobic training increased TAC in the aerobic training group compared to control and radiation groups. The results of t-test indicated that these changes were caused by intervention. Total antioxidant capacity is an estimate of the potential antioxidants potential in the body that interacts with each other. In the living environment, complex interactions between antioxidant forces and oxidants occur, and what is estimated by this indicator is the net result of these interactions (27). Increasing the production of free radicals and reducing the activity of the antioxidant system of the body disturbs the balance of oxidants and antioxidants, reduces the antioxidant capacity and increases the oxidative stress and produces destructive effects in the cells (2, 28); However, any healthy cell is enriched with a protective mechanism containing antioxidant enzymes such as SOD and GPx to help prevent harmful molecules frombeing converted to harmful molecules to maintain a healthy balance of ROS within the cell. (23) Regular exercise exercises provide some kind of compatibility In antioxidant systems, this increases the resistance to oxidative stress (12) to Regular aerobic exercise is expected to improve the ability of the body's antioxidant system to counteract free radicals (19) and, by improving its antioxidant capacity, can reduce ROS and its complications (29).

In the radiation+training group, there was a significant increase in total antioxidant capacity in comparison with the radiation group based on ANOVA test results, but according to the Tukey test results, this difference was not significant between the aerobic training group and the control group (P=0.717) and (P=0.202). That is, although the regular aerobic exercise in this group increased total antioxidant capacity in comparison with the radiation group, this increase was not as large as that of exercise and control groups.

Long-term radiation of 45.2 GHz microwaves increases the formation of MDA and negatively affects the activity of antioxidant enzymes (23). Reducing the activity of antioxidant enzymes may be related to their greater use against free radicals and, on the other hand, due to the restriction of antioxidant enzymes by activated oxygen species (30). Therefore, it seems that part of the antioxidant enzymes involved in the coping and cleansing of active oxygen species derived from the waves and maintaining and improving the balance and balance of oxidants/ antioxidants, and perhaps this is why the total

antioxidant capacity in this group There are no aerobic exercise groups. However, since it has increased in comparison with the radiation group and on the other hand, in the group of radiation+training, total antioxidant capacity in the post-test has increased compared to the pre-test, it may be argued that aerobic exercise can increase the Total antioxidant capacity in people exposed to electromagnetic radiation.

Considering the variable variations in the radiation+training group, it is important to note this point. The present study is the first study to be carried out in this field, and so far no studies have been conducted inside or outside the country. One of the limitations of this study is the lack of accurate control of the diet and sleep time of the rats.

CONCLUSION

It seems that doing five sessions of aerobic exercise per week can help increase the total antioxidant capacity of people exposed to radiation emitted by Wi-Fi routers. It is suggested that other studies on the effect of different training methods on the oxidative stress indices from the Wi-Fi radiation should be made to clarify the various aspects of the research.

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CONFLICT OF INTEREST

The authors have not announced any conflicts of interest.

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