REPORT

on research regarding:

"THE CHANGING OF CERTAIN HEART RATE INDICATORS UNDER THE CORRECTIVE INFLUENCE OF AN AIRES SHIELD PRO DEVICE

on the electromagnetic radiation of a mobile phone (Prestigio)

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ABSTRACT

We studied the influence of the AIRES SHIELD Pro corrective device on the cardiovascular system during use a Prestigio mobile phone by 15 21-year-old male volunteers.

The methodological framework consisted of physiological and statistical methods of ECG research.

purpose of the work was to assess the possible correction of electromagnetic radiation from a modern Prestigio mobile phone (MP) using an AIRES SHIELD Pro neutralizer based on an analysis of indicators of heart rate (HR) dynamics such as heart rate variability (HRV), index of regulatory system stress (IRSS), heart rate regulatory processes adequacy indicator (RPAI), and the vegetative regulation stress coefficient (VRSC) based on the indicators of a ECG scatterogram. The study was carried out under four sets of conditions:

a) the powered-off MP is 10 cm from the subject's head (temporoparietal area of the brain)

b) the MP is powered on in **standby** mode (without sound)

c) the MP is powered on in **talk mode** without sound

d) the MP is powered on in talk mode without sound and **connected to an AIRES Shield Pro neutralizer**.

The research objective included the following:

- a) substantiate the selection of physiological heart rate indicators that are sensitive to the effects of electromagnetic radiation from a mobile phone
- substantiate the expediency and effectiveness of using an AIRES Shield Pro neutralizer for the purpose of correcting the negative effects of electromagnetic radiation (EMR) from a modern mobile phone.

INTRODUCTION

As early as the 20s of the last century, Academcian V.I. Vernadsky spoke about electromagnetic fields (EMF) and the sources of electromagnetic radiation (EMR) that create these fields. In the 60s, L.A. Chizhevsky discovered changes in the properties of Corynebacterium diphtheriae (the causative agent of diphtheria) in response to solar disturbances [1963]. Four years earlier [1959], he put forward the theory of electrical and magnetic interaction of structural elements of blood, having shown that given an increase in solar activity indices and an increase in the earth's magnetic field, the functioning of hematopoietic organs is disrupted. He discovered the geometric regularity of red blood cells in the bloodstream and proved that under the influence of electromagnetic flows, erythrocytes in the blood moving through the blood vessels of healthy people and animals form "stacks of coin". He thereby laid the foundations for the structural analysis of blood. This fact was recently "discovered" once again [https://kp.ua/life/500683-uchenye-vyiasnyly-vkluichennyi-smartfon-vlyiaet-na-krov].

And though humans have largely adapted to the action of the natural electric and magnetic fields of the Earth, atmospheric electricity, radio emission from the Sun and the Galaxy, due the mass use of cellular communications and other devices, humans must now again adapt to the total anthropogenic EMF intensity, which significantly outstrips the natural baseline.

More and more evidence of the harm of mobile phones (MP) and other gadgets on human health is emerging.

It has been proven that when a MP contacts a human head, in its temporoparietal zone, the brain itself becomes an integral part of the "brain-MP" transmitter system. Moreover, the flow of EMR in the band from 400 to 1200 MHz leads to "local" thermal overheating of this area of the brain and forms "cooked" areas of the brain [Suvorov, Paltsev, 2002; Grigoriev, 2003, 2014; Gvozdarev, 2004; and others].

In addition to local damage when exposed to a MP's EMR, the body experiences disruptions in biochemical processes. There are changes in the metabolism of carbohydrates, proteins, nucleic acids, and the makeup of hormones from the pituitary gland, adrenal glands, thyroid and gonads. The production of melatonin decreases. Cumulatively, this leads to decreased immunity, oncological diseases, impotence, disrupted bone formation, cognitive impairment, and so on. [Grigoriev, Stepanov, 1998; Grigoriev, 2003; Odinaev, 2015; Zhavoronkov, 2016; Rakhimbekov, 2017; Khorseva, 2017; Hardell, Hansson, 2005; Lahkola et al. 2007; Sadetzki et al, 2008; Divan, 2008; Fragopoulou, 2010; Volkow, 2011 and others.].

Mobile phone manufacturers believe that modern phones have SARs (specific absorption rates) below the permissible values and that they have a more sensitive receiver, which allows the use of a lower-power base station transmitter and increased communication distance, reducing the negative impact of mobile phones. Moreover, it is believed that MPs are the safest in standby mode, when the intensity of electromagnetic radiation is reduced. However, there is data that indicates that a MP simply lying next to a person reduces his or her cognitive abilities [Ward, Duke, Gneezy, Bos, 2017]. Children are especially affected.

Nevertheless, due to the lack of clear correlations between the a person's functional state and the consequences of the influence of a mobile phone, the question of whether a mobile phone is harmless has not yet been taken off the agenda. There is no clear understanding of the mechanism of a mobile phone's impact on a person, and therefore no clear understanding of methods to correct it.

Hence, the purpose of this work was to perform a comparative study of the effect of the AIRES SHIELD Pro neutralizer on the dynamics of certain heart rate indicators in young volunteers when exposed to EMR from modern mobile phones in various modes and to analyze the possibility of using the neutralizer to correct emergent deviations.

MATERIALS, RESEARCH SCOPE AND METHODS

In this work, we used a modern Prestigio smartphone. The research was conducted carried with the informed consent of 15 apparently healthy male volunteers, aged 21 years, using a double-blind method in accordance with the ethical standards of the World Medical Association's Declaration of Helsinki (2000). The stability of the body's functional state (in terms of an EEG and ECG) during the course of the one to two weeks of research (04/05/2020 - 04/18/2020) was a requirement for the subjects' inclusion in the study.

EEGs and ECGs were recorded using the Encephalan 131 03 software package with built-in programs for recording and performing preliminary analysis of EEGs and ECGs.

Each subject was located in a darkened, soundproof room, in a reclining position with closed eyes, making it impossible to hear and follow the actions of the researcher. The mobile phone was always placed at a distance of 10 cm to the right of the subject's head in the projection of the frontotemporal area of the brain. The subject did not know the scenario determining the sequence in which stimuli were presented. This excluded the possibility of the formation of a mental attitude toward the research process.

Research scenarios:

1. record and visually analyze the EEG and ECG in accordance with the requirements and criteria of functional diagnostics for the selection of subjects
2. record an ECG in the first standard lead (limb-limb) and analyze a number of its baseline parameters (2 minutes)
3. record an ECG in the first standard lead (limb-limb) and analyze its parameters (5 minutes) with the MP powered off (standby)
4. record an ECG in the first standard lead (limb-limb) and analyze its parameters (5 minutes) with the MP powered turned in talk mode with sound off
5. record an ECG in the first standard lead (limb-limb) and analyze its parameters (5 minutes) with the MP powered turned in talk mode with sound off and a microprocessor ({MT + AIRES Shield Pro}).

We analyzed the artifact-free ECG segments in the first standard lead (limb-limb).

We evaluated the following:
1. the change in the spread of RR interval (**HRV**) values, as one of the main parameters of heart rate variability, which give an idea of the standard (root-mean-square) deviation of RR intervals from their mean [Baevsky 1979].
2. dynamics of the index of regulatory system stress or stress index (**IRSS**), which describes the level of stress from mechanisms for regulation of the heart rate, which is calculated using the formula IRSS = Amo / 2 * Mo * VAR, where Amo is the amplitude of the mode, Mo is the mode, and VAR is the range of variation of the RR interval values [Baevsky, 1979]
3. regulatory processes adequacy indicator (**RPAI = Amo/Mo**), which makes it possible to determine the effect of exposure on the sinus node of the sympathetic division of the vegetative nervous system [Baevsky, 1979; Baevsky, Berseneva, 1997; Yabluchansky, Martynenko, 2010]
4. stress coefficient (**VRSC = L/w-1.618)**, calculated on the basis of the data of the correlation rhythmogram (scatterogram), which makes it possible to assess the intensity of the mechanisms of heart rate (HR) regulation, where L is the length of the scatterogram cloud, w is its width, and 1.618 is the golden ratio [Ivanov et al., 2002; Patent 2002, Kuznetsova, Ivanov, 2015, 2016].

Due to the small sample size, the reliability of the results was assessed using the non-parametric Wilcoxon test with a confidence interval of at least $p < 0.05$.

RESEARCH RESULTS AND DISCUSSION.

1. **Heart rate variability** (HRV) reflects the irregularity of the heartbeat (RR intervals), which, according to R.M. Baevsky [1979], is caused by the nonlinearity of the regulation of the sympathetic, parasympathetic, and humoral systems, their connections with each other, with subcortical and cortical formations, and reactions to mental, physical, and other types of stress.

Statistical analysis of the data obtained revealed that HRV tends to increase relative to the baseline under the influence of a MP in standby mode and in talk mode, but without sound. This may indicate some emotional tension due to the subjects' mental attitude when anticipating the research. According to the conditions of the study, the subjects knew the essence of the study, but did not know the order of presentation of stimuli. Therefore, uncertainty about the situation could provoke a tendency to increase HRV (Fig. 1).

Moreover, there were no significant differences in HRV in standby mode and in the mode with a powered on MP without sound. The lack of differences can be explained, on the one hand, by the insufficient number of subjects, and on the other hand, possibly because the MP in "silent" mode did not have a significant impact on work of the vegetative nervous system (VNS) and the body's related system for adaptation to external influences.

The opposite effect was found when under the influence of the MP and neutralizer (MP+), when HRV reliably ($p < 0.05$) increased both relative to the baseline and relative to the two previous states.

Research by R.M. Baevsky [1979, 1997] showed that HRV reflects the effectiveness of the functioning of autonomic nervous regulation of the body, in particular, the heart's ventricular rhythm. Consequently, an increase in heart rate variability indicates activation of the parasympathetic nervous system and improvement of the body's functional state.

When a MP is brought to a person's head, his or her brain becomes a conductor and forms a closed circuit: brain-MT-neutralizer. Moreover, the neutralizer becomes an active participant in this circuit. The emerging triad probably leads to an imbalance in the work of the medulla oblongata, which specifically includes the centers of regulation of respiration and heart rate. AIRES SHIELD Pro neutralizer (MP+) not only reduced the negative impact of the mobile phone's EMR, but also normalized the subjects' emotional and functional state, improving the functioning of the autonomic (vegetative) nervous system.

2. Regulatory Processes Adequacy Indicator (RPAI)

As already mentioned, the cardiovascular center, which combines the parasympathetic, sympathetic, and vasomotor centers, is located in the medulla oblongata. These centers are regulated by subcortical nodes and the cerebral cortex. The regulatory processes adequacy indicator (RPAI) is used to identify the interrelationship between the level of functioning of the sinus node (SN) and sympathetic activity. This indicator is calculated based on data of the amplitude of the mode of the RR intervals (AMo is the difference between the largest and the smallest RR intervals) and the mode (Mo is the most frequent RR interval). These indicators allow us to evaluate the involvement of the sympathetic and parasympathetic divisions of the VNS. The parasympathetic effect is manifested by a large range of temporal characteristics of the RR intervals, and acetylcholine has pronounced trophic effects on the myocardium, which together indicates the high level of the circulatory system's functional reserves, i.e. the body's adaptive capabilities.

The strengthening of the sympathetic (ergotropic) effect indicates the predominant centralization of regulation of the SN and an increase in the physiological cost of adaptation, i.e. a decrease in functional reserves of the heart and the body as a whole.

Figure 2 illustrates the change in this indicator under the influence of the MP in comparison with the initial state (baseline), where we can see a significant ($p < 0.05$) decrease in the magnitude of the RPAI under the influence of a microprocessor relative to the baseline. Consequently, the influence of the parasympathetic nervous system increased under the influence of the MP. The cardiovascular system's degree of adaptation to the effects of the MP's EMF increased, and the subjects' functional state improved. This confirmed the previous conclusion.

3. Index of regulatory system stress (IRSS), or stress index.

The index of regulatory system stress is an equally important indicator in assessing the cardiovascular system's adaptation to stressful influences.

This indicator reflects the degree of centralization of management of the vegetative nervous system and heart rate, among other things. It has been proven that the smaller the IRSS value, the more the activity of the parasympathetic division and the autonomous regulatory circuit and the higher the IFS ($IFS = L \times (L/w) \times RR$), i.e. a better functional state and higher adaptive capabilities. These two indicators are inversely related to each other and indicate the intensity of the mechanisms of regulation of the heart rhythm. The IRSS is extremely sensitive to the sympathetic nervous system's increased tone, and even a small load (physical or emotional) increases it by 1.5-2 times; under significant loads, it grows 5-10 times. It is measured in conventional units. In healthy people, it does not exceed 140 cu.

As shown in Fig. 3, the baseline IRSS was within the limits of 40 cu. In the standby (base) and MP-powered-on-but-silent scenarios, the IRSS increased and significantly ($P < 0.05$) differed from baseline state. However, these two states did not differ, which is consistent with the previous changes in the HRV and RPAI. This is also consistent with data from other authors [Ward, Duke, Gneezy, Bos. 2017], confirming that even simply locating a mobile phone near a person (just like anxiety while waiting) worsens his or her functional state and indicates tension (stress) in functional systems. However, when the microprocessor is powered on (MT+), the IRSS significantly ($p < 0.05$) decreased (almost 2 in comparison with the MP) with respect to the first three states. The IRSS's reliable decline in the situation (MT+), once again suggests that the subjects' functional state improved due to the increased influence of the parasympathetic nervous system.

Thus, when connected the MP, the microprocessor reduces the degree of stress of regulatory systems, increasing the body's functional reserves for maintaining homeostasis.

It should be emphasized once again that the subjects did not know the research scenario and, therefore, could not adjust themselves mentally for the "powering on of the MP", "listening" to it, or connecting the microprocessor.

And finally, one more indicator — **the coefficient of stress of heart rate regulatory mechanisms (VRSC).**

Research by R.M. Baevskigo [1979, 1997] and N.I. Yabluchanskiy [2010] showed that in the spectral analysis of the heart, the length [L] of the scatterogram correlates with the low-frequency part of the spectrum, slow waves (LF) in the range from 0.04 Hz to 0.15 Hz, which corresponds to a period between 7 seconds and 25 seconds and reflects the work of the sympathetic system (the main mediator is norepinephrine).

The high-frequency component of the spectrum in the range from 0.15 Hz to 0.4 Hz corresponds to a period between 2.5 sec and 7 seconds (HF), is mainly responsible for the work of the parasympathetic system and for breathing, and correlates to the width [w] of the scatterogram. The main mediator is acetylcholine. The LF/HF ratio reflects the balance of the sympathetic and parasympathetic nervous systems.

In order to quantify the stress of autonomic heart rate regulation, we introduced a coefficient (VRSC = L/w-1.618), which is expressed in conventional units and is calculated based on the change in the length (L) and width (w) of the subjects' scatterograms. Besides the balance of the divisions of the vegetative nervous system, this indicator reflects well the emotional state of the subjects [Invention Patent No. 2005114249/20 (016343), No. 2005114250/20 (016343), No. 2005114251/20 (016343); Ivanov et al., 2002; Kuznetsova et al., 2006; Kuznetsova, Ivanov, 2016].

Fig. 4 shows changes in this indicator depending on the time of the study.

As can be seen from the figure, the coefficient of stress (VRSC) of heart rate regulatory mechanisms in the baseline was significantly ($p < 0.05$) lower in comparison with the three other states.

In a situation where the MP is near the subject's head (base), this indicator significantly ($p < 0.05$) increased relative to the initial state, which indicated a moderate predominance of parasympathetic activity and increased concentration of attention. However, when the MP is turned on (without sound), the value «K» revealed a downward trend relative to the "base", which gave reason to assume an increase in the sympathetic, centralized influence of the MP on subcortical formations [Kuznetsova, 2006; 2016].

When the microprocessor is included (MT+), VRSC reached its maximum values ($p <0.01$) for the entire study period, which indicated a pronounced predominance of the parasympathetic nervous system and autonomic regulation of heart rate.

Thus, we can conclude that the MP plus the processor reduce the stress of heart rate regulatory mechanisms, improving the adaptive capabilities of the cardiovascular system by influencing the subcortical formations of the brain. This data is consistent the results of research by other authors [Ganelina, 1973, 1975; Chizhevsky, 1980; Andronova, 1982; Vladimirsky, 1982; Grigoriev, 2001, 2014; Blyakher, 2017], which proved the negative impact of a mobile phone's EMR on human health.

CONCLUSIONS

Under the influence of an AIRES Shield Pro neutralizer:

1. the heart rate variability (HRV) increased
2. the heart rate regulatory processes adequacy index (RPAI) increased
3. the stress index (IRSS) decreased
4. the coefficient of stress of heart rate regulatory mechanisms (VRSC)

Thus, heart rate variability is an important characteristic of the work of the heart muscle (myocardium) due to the relationship between the centers of the medulla oblongata (autonomic regulation) and the cerebral cortex (centralization of regulation) of the brain.

Autonomic and central regulation are closely related. That is why the body constantly adjusts (adapts) to various kinds of influences, including the effects of natural and anthropogenic EMF and EMR. If the effects of the former on human health have been studied for several decades, then the role of the latter has been little studied. And there are not sufficiently reliable methods of protection.

The results of the study suggest that the revealed unidirectional changes in the four analyzed indicators of heart rate variability, which indicating an increase in the influence of the parasympathetic (autonomic) nervous system, i.e. an improvement in the body's functional state, are the result of the effects of the AIRES Shield Pro neutralizer. Additionally, there is reason to believe that the AIRES SHIELD Pro neutralizer contributed to the improvement of the subjects' emotional state. We can conclude that the AIRES SHIELD Pro neutralizer as a whole acts as a health-improving procedure, increasing the body's physical and psycho-emotional adaptive capabilities.

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Fig. 1. Comparative characteristics of variability among subjects depending on the proposed tasks. Key: The abscissa is the "baseline" – state before the start of the test, "base" – waiting for the study, telephone (MP) near the subject, but not switched on, MP – switched on, but with talk turned off, and MP+ – powered on with the addition of a microprocessor (correct – to +); The ordinate is the frequency of heart contractions, ms.

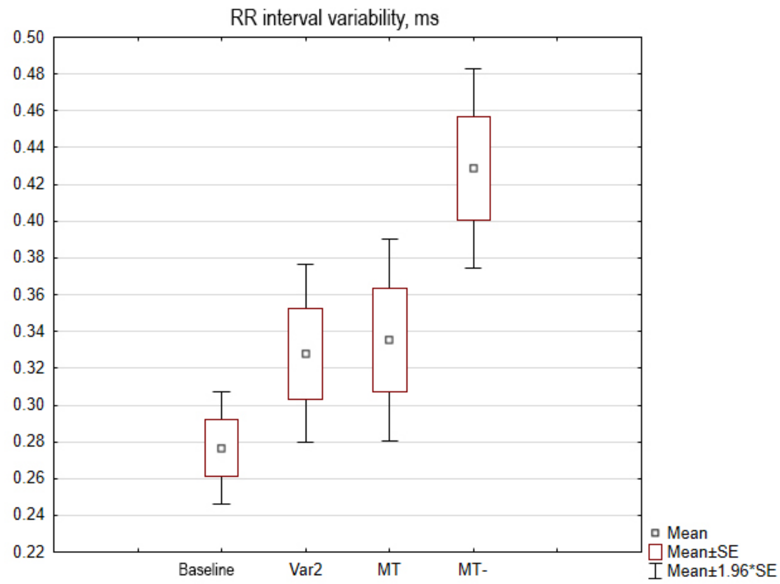

Fig. 2. Change in heart rate regulatory processes adequacy indicator (RPAI) under the influence of a microprocessor

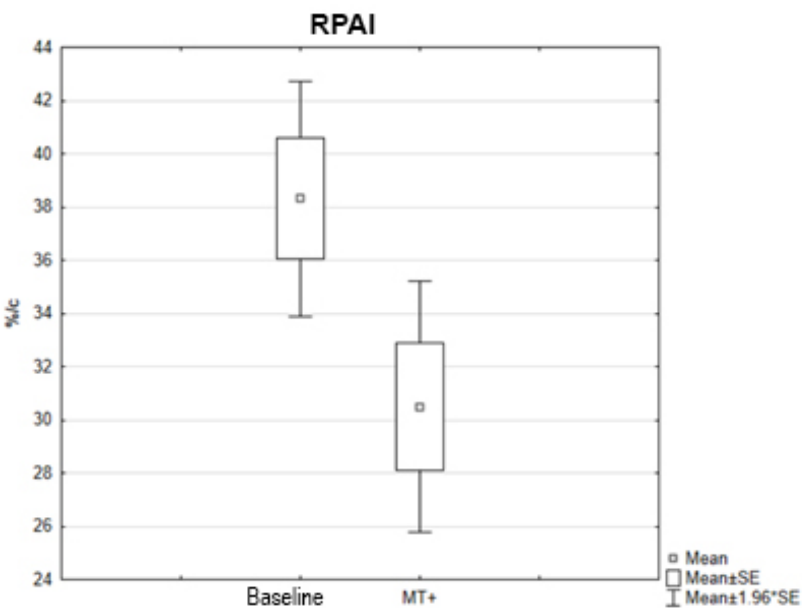

Fig. 3. Comparative dynamics of the IRSS value (stress index) of subjects in various states

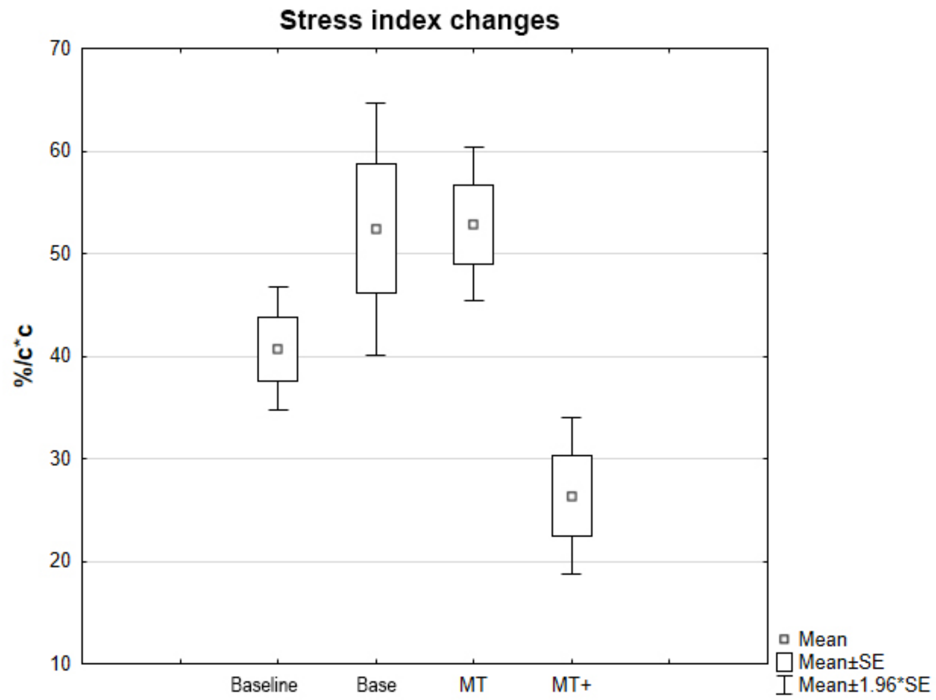

Fig. 4. Comparative dynamics of the stress coefficient of the vegetative regulation of test subjects in various states.