

Human Body Affected by Mobile Phone and Electromagnetic Radiation

Richard Kaľavský¹, Silvia Duranková²

^{1,2}Department of Biology, Faculty of Humanities and Natural Sciences,
University of Prešov, 17. Novembra, SK-081 16 Prešov, Slovakia
Email: richard.kalavsky@smail.unipo.sk, silvia.durankova@unipo.sk

Abstract— Humans have been surrounded by various forms of radiation since creation. The first type of radiation is electromagnetic in nature. Radioactive radiation partly emanates from the earth surface. Nowadays, each of us uses a mobile phone daily. Computers, monitors, and televisions have added seriousness to this issue, as they generate both electrostatic and electromagnetic fields. Electromagnetic radiation can cause everything from insomnia to serious health problems that threaten people lives. It is this study that is intended to bring the issue of the occurrence and localization of such zones into focus. Such electromagnetic radiation, invisible to humans, is faced by a large part of the population. It is dangerous to stay in these locations for a long time. People who sleep in this zone for long periods of time are the most vulnerable. In our study, we also looked at the impact of the use of mobile phones and other devices that generate electromagnetic fields. In this study, our aim was to provide a theoretical overview of this issue, which has not received much attention, and which can be a trigger for many health diseases, especially in combination with geopathic zones.

Index Terms—Electromagnetic radiation, Health, Phone radiation, Electronic devices

I. INTRODUCTION

Since ancient times, man has known how to find out where geopathic radiation is, but the methods were not the most reliable at the time. In the last century, electrical engineering, electronics, and telecommunications began to develop very rapidly [1].

Our body, mind, endocrine system, glands and immune system are controlled by very weak electrical brain waves that interact with the electromagnetic environment. Therefore, there are many question marks as to whether man-made electromagnetic fields can be a source of health risks. Nowadays we are exposed to various types of electromagnetic radiation that is unnaturally high. Patients in hospital usually lie on a steel-framed bed where there may be several electronic devices around them. This is also the case in a typical bedroom, where a bedside lamp, electric clock, possibly a mobile phone charging and many others are placed on a bedside table near the bed. In some rooms there is even a computer or a TV with remote control. In such a case, the steel-framed bed will act as an antenna, and the electronics create electromagnetic smog that affects the well-being of the individual. Electric current in a wire is like water flowing through a pipe. An electric current must be induced to flow through the wire. Therefore, the higher the voltage, the stronger the electric field, and the stronger the current, and the greater the magnetic field. The electromagnetic field is determined by

the wavelength and frequency of its oscillation, we can compare it with waves on the surface of water. Wavelength is the distance between waves and frequency is the number of waves occurring in a given time. The Earth's natural electromagnetic fields operate at very low frequencies between 1 and 30 Hz, as do all biological systems. And 10-16 kHz is the human hearing range. [2] [3] [4].

In today's fast-paced times in which we live, we are exposed to a lot of stressful situations and stress itself. Therefore, the thought of whether stress has any effect on our health is quite out of place. Stress as such is a factor which can be a different trigger for various health problems, this factor is accepted even by WHO itself. Many people do not even perceive geopathic stress because they are unaware of its presence. From most of the available texts in the form of books, magazines, or on the Internet or scientific publications, we can read that geopathic stress is a complex phenomenon, composed of weak electromagnetic fields of different wavelengths. Of course, other types of radiation also contribute to geopathic stress, but many of them may not have been discovered yet [5].

Regardless of the source, electromagnetic fields can be harmful to health, affecting the nervous system, cardiovascular system or even the immune system, but also increasing the risk of cancer. In addition to geopathic stressors emanating from the Earth, there are electromagnetic fields created by modern technology around the world. Fields of technology typically originate from telecommunications, radio and television antennas, antennas, electrical poles and transformers. When it comes to geopathic stress, it must be understood that technical fields and also factors of space or irregularities of the earth's magnetic field cause much smaller and more serious diseases. The condition of the measured person observed in the geopathic zone compared to the more neutral zone showed an increased stress induction and an increased risk of damage to the immune system. Practitioners have noticed that some people experience a relatively rapid decrease in comfort when in geopathic zones. Some people experience symptoms of nervousness. [5] [6].

II. METHODS

In this study, 202 respondents including 56 males and 146 females completed an anonymous questionnaire. The questionnaire was freely available to the public in electronic form and respondents of different age groups could participate. The questionnaire was divided into several sections focusing on the impact and mobile phone

and electromagnetic field radiation. All the data obtained from the questionnaire were processed and evaluated in excel charts. However, the most relevant graphs are included in this study.

III. RESULTS AND DISCUSSION

Nowadays, people can't imagine a normal life without a mobile phone. Even this technological convenience has many opponents in the technology sectors. Mobile phones have experienced the biggest boom alongside computers. They became available in Slovakia in large numbers in 1991. Each year the number of owners of these devices has increased rapidly and is still increasing. We primarily use mobile phones for long-distance communication. This process is mediated by radio waves. In the Figure 1 we can see where our respondents leave their phone while they sleep [7].

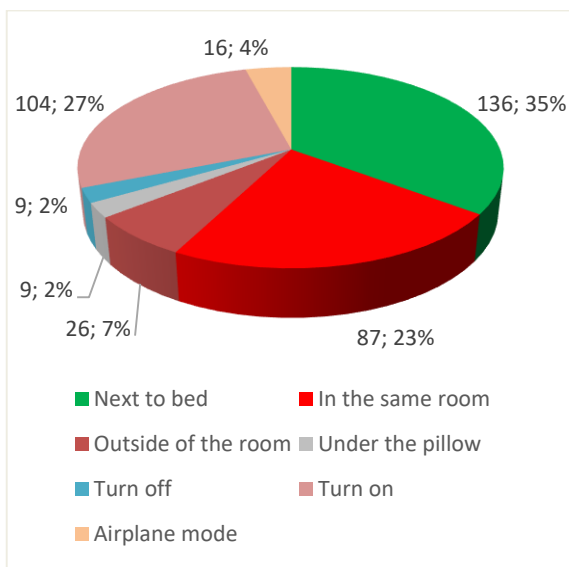


Fig. 1. Phone position during sleep

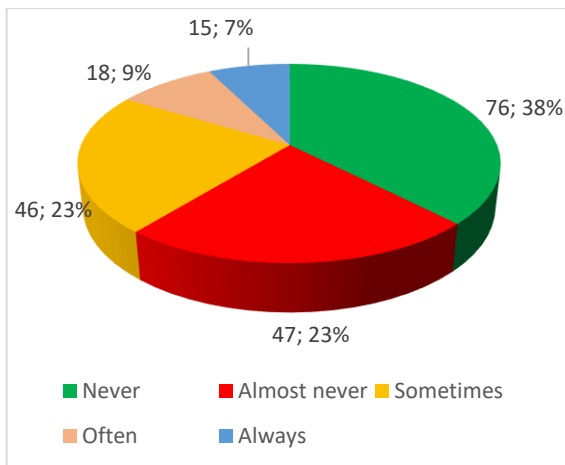


Fig. 2. Using a mobile phone during the night

Sleep is one of the most important human processes, but it is easily disrupted. Most people leave their mobile phone by their bedside at night, as shown in the Figure 1, with up to 136 respondents. As many as 104 participants leave their mobile phone on all night. The worst case of positioning the phone while sleeping is placing it under the pillow, as

9 of our respondents do. If the mobile phone and head are in close contact more interaction occurs. It is most ideal to keep the phone completely switched off during sleep and place it as far away from the room in which we sleep as possible. It is also very bad for our sleep patterns if the mobile phone is used at night during waking hours, as 7% of our respondents do Figure 2 [8] [9].

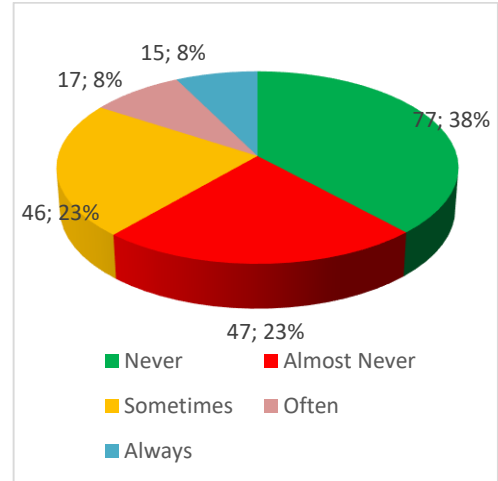


Fig. 3. Waking during the night

The hormone melatonin is mainly produced during the night and during sleep, while during the day the levels of this hormone are low and no production takes place. The disruption of melatonin production may be due to constant waking during the night. The production of the hormone is affected either by the interaction of electromagnetic fields from various electronic devices found in the room or by light manifestation whether it is LED indicators on the phone and the like. We can observe the results in Figure 3. Our participants do not wake up at all during the night and in 77 cases out of 202 participants. However, 15 people were observed to be constantly waking up during the night [10] [11].

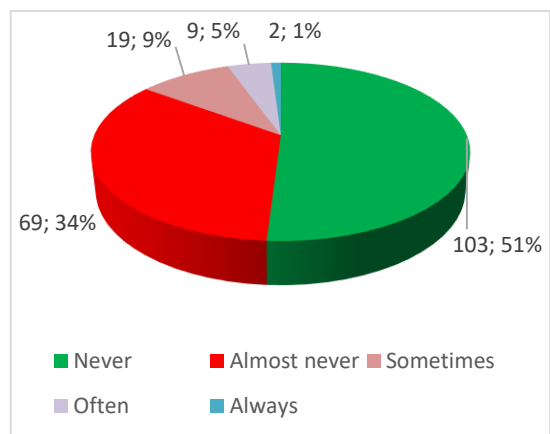


Fig. 4. Headache when using a mobile phone

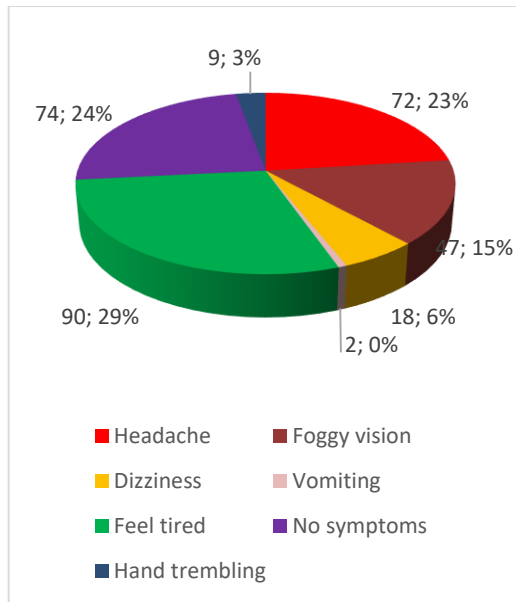


Fig 5. Health symptoms when using a mobile phone

Phone use can cause headaches, which are caused by electromagnetic waves from the phone disrupting brain waves. Figure 4 shows us the results where 103 of our 202 respondents do not experience headaches at all. A constant headache is experienced by 2 of our respondents. Another factor that can affect headache is the time of mobile phone use. Apart from headache, we may also experience other symptoms when using electronic devices Figure 5. Most of our participants experienced the feeling of tiredness, this symptom was reported by 90 people. This may be mainly due to the prolonged use of electronic devices that are close to the human body and especially the head. Electromagnetic waves from these devices, if very strong and prolonged, can cause vomiting or symptoms of vomiting in some people. This was reported by 2 respondents in our survey. In 74 cases they do not experience any symptoms [1].

The body consists of two-thirds water, half of which is outside the cells. The electromagnetic properties of the body depend mainly on the fact that many ions are distributed in the liquid, where water and some molecules are electric dipoles. Because ions are massive and do not conduct electrons like, for example, metals, they are available in the body and can slow down electromagnetic phenomena. The altered ion balance around the excitable cell membrane contains a certain amount of energy. When the ion concentration changes, the cell responds to the change in polarity with an immediate change in ion concentration. If the concentration of ions in nerve fibers is disturbed so that the fiber moves around at a speed of 100 m/s, this phenomenon can be seen as the extremely slow movement of an electrical impulse. Cells communicate with each other through ionic or nonionic chemical messengers. It has been suggested that electric fields can also act as messengers, but this hypothesis has not yet been scientifically confirmed. [3] [9] [12].

A factor that affects us more and more nowadays is electromagnetic radiation but emanating from mobile phones. These devices are very easily available nowadays.

The increase in the owners of such device is increasing and increasing every year. Manufacturers are coming up with new technologies and conveniences to install in mobile phones. To make calls or browse the internet and many other operations on the phone, data transmission is used through a signal, followed by a transmitter. The signal is transmitted in the form of electromagnetic waves. Young people who are primarily in managerial roles use their mobile phones more frequently to make calls, thereby exposing themselves to increased electromagnetic radiation. In the past, it was not easy to do research on the impact of this type of radiation, as the prevalence of mobile phone use was not extensive. However, nowadays we know the results of some studies that have only looked at the relative effects of electromagnetic radiation on a living organism. What we have learnt from these studies is that there can be health problems from mobile phone use. These include symptoms such as blurred vision, headaches, feeling tired, and hot flashes in the ear area or even problems with the activity of the autonomic nervous system referred to in older literature as autonomic. It has been shown that certain symptoms were more frequent with increased number and increasing length of calls made [4] [13] [14].

High ratios of some energy applied to an object creates heat, ionization, and destruction. In a living organism, the impact from low to average ratios of non-ionizing electromagnetic energy induces an electric current density that stores a certain amount of energy. This energy can occur in 2 phenomena. The first is as a precise passage of electric current through the body and the second has a physiological and thermal effect. Electrical and magnetic fields as a means of energy and physical forces based on charges. There are no free electrons in the human body and conduction is due through bound charge such as ions. Low frequency fields cause migration of ions modifying normal ion concentrations leading to physiological effects. Muscle contractions and nerve impulses can be triggered by electrically generated ion flux [9] [13] [15] [16].

Exposure to electrical or electromagnetic stress as we have already mentioned has bad effects on the human body. Any cable through which an electric current flow creates a magnetic field around itself. If the current is strong enough and the patient is exposed to the generated magnetic field for a long enough period, changes in cellular regulation mechanisms occur that are of the nature of natural geopathic stress mechanisms. Electrical systems operate at approximately 50 Hz, which is just above the natural frequency generated by the Earth. The frequency generated by the Earth is 30 Hz and our bodies are set to this minimum. Any frequency close to that will disturb us. The pineal gland is a structure in the brain that is directly sensitive to the Earth's magnetic field. The pineal gland produces many psychoactive chemicals or hormones such as melatonin, dopamine, serotonin, and many others. If the secretion of these hormones is disturbed, neurological and behavioral problems can occur. Electromagnetic resonance comes into the home, office, or other premises through the electrical, telephone, water, or gas supply. Symptoms associated with prolonged exposure to high voltage electric

fields are well described by residents of Fishpond, Dorset (UK), which is lined with such masts, generators, and the like. Residents report symptoms such as headaches, poor sleep, wakefulness, fatigue, and mood swings even reduced birth rates [11] [17] [18].

As the use of mobile phones has increased, so have concerns about the harmful effects of mobile phone radiation on human health. In 1996, the World Health Organization set up a project to assess the scientific knowledge on the potential health effects of electromagnetic frequencies in the range 30 Hz to 300 GHz. The potential harmful effects of this radiation from mobile phones remain controversial. Agarwal in his study highlighted the effect of radiation from mobile phones in sperm motility. Cell phone radiation has been shown to cause oxidative stress in unprocessed semen and leads to a decrease in sperm motility and viability. One reason for this is that many men carry cell phones in their pants pocket or clipped to their belt. Alteration of semen parameters through oxidative stress can lead up to infertility. Based on the *in vitro* results, we can speculate that carrying mobile phone in the pocket may cause deterioration in sperm quality, however, we must mention that mobile phone and the male reproductive organ are separated by several layers of fabric, which may extrapolate these effects observed *in vitro*. Observations under real conditions require further studies and research [2] [7] [9].

Exposure to electromagnetic fields in mobile communications have raised public and individual concerns on the possible adverse effects on people who are exposed to such radiation. More than half of the population in more developed countries use mobile phone daily. There has also been an increase in use among younger and older age groups. The impact of electromagnetic fields from mobile phones is of interest to several bodies, either from research or a biological point of view. Radiation from MT mainly covers the human head. Compared to other inanimate materials used in applied electromagnetics, the human body is composed of biological tissues that have specific electrical properties. Biological tissues in humans can be considered as diamagnetic materials with the same permittivity to the permittivity of the environment. Therefore, it is necessary to keep in mind Maxwell's equation for the continuation of magnetic flux, so we can state that the human body is transparent to the magnetic field. Human eyes are among the most sensitive organs and have high values of relative permittivity. To calculate SAR (specific absorption rate), a value that gives us the rate of energy that is absorbed by a person's body when exposed to a radiofrequency field, so the SAM (Specific Anthropomorphic Mannequin) is used as a head model, which represents the 90th percentile shape of a male head [18] [19] [20] [21] [22] [23].

IV. CONCLUSION

The aim of our work was to find out whether our participants experience adverse symptoms when using electronic devices. We investigated whether our respondents experience headaches when using a mobile phone or whether they also experience other symptoms. In

our survey, almost 51% of the participants did not experience any headache when using a mobile phone. Of course, there is an interaction of the electromagnetic field with the human body, but the field is not strong enough to cause a permanent headache in our respondents. Another factor that can influence this is the prolonged use of a mobile phone, and this for several hours every day. When using other electronic devices, the most common symptom was feeling tired, this is also claimed [11]. Which was also confirmed in our survey. To eliminate these symptoms, we recommend using cell phones or other electronic devices as little as possible. If this is not possible, take at least short breaks during continuous use. In some people, the interaction can be so strong that it causes blurred vision, dizziness or even dizziness. However, these symptoms are a manifestation of very long-term and strong electromagnetic radiation, but this was not observed in our respondents. [5] [13] [20].

REFERENCES

- [1] A. Dubrov, "Geopathic zones and oncological diseases," *Journal of Proceedings of the sixteenth BDA congress on Earth's fields and their influence on human beings*, pp. 42-44, 2008.
- [2] T. Saunders, (2023, November) "Health hazards and electromagnetic fields," *Complementary Therapies in Nursing and Midwifery*, vol. 9, no. 4, pp. 191-197, doi: 10.1016/s1353-6117(03)00086-6.
- [3] W. Van Loock, "Elementary effects in humans exposed to electromagnetic fields and radiation," 2009 5th Asia-Pacific Conference on Environmental Electromagnetics, Xi'an, China, 2009, pp. 221-224, doi: 10.1109/CEEM.2009.5304780.
- [4] Z. Matoušek, M. Šostronek and J. Jakub, "Vplyv elektromagnetického žiarenia mobilných telefónov na ľudský organizmus," *Journal of Výchova a vzdelávanie elektrotechnikov-EMC* 2009. [Online]. Available: http://www.aos.sk/spe/seminare/SPE_2009/zbornik/07matousek_09.Pdf
- [5] H. Chafekar, P. Jarad, "Effect of Geopathic Stress on Pavement Distresses," *Journal of Mechanical and Civil Engineering*, pp. 1-8, 2012.
- [6] G. W. Hacker, E. Pawlak, G. Pauser, G. Tichy, H. Jell, G. Posch, G. Kraibacher, A. Aigner, and J. Hutter, "Biomedical Evidence of Influence of Geopathic Zones on the Human Body: Scientifically Traceable Effects and Ways of Harmonization," *Complementary Medicine Research*, vol. 12, no. 6, pp. 315-327, 2005.
- [7] S. H. Lee, "Mobile Phone Culture: The Impacts of Mobile Phone Use," *Encyclopedia of Mobile Phone Behavior*, Jan. 2015, doi: 10.4018/978-1-4666-8239-9.ch055.
- [8] P. Agarwal et al., "Assessing the quality of mobile applications in chronic disease management: a scoping review," *Npj Digital Medicine*, vol. 4, no. 1, Mar. 2021, doi: 10.1038/s41746-021-00410-x.
- [9] S. B. Veerachari and S. Vasan, "Mobile Phone Electromagnetic Waves and Its Effect on Human Ejaculated Semen: An *in vitro* Study," *International Journal of Infertility and Fetal Medicine*, vol. 3, no. 1, pp. 15-21, Jan. 2012, doi: 10.5005/jp-journals-10016-1034.
- [10] Kalantar and Sedighzade, "Reduced order model for doubly output induction generator in wind park using integral manifold theory," *Iranian Journal of Electrical and Electronic Engineering*, vol. 1, no. 1, pp. 41-48, 2005.
- [11] R. Creightmore, "Geopathic stress. The geomancy group," 2012. [Online]. Available: <http://www.safespace.net.nz/pdf/GEOPATHIC%20STRESS%20by%20Richard%20Creightmore.pdf>
- [12] . Manickam, "Potential Impact of Geopathic Radiation on Environment and Health," *Current World Environment*, Nov. 2018, doi: 10.12944/cwe.13.special-issue1.05.
- [13] Garcia and Mendes, "Geological factors and health problems," *Journal of Chemical Health Risk*, vol. 3, no. 1, pp. 23-32, 2017.
- [14] H. Salarvand, "Resilience Enhancement of Active Distribution Networks Via Mobile Energy Storage Systems and Protection Coordination Consideration," *Iranian Journal of Electrical and Electronic Engineering*, Dec. 2022, doi: 10.22068/IJEE.18.4.2541.

- [15] W. Van Loock, "Human Safety and Health in Electromagnetic Fields," 2007 7th International Symposium on Electromagnetic Compatibility and Electromagnetic Ecology, St. Petersburg, Russia, 2007, pp. 315-318, doi: 10.1109/EMCECO.2007.4371721.
- [16] F. Ozdemir and A. Kargi, "Electromagnetic Waves and Human Health," InTech eBooks, Jun. 2011, doi: 10.5772/16343.
- [17] V. Salnikov, "Formation of electromagnetic systems in geoactive zones," IOP Conference Series, Nov. 2018, doi: 10.1088/1755-1315/201/1/012019.
- [18] D. Poljak, "Human exposure to electromagnetic fields," Advanced Modeling in Computational Electromagnetic Compatibility, pp. 453-491, 2005.
- [19] M. Kiani, "General Formulation to Investigate Scattering from Multilayer Lossy Inhomogeneous Metamaterial Planar Structures," Iranian Journal of Electrical and Electronic Engineering, Mar. 10, 2013. http://ijeee.iust.ac.ir/browse.php?a_code=A-10-866-1&slc_lang=en&sid=1
- [20] L. Ahma, M. Ibrani, and E. Hamiti, "Computation of SAR Distribution in a Human Exposed to Mobile Phone Electromagnetic Fields," Progress in Electromagnetic Research, Jan. 2010.
- [21] G. Figueiro, "The impact of light from computer monitors on melatonin levels in college students," Journal of Neuroendocrinology letters, vol. 32, no.2, pp.158-163, 2011.
- [22] S. Günes-Durak, "Investigation of microplastics removal methods from aquatic environments", Heritage and Sustainable Development, vol. 3, no. 1, pp. 58-63, May 2021.
- [23] F. Veljovic, A. Voloder, S. Burak, B. Kulovac, and R. Karabeg, "The optimal design of school desks depending on the height and weight of students", Heritage and Sustainable Development, vol. 2, no. 1, pp. 46-51, Jun. 2020.