Connections of physical activity, heart rate and Earth's magnetic field fluctuation for young individuals

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Research background: The possibility that Earth's geomagnetic activity can affect humans has been debated for many years [1]. Cells in human body are embedded in an environment of both external and internal fluctuating magnetic fields that can affect virtually every circuit in biological systems to a certain degree, depending on the specific biological system and the nature of the magnetic fields [2]. Earth's magnetic fields fluctuations do not appear to have visible effect on healthy people, but for people with health problems this impact might make them feel worse [4]. It has been shown that magnetic storms are associated with higher risk for heart attack, also heart rhythm disorders, high blood pressure, and breathing difficulties [5]. Rhythms in the Earth's magnetic field and the human brain and cardiovascular system have the same or similar frequencies. There are some theories as well as experimental data suggesting that changes in these fields can affect human's autonomic nerves system and cardiovascular systems [6].

Purpose of research: to investigate links between physical activity levels, heart rate and Earth's magnetic field activity in college students.

Objectives of research: 1. To compare the impact of Earth's magnetic field fluctuations on heart rate in physically active and inactive young (age 23-26) individuals during a two week period at different times of the day. 2. To examine potential links between heart rate and variations in different frequencies of Earth's magnetic field activity levels in physically active and inactive individuals.

Methodology of work: Participants were 20 postgraduate students attending the Lithuanian University of Health Science. Participants were divided in two groups: physically active; and physically inactive. Heart rate was recorded (Bodyguard2)", for 24-hours over 15 consecutive days. Participants filled out a questionnaire that assessed their health and physical activity; and recorded their activities in an activity log, including the type of activity, timing and other factors that might have affected their heart rate.

Earth's magnetic field fluctuation data were collected from the Global Coherence Initiatives (GCI) Monitoring System, a worldwide network of magnetometers that collect and record a

continuous stream of earth's magnetic field data. Three different frequencies of Earth's magnetic field activity were selected for the study (0-1Hz, 1-7Hz, 7-45Hz).

The research took place at the Lithuanian University of Health Sciences, Institute of Sports. Students were invited to participate in the study on a volunteer basis. Twenty students agreed to participate in this research. They were asked to wear the HRV recorder for 15days. The participants were divided into two categories, physically active (n=12) and physically inactive (n=)8. Physically active students were defined as active for 30 minutes or longer at least twice per week and physically active was less than this. Physical activity included aerobic physical exercises, skiing, running, power exercises and other variations of physical activity. The period of day was divided into 4 ranges, 1) morning from 6 a.m. to 12 p.m., 2) afternoon from 12 p.m. to 6 p.m., 3) evening from 6 p.m. to 12 a.m., and 4) night from 12 a.m.to 6 a.m. For statistical analysis SPSS 22 and Microsoft Office Excel was used. Significance levels was checked with Wilcoxon Test and $p<0.05$ was accepted as significant.

Results:

Correlations between the physically active and inactive groups' heart rate and Earth's magnetic field in the 0-1Hz frequency range found that both groups had a similar trend in standard deviation. Overall, in the morning times there were not strong correlations between the two groups' heart rates and Earth's magnetic field (Figure 1). However, we found some significant differences between these two groups on days 7, 11, 12.

Heart rate and Earth's magnetic field correlations compared between physically active and inactive groups during the day times found significant differences on days 8 and 9 (Figure 2).

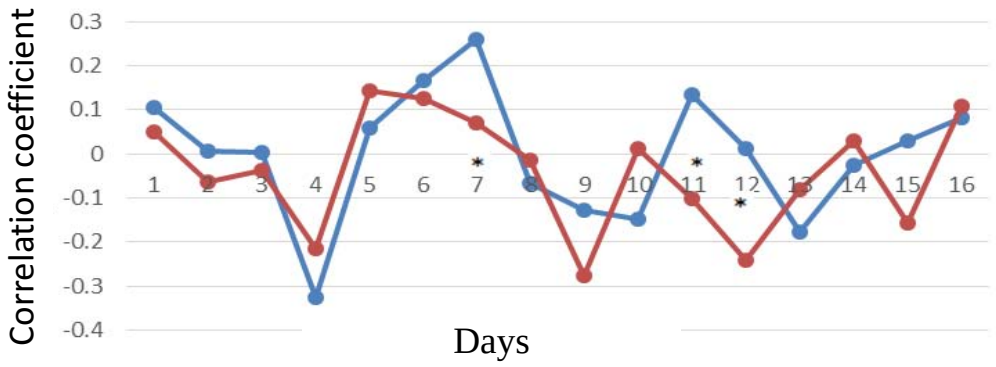

*Figure 1. Heart rate and Earth's magnetic field correlations between physically active and inactive individuals group in the morning at 0-1Hz frequency (*P<0.05)*

A comparison of the physically active and inactive groups heart rate and Earth's magnetic field correlations in 0-1Hz frequency during the evening time of day we found that there were significant differences on days 8, 9 and 13 (Figure 3).

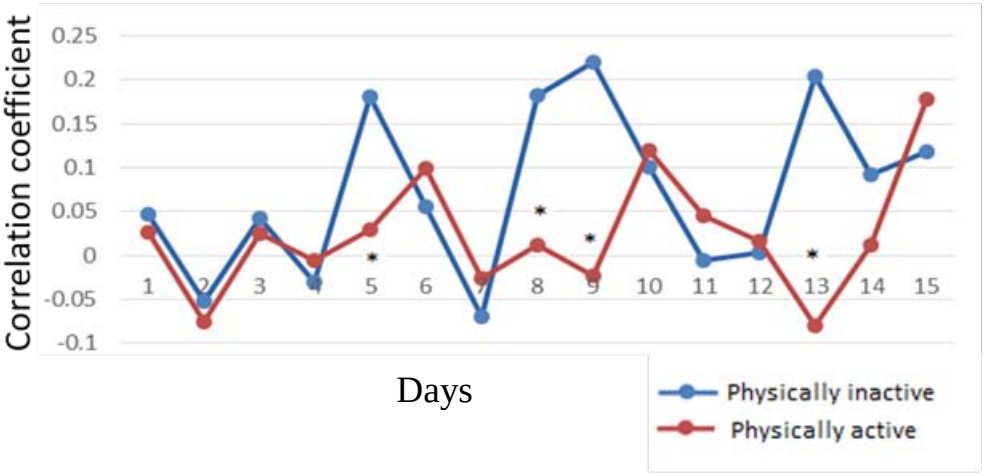

*Figure 3. Heart rate and Earth's magnetic field correlations between physically active and inactive individuals group in the morning at 0-1Hz frequency (*P<0.05)*

We also compared correlations of all three frequencies (0-1Hz,1-7Hz, 7-45Hz) of the earth's magnetic field data with correlation coefficient standard deviations at different times of the day (Figure 4). The physically active individuals had higher correlations in standard deviation in all four periods of day (morning, day, evening, night).

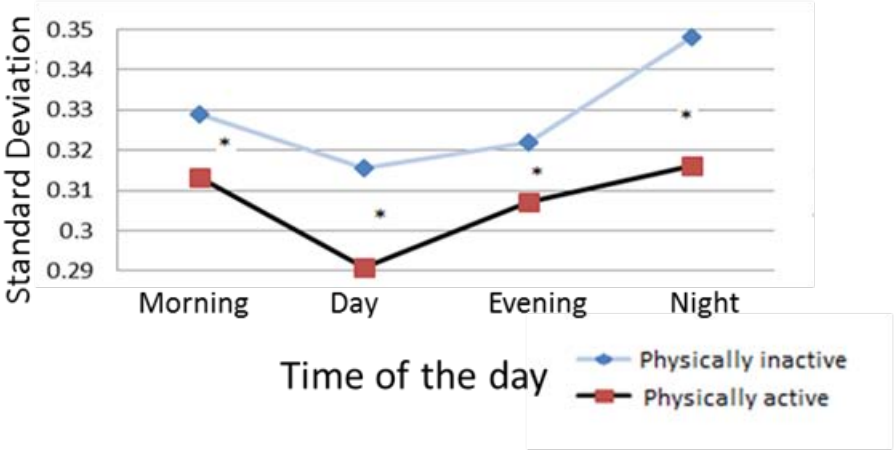

*Figure 4. Heart rate and Earth's magnetic fields correlations fluctuations in all measured frequencies (*P<0.05)*

Conclusions: 1. Variations in the correlations between heart rate and Earth's magnetic field were considerably higher in the physically inactive group during all times of day compared to the physically active.

2. Statistically significant connection between heart rate and Earth's magnetic field activity was found in the physically active group in 0-1 Hz Earth magnetic field fluctuation frequency.

Discussion: These findings could be important for people who have some health problems with the changes of Earth magnetic field intensity. These findings suggest that physical activity might prevent negative effect on humans' health. Physically active people seem to be more stable in their physiology and less affected by changes in Earth's magnetic field.

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