CORRELATIONS BETWEEN EARTH‘S LOCAL MAGNETIC FIELD AND HEART RATE OF YOUNG INDIVIDUALS AND PROFESSIONAL RIDERS DURING DAILY ACTIVITIES AND INTERACTIONS WITH A HORSE

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Every cell in our bodies is under the influence of an external and internal environment of fluctuating invisible magnetic forces [1]. Because the magnetoreception of neural structures should be evolutionarily adjusted to these magnetic fields, humans may also have a special sensitivity to geomagnetic fields [2]. Human health is affected by space weather component [3]. The natural variation in the geomagnetic field in and around Earth has been reportedly involved in relation to several human cardiovascular variables, including heart rate (HR) [4].

The aim of research was to compare correlations between Earth‘s local magnetic field‘s variations and heart rate of young individuals and professional riders during daily activities and interactions with horse.

The goals of research: 1. To evaluate correlations between Earth‘s local magnetic field‘s variations and heart rate of young individuals and professional riders during daily activities.

2. To evaluate correlations between Earth‘s local magnetic field‘s variations and heart rate of young individuals and professional riders during interactions with horse.

3. To compare the variation of correlations between Earth‘s local magnetic field‘s variations and heart rate of young individuals and professional riders during daily activities and interactions with horse.

The methods of the research.

Contingent

The group of young individuals (non riders) included 15 students, age 27.4±12.1 years (on average ± SD). The group of professional horseriders included 7 individuals, age 26.3±3.2 years old.

Inclusion criteria:

- Young age (till 44 years old, by WHO);

- Any current health complaints;
- I group: nonriders;
- II gruop: professional riders.

Means:

- „Firstbeat Bodyguard 2“ heart rate monitors (Fig. 1.);
- Magnetometer;
- Software;
- Activity log.

Fig. 1. Heart rate monitor „Firstbeat Bodyguard 2“

Location of research – LUHS Institute of Sport and LUHS Institute of Animal Science, Baisogala. Date of research – May – July 2015.

Geomagnetic field‘s (GMF) data were taken from Global Coherence Monitoring System developed by HeartMath Institute (California, USA), a worldwide network of magnetometers that collect a continuous stream of data from the earth’s magnetic field. One of the magnetometers is located in Baisogala, Lithuania.

„First beat“ monitors recorded RR intervals over 24 hours period at 1000 Hz frequency. From these recordings heart rate (HR) was calculated for each individuali in real time. And finally HR data were synchronised with strenght bands of local GMF (Fig. 2.).

We analysed heart rate correlations with Earth‘s local magnetic field in different frequency bands during daily activities of different intensity and interactions with horse.We were interested in three different frequency bands of local GMF: [0; 1] Hz, [1; 7] Hz and [7; 45] Hz. These geomagnetic frequencies called Schumann resonances overlap with those of the human brain, and the cardiovascular and autonomic nervous systems.

Daily physical activities (from logs‘ recordings) were differentiated to low, moderate and high intensity levels (according to metabolic equivalent values) and sleep phase.

Interactions with a horse included stroking, brushing and feeding the horse directly from hand.

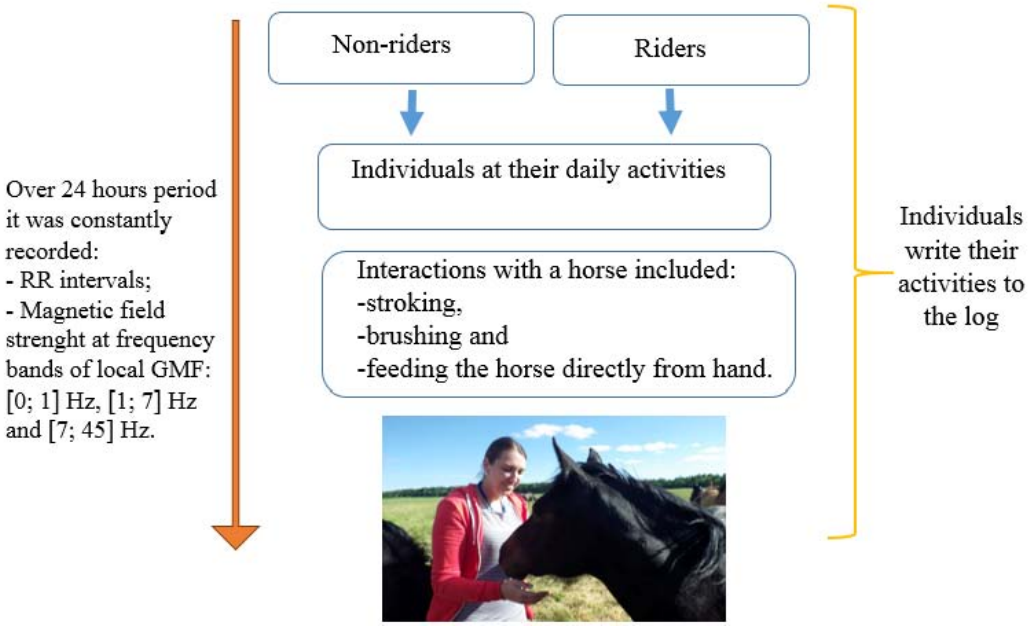

Fig. 2. Study design

Data are presented as median (min - max) and interquartile range (IQR). The statistical analysis was exercised using “IBM SPSS Statistics 22.0”,“Microsoft Office Excel”, „MATLAB“ and software especially designed for processing data from magnetometer and synchronising them with HR recordings - „Spectrogram_ML“. For the evaluation of correlations Pearson‘s correlation coefficent was used. The nonparametric Mann–Whitney test was used for comparisons of two independent samples. To compare two dependent samples, the nonparametric Wilcoxon test was applied. The difference was considered statistically significant at $p<0.05$.

Results

It is observed, that during low-intensity physical activity, in a group of professional riders, HR and local GMF correlation coefficients of the median was negative in all frequency bands of GMF. In the first local GMF strength bar ([0, 1] Hz), HR of the young individuals and the local GMF correlation coefficients between HR of the young individuals and the local GMF, were positive 0.01 (-0.26-0.49) IQR = 0.14, and between HR of professional riders and local GMF - negative, - 0.08 (-0.12-0.38) IQR = 0.03 (Fig. 3.).

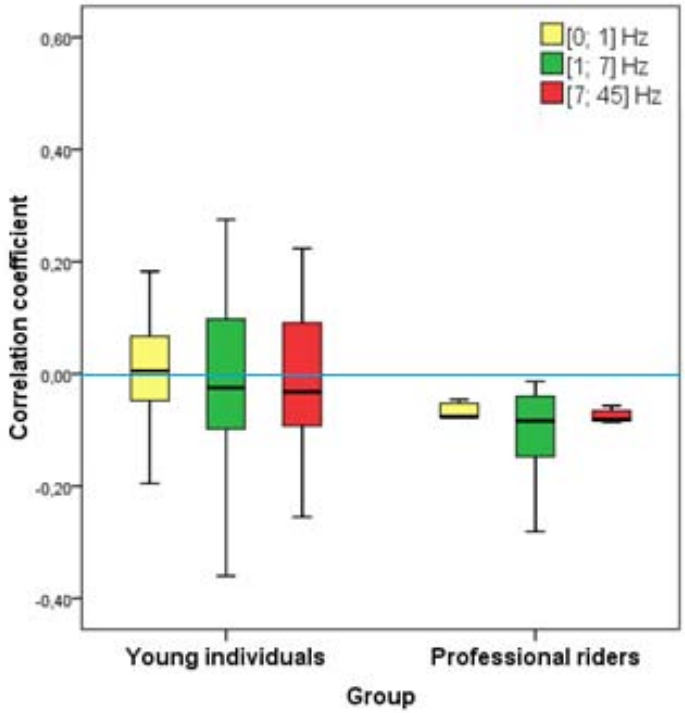

Fig. 3. Correlations of GMF frequency bands and heart rate during low intensity physical activity

During high-intensity physical activity, it was observed correlations‘ analogy to low-intensity activity, it‘s only seen more shift of the correlations towards the negative meanings direction (Fig. 4.).

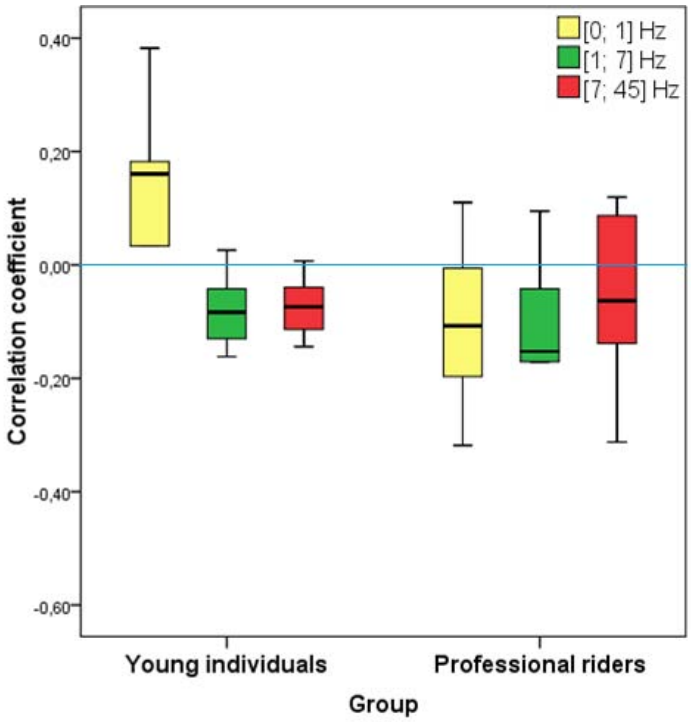

Fig. 4. Correlations of GMF frequency bands and heart rate during high intensity physical activity

During interactions with a horse, the difference established between HR of young individuals (non riders) and professional riders, at the second GMF frequency band [1; 7] Hz: young individuals -0.1 (-0.47-0.70), IQR=0.50 and professional riders -0.15 (-0.27-0.31), IQR=0.18, $p<0.05$ (Fig. 5.).

Although there was no significant difference comparing these groups at the strength of other frequency bands of GMF, we noticed that medians of the correlations of professional riders‘ HR and GMF were more negative than in the other group.

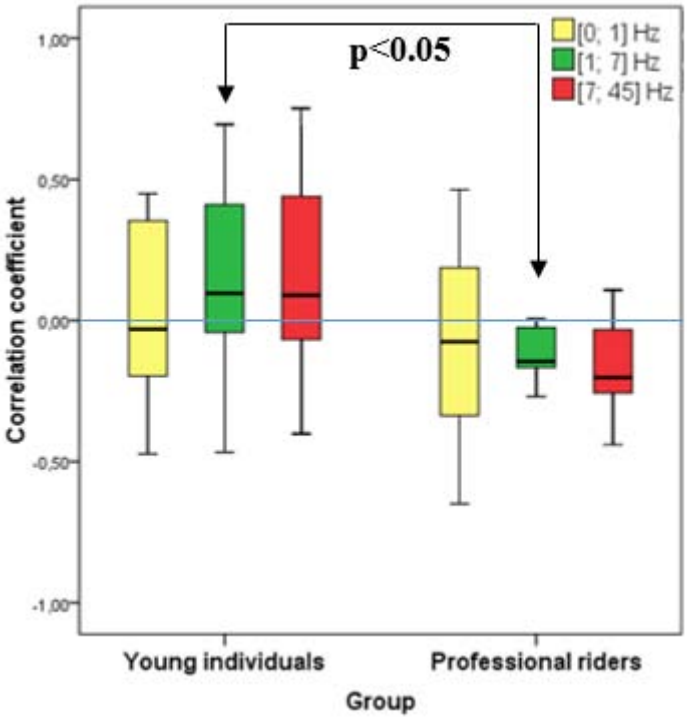

Fig. 5. Correlations of GMF frequency bands and heart rate during interactions with a horse

Difference established between heart rate of young individuals (non riders) and professional horse riders, at the second GMF frequency band [1; 7] Hz.

During sleep phase, in GMF frequency band of [1; 7] Hz there was equal correlations in both groups of individuals. This frequency band overlap with theta and alpha brainwaves, which are present during deep meditation (Fig. 6.).

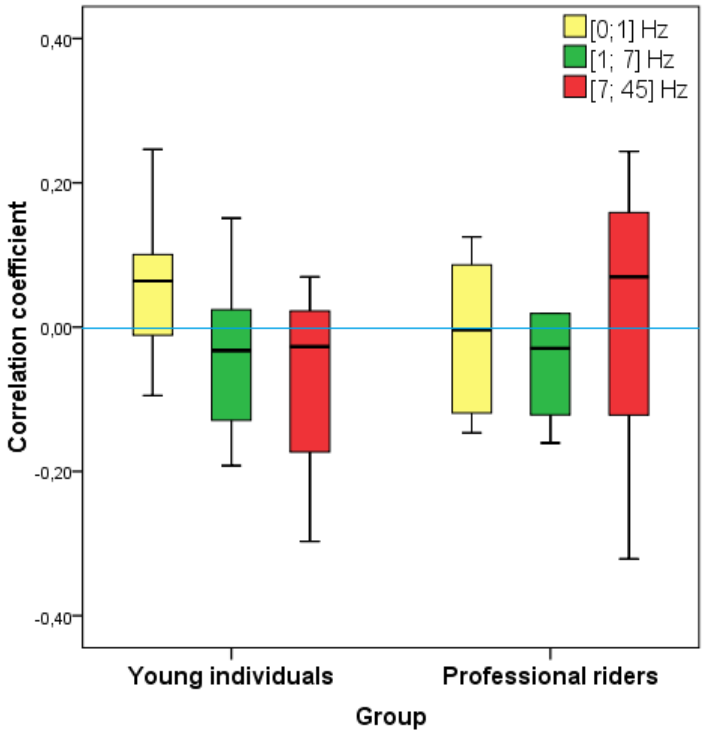

Fig. 6. Correlations of GMF frequency bands and heart rate during sleep

Case analysis of two individuals: nonrider (Fig. 7.) and rider (Fig. 8.). We took the data of one hour period and looked how GMF streght at frequency band of [7; 45] Hz and HR values correlates parallel in this time period. Vertical lines mark the time, when individuals performed their tasks with a horse.

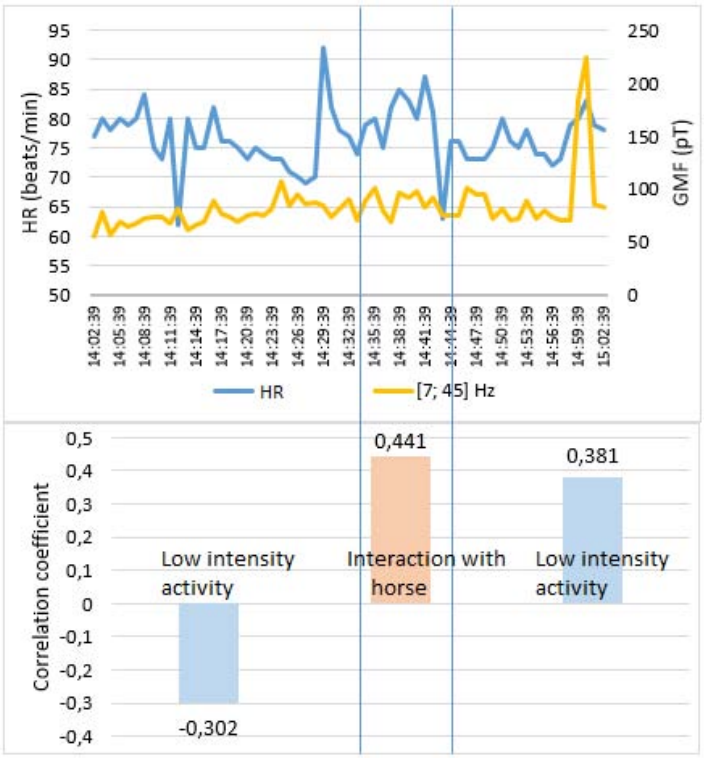

Fig. 7. One hour period data of GMF correlations with HR of young (nonrider) individual

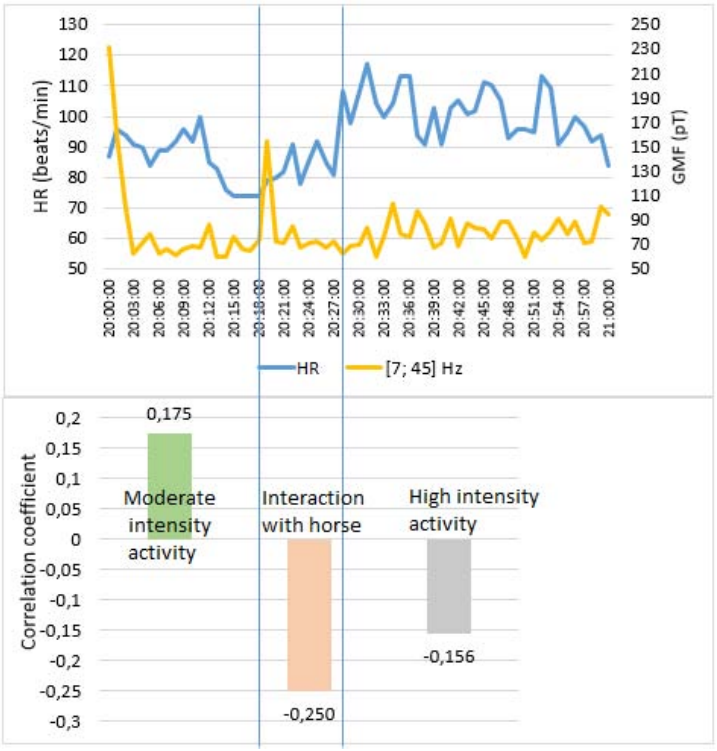

Fig. 8. One hour period data of GMF correlations with HR of professional rider

Conclusions

1. It was established an inverted correlation between heart rate and the local Earth's magnetic field strength, in a group of professional riders, during low and high intensity physical activity, which means a positive supportive effect on a person's health.

2. During the sessions with a horse, in a group of professional riders was established an inverted correlation between heart rate and the local Earth's magnetic field strength. In the group of young individuals, there was a direct correlation. This type of correlation could be led by psychological adjustment and physical preparation.

3. After comparing both groups, most distinguished frequency band of Earth's magnetic field strenght was 1-7 Hz in which identified differences between heart rate and local Earth's magnetic field correlations - inverted correlation with low-intensity activities and sleep confirms the positive physiological effects of low frequencies at rest. In both groups, at the different frequency bands, the nature of correlations differs - the higher the frequency of the magnetic field is, the less impact it had on heart rate during interactions with the horse.

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