CORRELATION BETWEEN PHYSICAL EFFORT AND CEREBRAL ACTIVITY AT SPORTSMEN

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Abstract: Our study objective, was to establish a real correlation between physical effort and cerebral activity at sportsmen, both, by using one of the electroencephalographic (EEG) indexes, the edge frequency, which characterise most relevant EEG changes, specific to studied sport activities and statistically comparing the obtained results.
Studied group was composed of 27 professional athletes, both genders, with same medium age, height and weight and similar professional training , which practice fence, volleyball or handball, for at least 6 years.
Electroencephalographic evaluation (line spectral and indexes) was realized by using the Nihon-Kohden EEG-9200 device, the EEG MAPPING QP-220AK programme, applied to the studied sportsmen during all tested moments (R1, A, R2, B, R3, C, R4, D R5), activities that can emphasize possible specific cerebral patterns.
The p values of Student test, obtained by the inter-sports statistical comparison of edge indexes, measured for each of the tested moments, were represented by cerebral mapping.
Were emphasized significant differences between the three studied sports, depending on the activated cerebral area specific to each sportive discipline and correlated with the test moments, especially in the parietal and frontal cerebral areas.
EEG differences recorded for each sportive discipline, outlined a real correlation between physical effort and cerebral activity, due to cortical adaptation to long term effort, emphasised through functional plastic cortical changes.
Keywords: *sport disciplines, professional training, edge frequency, cerebral mapping.*

Introduction

Our study objective, was to establish a real correlation between physical effort and cerebral activity at sportsmen, both, by using one of the electroencephalographic (EEG) indexes, the edge frequency, which characterise most relevant EEG changes, specific to studied sport activities and statistically comparing the obtained results.

The relevant studied parameter for the research, represents the frequency from which all inferior frequencies represent 90% of whole EEG line length.

Electroencephalography (EEG) represents the technique of cerebral electrical activity acquisition during a period time, through electrodes put on the scalp [1, 2, 3].

Material and methods

Studied group was composed of 27 professional athletes, both genders, which practice fence, volleyball or handball, 9 fencers, 9 volleyball athletes and 9 handball players for at least 6 years. Considering that, the investigations took place in equivalent conditions for all subjects, we can state, that the determining factor, for the different behaviour of the administered tests, were the cerebral changes, induced by the sports practice for a long period of time, as a result of repeated complex movements performed during specific training [4, 5].

The testing was performed under current ethical rules, each participant being informed of the experimental processes.

Electroencephalographic evaluation (line spectral and indexes) was realized by using the Nihon-Kohden EEG-9200 device, the EEG MAPPING QP-220AK programme, applied to the studied sportsmen during all tested moments (R1 - initial repose, A- right hand contraction, R2 - repose after right hand activity, B - left hand contraction, R3 - repose after left hand activity, C - right hand contraction mental exercise, R4 - repose after right hand contraction mental exercise, D - left hand contraction mental exercise, R5 - repose after left hand contraction mental exercise), activities that can emphasize possible specific cerebral patterns.

The EEG response was registered with surface electrodes which have a letter to identify the lobe (F frontal, T temporal, P parietal, C central, O occipital) and a number to identify the hemisphere location (even numbers refer to electrode positions on the right hemisphere, odd numbers to those on left hemisphere), placed on the scalp according to the electroencephalography 10-20 system, bipolar acquisition, 16 channels, the reference being the two ears (A1, A2), using a time constant of 0,3 seconds and a filter below 50 Hz [6].

For a correct identification of cerebral adaptations, specific to commanded actions apparition, was used amplitude and frequency cerebral mapping (Figure 1).
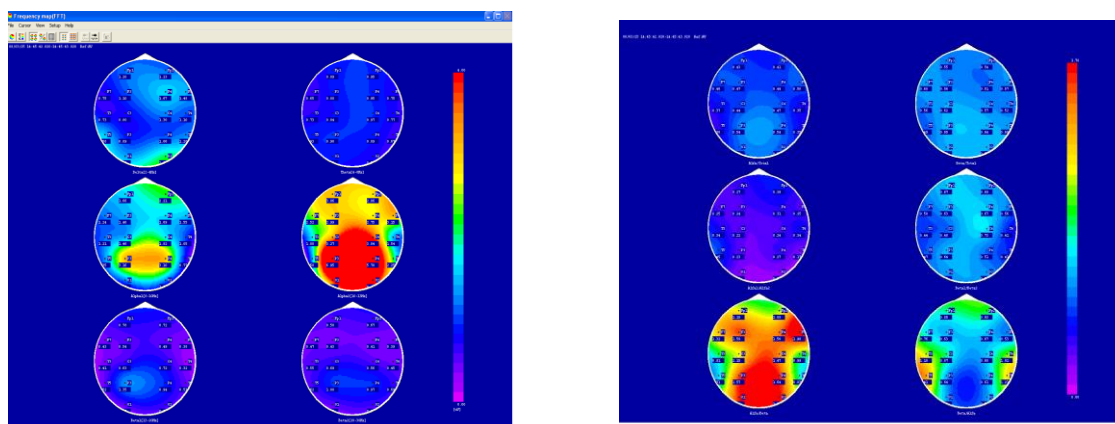

Figure 1. Cerebral mapping changing aspect as a new activity is performed

The used EEG MAPPING QP-220AK programme offered beside the frequencies spectrum, also synthetic indexes (peak frequency, median frequency, average frequency, edge frequency) suitable for statistic study. Because from the mentioned ones, the edge frequency characterizes most relevant the EEG modifications specific to each sport discipline, we choose to study this one.

For statistical comparison of the obtained data, the Student (t test) was used.

Results

For a better analyse, the p values of Student test, obtained by the inter-sports statistical comparison of edge indexes, measured for each of the tested moments, were represented by cerebral mapping.

Observing this graphic representation, were remarked the presence of significant differences between handball and fence, for most of the experiment moments, in the area of the P4 electrode – right parietal, emphasized like specific element.

Significant differences illustration between handball and volleyball, revealed most of the areas with significant p values, constant p values being the F3, P3 and P4 electrodes areas.

Fence - volleyball comparison, from the edge differences point of view, emphasized significant differences for all test moments, for different cortical areas, but constant values were P3 area for most of the moments test (Figures 2 -10).
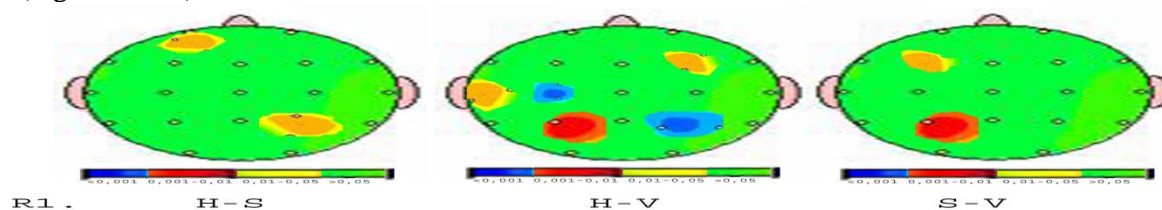

Figure 2. Mapping graphic representation of significant differences areas at comparison of edge indexes average values for moment R1 for all sports
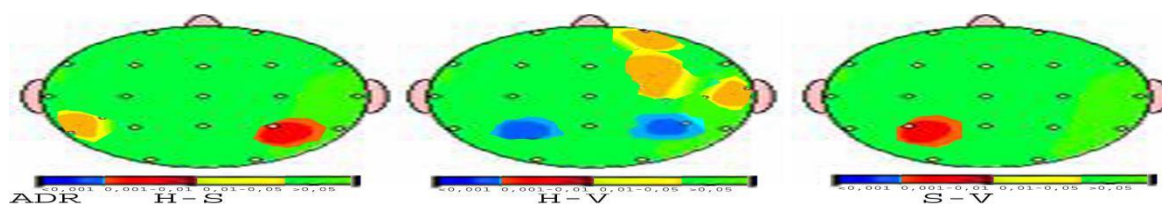

Figure 3. Mapping graphic representation of significant differences areas at comparison of edge indexes averagevalues for moment A for all sports

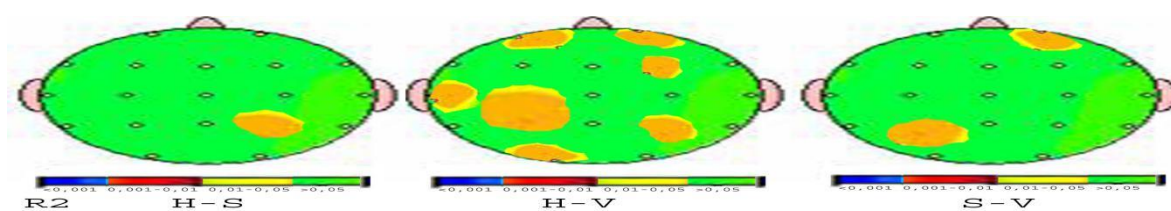**Figure 4.** Mapping graphic representation of significant differences areas at comparison of edge indexes average values for moment R2 for all sports
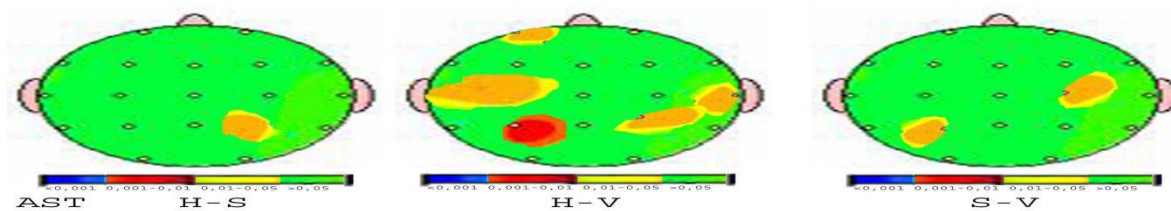

Figure 5. Mapping graphic representation of significant differences areas at comparison of edge indexes average values for moment B for all sports
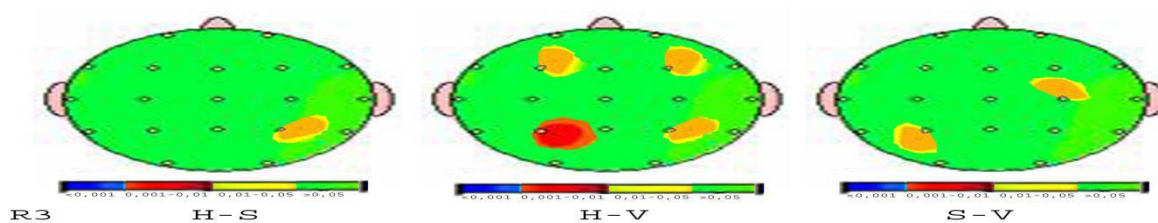

Figure 6. Mapping graphic representation of significant differences areas at comparison of edge indexes average values for moment R3 for all sports
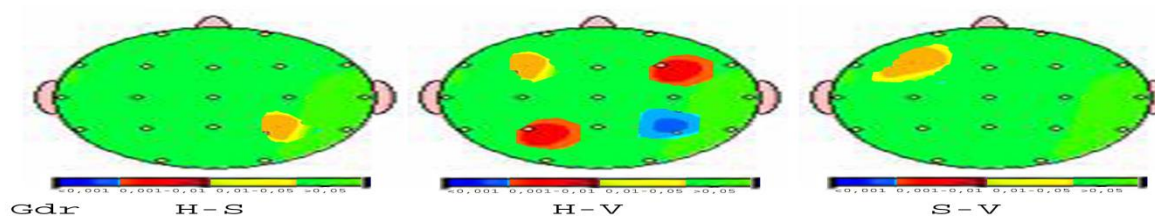

Figure 7. Mapping graphic representation of significant differences areas at comparison of edge indexes average values for moment C for all sports
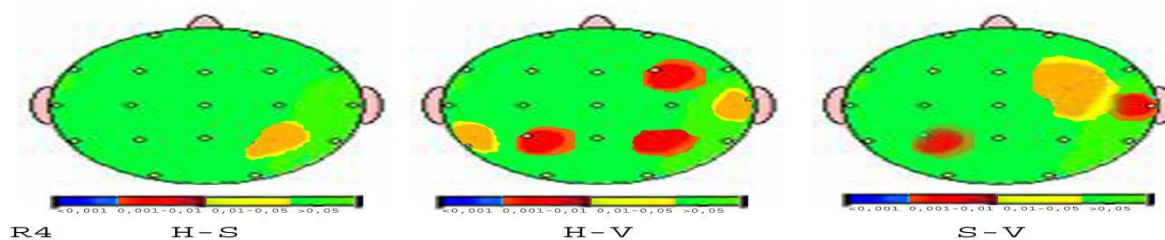

Figure 8. Mapping graphic representation of significant differences areas at comparison of edge indexes average values for moment R4 for all sports
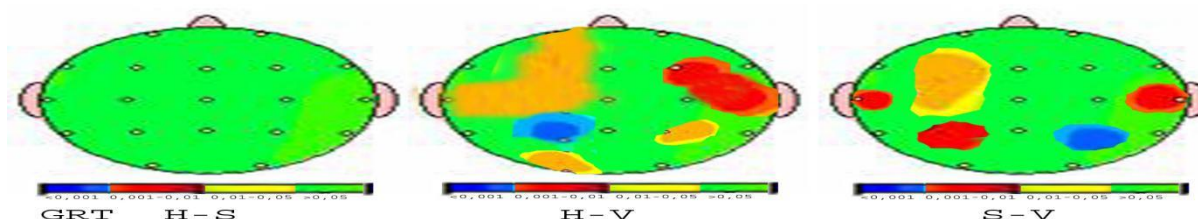
Figure 9. Mapping graphic representation of significant differences areas at comparison of edge indexes average values for moment D for all sports
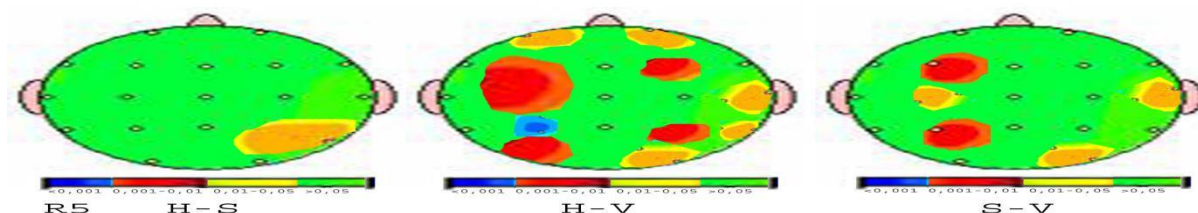

Figure 10. Mapping graphic representation of significant differences areas at comparison of edge indexes average values for moment R5 for all sports

Discussions

Present study aimed to emphasize EEG changes, produced by different actions (fists successively contractions, movement thinking without perform it), in comparison with the relaxation moments between actions, at sportsmen.

Following the electroencephalographic activity of each studied sportive discipline, we observed different response patterns, but constant for the same group of athletes.

Due to the particularities of each sportive discipline, is pointed out, the idea of some athletes presenting a performed movement imagination bigger than the one of other tested sport, which is produced by structural cerebral changes [8].

Despite, the speciality literature [8, 9, 10] had described many data, regarding the sportsmen motor memory, proving the cerebral differences inter-sports, produced by the long term specific physical exercises, remains an original aspect, enough conspicuous outlined by the previous electroneurophysiologic studies, that we have tried to achieve through our study.

Conclusions

Were emphasized significant differences between the three studied sports, depending on the activated cerebral area specific to each sportive discipline and correlated with the test moments, especially in the parietal and frontal cerebral areas.

EEG differences recorded for each sportive discipline, outlined a real correlation between physical effort and cerebral activity, due to cortical adaptation to long term effort, emphasised through functional plastic cortical changes, specific to each studied sportive discipline, characterized by different values of the edge frequency index.

Author contribution

All authors have contributed equally to this article.

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