THE IMPACT OF EEG BIOFEEDBACK TRAINING PERFORMED UNDER NORMOXIC AND NORMOBARIC HYPOXIC CONDITIONS ON SIMPLE AND COMPLEX REACTION TIMES IN JUDO ATHLETES

Over the past several decades, numerous studies have sought to identify innovative methods to support the training process, aiming to enhance the athletic performance of competitors. The careful selection of training parameters tailored to an athlete's capabilities is crucial for ensuring harmonious development of fitness, maintenance of health, and the efficient construction of motor skills, which form the foundation for later sporting successes. Given the athlete's high level of technical, tactical, physical, and psychological preparation, there is a continuous search for new methods that could provide a competitive edge. One such potential solution is the application of normobaric hypoxic conditions.

The objective of the research was to assess the impact of EEG biofeedback training under normoxic and normobaric hypoxic conditions on the simple and complex reaction times of judo athletes, and to determine the optimal training approach considering the frequency of sessions that significantly improves the athletes' reaction times. The study posed the following research questions:

1. What was the dynamic variability of relative increases in Theta and Beta wave amplitudes obtained during biofeedback training under normoxic and normobaric hypoxic conditions?
2. What was the dynamic variability of relative increases in the simple and complex reaction time value dynamics before and after biofeedback training in Vienna test systems?
3. To what extent did the conducted EEG biofeedback training under normoxic conditions affect reaction time in the examined groups of judo athletes?
4. Which of the applied EEG biofeedback training procedures, in terms of their frequency and the conditions under which they were conducted, significantly impacts the improvement of simple and complex reaction times in the examined groups of judo athletes?

The study involved 20 male athletes with International Master Class (IMC) status, who were randomly divided into a research group (RG) (n = 10; age 19.6 ± 1.4 years; body height 182.2 ± 5.1 cm; body mass 78.6 ± 7.9 kg; percentage of body fat, %FAT 10.1 ± 5.7%) and a control group (CG) (n = 10; age 20.1 ± 1.6 years; body height 182.1 ± 4.5 cm; body mass 74.1 ± 6.1 kg; %FAT 8.8 ± 1.7%). EEG biofeedback training was conducted in four cycles, diversified in terms of frequency and applied conditions. The first cycle was conducted under normoxic conditions, and the second under hypoxic conditions, both with the same frequency – training was carried out every other day. Correspondingly, the third cycle was under normoxic conditions, while the fourth was under hypoxic conditions, with increased training frequency – sessions were conducted daily. Both the research and control groups followed the same training protocol characterized by the same cyclicity and duration. The primary training protocol for the research group was theta/beta1 training, which develops attention concentration ability, while the control group underwent sham training using a displayed EEG simulation independent of the produced brain wave patterns. The impact of EEG Biofeedback training on the reaction times of judo athletes was tested using selected trials from the Vienna Testing System (VTS). Tests were conducted immediately before and after the EEG Biofeedback training sessions.

The research demonstrated that daily EEG-BF training under normoxic conditions significantly improved simple reaction time, and training every other day significantly enhanced complex reaction time. Conversely, training under normobaric hypoxic conditions did not result in improved simple or complex reaction times after the EEG-BF training sessions among the examined groups of judo athletes. No similar changes were observed in the control group.