ASSESSMENT OF HEART RATE VARIABILITY AND RECOVERY RESPONSE TO PHYSICAL EXERCISE IN ADOLESCENT ATHLETES USING THE "BIOMISH" HARDWARE-SOFTWARE COMPLEX

Makhmudov Sardor Mamasharifovich
Samarkand State Medical University
Samarkand, Uzbekistan

Abstract: This paper examines methods for assessing the response to physical exertion and recovery in athletes aged 15–17 who participate in cyclic sports. It analyses indicators of heart rate variability, heart rate and stress response, recorded using the "BioMouse" hardware and software system. Comprehensive monitoring can be used for the individual assessment of functional status and the adjustment of training loads.

Keywords: BioMouse, heart rate variability, RMSSD, SDNN, exercise load, recovery, sports monitoring.

Introduction. The effectiveness of sports training depends not only on the volume of physical work performed, but also on the body's response to the workload and the subsequent recovery process. Excessive training loads or insufficient recovery time can increase an athlete's fatigue levels, diminish training quality, and lead to adverse changes in their functional state.

Heart rate variability is one of the indicators used to evaluate how the autonomic nervous system regulates cardiac activity. Parameters such as RMSSD and SDNN characterize the variability of the intervals between heartbeats. Their dynamics can provide valuable additional insights when monitoring changes during physical exertion and recovery.

However, assessing heart rate variability parameters in isolation is insufficient. Analysing them in conjunction with data on resting heart rate, stress index, sleep and the athlete's subjective state helps to better understand the functional response. The "BioMouse" hardware and software system can be used for the systematic recording of such monitoring data and the study of its dynamics.

Aim of the study. Assessment of the response to physical exertion and the state of recovery in adolescent athletes based on heart rate variability and other functional indicators using the 'BioMouse' hardware and software system.

Materials and methods. The study involved 110 athletes aged 15–17: 37 runners, 34 swimmers and 39 cyclists. As part of the functional monitoring, data on RMSSD, SDNN, resting heart rate, stress index indicators, skin

conductance response, sleep duration and subjective status were examined as part of the functional monitoring.

The dynamics of these indicators before and after exercise were analysed by sport. When interpreting the results, it is necessary to take into account the influence of measurement conditions and individual functional characteristics.

Results and Discussion. According to the results presented in the study, following physical exercise, athletes showed a reduction in RMSSD and SDNN—indicators of the stress index—as well as an increase in resting heart rate. These changes may reflect temporary shifts in autonomic regulation in response to exercise.

The extent of the observed changes varied depending on the sport. In particular, the post-exercise changes in runners were characterised as relatively pronounced. However, this should not be interpreted as a definitive conclusion that recovery is poorer in all runners. To draw such a conclusion, it is necessary to take into account the intensity of the exercise, the timing of the measurements, baseline heart rate variability values, and repeat measurements during the recovery period.

Table 1.

Key indicators used in monitoring physical activity

Indicator	Assessment content	Monitoring value
RMSSD	Short-term variability of consecutive heartbeats	Monitoring the dynamics of the vegetative response
SDNN	Overall measure of variability in normal heart intervals	Assessment of heart rate variability
Resting heart rate	Heart rate	Monitoring changes in response to exercise and recovery
Stress Index	A calculated indicator based on heart rate distribution	Further assessment of the dynamics of functional stress
Sleep and subjective state	Rest and an athlete's well-being	Interpreting physiological indicators in context

Note: The table describes the purpose of the indicators in the assessment; it does not show their numerical results.

Regularly recording monitoring results makes it possible to determine an athlete's individual baseline level and the fluctuations in their performance that

are characteristic of them. When assessing training load, a series of measurements taken under standardised conditions may prove more informative than a single measurement.

Conclusion. Monitoring heart rate variability and other functional parameters using the "BioMouse" hardware and software system enables a comprehensive assessment of athletes' responses to physical exertion and their recovery process. During the study, a decrease in RMSSD and SDNN values was recorded following exercise, along with an increase in heart rate and the stress index. These changes may play an important role in characterising the body's response to physical exertion. However, for a correct interpretation of the results, it is necessary to take into account the conditions under which the measurements were taken, individual baseline values and the dynamics of recovery. Thus, multi-parameter monitoring can serve as an additional tool for monitoring the functional status of athletes and tailoring training loads to individual needs.