

METHODS OF OPERATIVE AND INFORMATIVE CONTROL OF THE LEVEL OF MUSCLE LOADING USED IN THE TRAINING FOR SAMBO WRESTLERS

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Abstract: The aim of this paper is to find out effective, informative and available monitoring techniques and ways of assessment of sambo wrestlers' functional readiness for training and competitive activity. Recent research based on the standard medical examination data suggests that many sambo wrestlers demonstrate unsatisfying types of cardiovascular response to exercise. The paper provides the results of a comparative analysis concerning the efficiency of utilization of two methods that allow controlling the functional state of sportsmen in the training for sambo wrestlers. These two methods include the assessment of heart rate recovery dynamics and ECG recording during training. As it was revealed, both techniques allow maintaining athletes' physical health. However, the ECG recording method, developed by Professor Zavyalov, seems to work better to increase the level of sambo wrestlers' functional readiness for intensive training and competitive activity. Sambo wrestlers who underwent ECG recording have demonstrated significantly less recovery interval after physical exertion ($p < 0.05$), this being one of the key criteria of the level of sportsmen's functional readiness for high performance achievement.

Key words: sambo wrestling; training process; physical exertion; functional readiness; screening, heart rate; electrocardiogram.

Introduction

It is known that sambo wrestling is one of national sports in the Russian Federation and has a long history of winning (Serporezyuk & Chekhranov, 2014). At the same time, according to S. Vardar, sambo wrestling, as well as freestyle wrestling, Greco-Roman wrestling, women wrestling, grappling and jiu-jitsu, is considered to be one of the main styles of the universally acknowledged amateur competitive wrestling (Vardar et al., 2007). It seems that one of success criteria and the reason for the acknowledgement of sambo as one of leading global amateur wrestling styles is the fact that sambo is not a "pure" wrestling style, but one of "synthetic" or "mixed" styles, representing a mixture of techniques from different kinds of martial arts. Of special note is that due to its universality, sambo wrestling technique may be successfully used to compete and win not only by "pure" sambo wrestlers, but also by judoists, "Kuresh" wrestlers and other sportsmen practicing wrestling in uniform (Mirzabozinov, 2015). This fact also contributes to the popularization of sambo wrestling. Specialists also underline a significant success of sambo wrestlers who have been competing in various mixed martial arts organizations (Koepfer, 2008).

The name of Fedor Emelianenko, a multiple Russian and world champion in combat sambo is well-known to admirers of mixed martial arts and it makes sambo wrestling attractive for the young. The large number of young people willing to attend the sambo classes contributes to the establishment and successful functioning of sport classes and clubs in many Russian universities. As V. Volkov and colleagues specify, artistic gymnastics competitions for Russian student teams only include as many as ten sides, but Russian sambo student competitions are attended by approximately 100 teams from different Russian universities (Volkov et al., 2015). However, a large number of people engaged in sambo wrestling represents only one of the criteria for its successful development in Russia. As O. Pryimakov and colleagues suggest, to keep the traditions of sambo wrestling winning alive, it is necessary to continuously improve facilities and resources as well as to develop methodological basis for athletic training, concerning, in particular, the issues of functional reserve evaluation system and training load optimization (Pryimakov et al., 2016).

According to S. Dadelo, improvement in sport scores in sambo wrestling depends on quality of the wrestlers' technical and tactical training (Dadelo et al., 2013). It is also suggested that together with studying sambo tactics and techniques a sportsman needs excellent functional training (Osipov et al., 2012). Wrestlers are known to have a series of wrestles within a day. This means that without having a sufficient level of general and specific endurance, they will not be able to reach final wrestles and demonstrate strong performance (Cherepov

& Shaikhedinov, 2016). At the same time, specialists note that a heavy increase of training load, although being typical for wrestlers in the contest season, in case of incomplete wrestlers' functional systems recovery can lead to a variety of negative consequences. These negative outcomes are often manifested in the decrease of sportsmen's adaptive abilities and their competitive performance (Vybornov, 2013). Our investigations concerning health assessment of various sportsmen representing Krasnoyarsk Krai have demonstrated that the most unfavorable types of cardiovascular response to exercise were registered in martial artists, including sambo wrestlers (Osipov, 2007).

A considerable increase of training load is typical for training for contests and high sporting achievements. However, it does not solve the problem of functional proficiency and performance ability. Moreover, it can also do harm to the sportsmen's health (Osipov, 2011). Similar problems have been registered during preparation of judoists for competitive activity. L. Qiang assumes that excessive training during preparation for competitions leads to body functional systems overload and increase of traumatic incidence rate (Qiang, 2015). In case of long and high intensity training, lack of control over effects of training and competition load is suggested to lead to overexertion and negative cross-adaptation (Pokhachevskiy et al., 2011).

The described adverse circumstances determine an urgent need for qualitative change introduction into the process of sambo wrestlers' training for competitive activity. In the current context, the process of sportsmen's preparation is based on objective data about their state of health, which requires constant control over their training activity efficiency (Tron et al., 2013). It seems that informative and effective methods of control over the level of sportsmen's muscle loading should be widely used in sambo wrestlers' training to contests, especially since the absence of such control is suggested to have extremely adverse effect on the level of sambo wrestlers' functional state (Osipov, 2007).

Material & methods

According to L. Qiang, operating monitoring of training activity with express-assessment of sportsmen's state should be used in martial artists' training. The author considers heart rate (HR) to be the most representative and easy-to-assess criterion of sportsmen's functional state. Control over training load with the use of HR monitoring allows achieving a higher quality of training for wrestling (Qiang, 2015). According to A. Makhalin, assessment of functional potential of sambo wrestlers should be based on the evaluation of sportsmen's vital lung capacity (VLC) (Makhalin, Savchenko, & Tokmashev, 2016). To evaluate wrestlers' specific endurance it is also suggested to use special test tasks, based on throwing of training dummies within a certain period of time (Zebzeev & Zdanovich, 2013). Assessment of sportsmen's functional performance is also reported to be possible with the use of a specific judo fitness-test, measuring a quantity of the sportsman's throws of two other sportsmen within a certain period of time (Drid, Trivic, & Tabakov, 2012). According to P. Drid and colleagues, this judo fitness test may be used not only for judo wrestlers but also for jiu-jitsu and sambo sportsmen (ibid.).

A. Zavyalov proposes to use electrocardiography for monitoring of the level of sportsmen's training load during training sessions. The author believes that any ECG deviations appearing in the course of active muscular performance allow making a qualitative and informative assessment of the level of fatigue in sportsmen (Zavyalov, 2013). It is to be noted that operative control over the human cardiovascular system in the course of person's active performance is critical during the process of training as cardiac arrest emergency is the main mortality factor in young athletes. If this occurs, it is often caused by the presence of cardiovascular diseases and pathologies that were not diagnosed earlier (Harmon, Asif, & Drezner, 2011).

At the same time, as A. Alattar states, the use of ECG in the course of the training process remains a disputable issue. The European Society of Cardiology stands for inclusion of ECG in screening protocols of examination of sportsmen and emphasizes a great potential of this method in the matter of identification of athletes with the risk of cardiac arrest emergency due to various cardiac disturbances. Conversely, American specialists do not recommend frequent usage of ECG for mass screening of sportsmen because of rather high frequency of false-positive signals (Alattar, & Maffulli, 2015). However, even specialists from the USA recommend to account for HR dynamics in physiological testing programs for martial artists (Curby, 2010). However, the assessment of HR dynamics is possible via the ECG. The method of ECG is also on the list of recommended screening methods by the American Coaching Association (Conley et al., 2014). The use of the method of ECG control over functional state of wrestlers is also admitted by some Russian specialists. For instance, A. Zavyalov recommends implementing of the ECG monitoring method in freestyle wrestling (Zavyalov, 2007). We have also used this method in the course of training for beginner sambo wrestlers (Osipov, 2008).

The literature review made it possible to find two most prospective methods of control and evaluation of sambo wrestlers' functional state: HR dynamics evaluation during training exercises and in the recovery

period between control wrestles and ECG monitoring during training sessions. This allowed us to proceed to the next step in our investigation which consisted in the evaluation of the effectiveness of these two methods.

The research was carried out on the basis of Wrestling Academy named after D.G. Mindiashvili. Two groups of sambo wrestlers, who showed satisfactory results of cardiac response to exercise during a medical examination in the Krasnoyarsk Exercise Therapy Centre (a specialized medical facility for compulsory assessment for Krasnoyarsk Krai sportsmen with athletic titles and categories) were included in the study. The aim of the research was to increase the level of the wrestlers' functional proficiency and performance ability by means of control over their training load during training sessions. In group 1 the control was realized by means of HR monitoring during the wrestlers' training sessions, while in group 2 ECG recording was used with interpretation of the received data according to Professor Zavyalov's ECG measurement tables (Zavyalov, 2013). The duration of the study was six months. Each group comprised 15 sambo wrestlers (candidate masters and masters of sports of Russia) aged from 17 to 20 years.

The study participants had two hours training sessions six days a week. Group 1 wrestlers underwent the assessment of cardiovascular system response to training during both wrestles and recovery periods; the main assessment criteria were HR and HR recovery during periods of rest between training wrestles. Specialists suggest giving special attention to the first five minutes of the recovery period, since this time interval is the minimal rest time between wrestles according to sambo contest rules (Ankudinov, 2012). Group 2 sportsmen only had admission to full value training sessions if they had no ECG deviations. In case of any ECG deviations (biphasic or negative T-waves, QRS segment broadening over 0.1 second, etc.) the wrestlers were only admitted to warming up. The criterion for discontinuation of training sessions for group 2 wrestlers was appearance of ischemic ST-segments on ECG or flattening of T-wave, since these results were considered to be indicators of cardiac fatigue during training (see Figure 1).

Figure 1. ECG without pathological findings (A); ECG with ischemic ST segment deviation (B).



Results

At the outset and in the end of the study sportsmen of both groups underwent medical examination in the Krasnoyarsk Exercise Therapy Centre (a specialized medical facility for compulsory assessment for Krasnoyarsk Krai sportsmen with athletic titles and categories). For the assessment of the level of the wrestlers' functional readiness and the state of their cardiovascular system a standard test was used which included run at the pace of 180 steps per minute for three minutes with ECG registration at rest, immediately after the load and within the first five minutes of the recovery period.

At the baseline all sportsmen showed satisfactory cardiac reaction to training load (4-5 minutes average recovery period). However, after six months of training sessions the results of the tests began to differ significantly. Among group 1 sportsmen eleven wrestlers had satisfactory cardiac recovery after the testing load and four wrestlers were graded "good"; the average mark among the group was "satisfactory". In group 2 there were twelve sportsmen graded "good" and three sportsmen graded "excellent"; the average mark among the wrestlers of this group was "good".

The recovery period totaled 3.5-5 minutes for group 1 sportsmen and 3-4 minutes for group 2 sportsmen. The average HR indices during training sessions in the beginning of the study totaled 166 ± 8 for group 1 and 170 ± 6 for group 2. HR dynamics only increased a little in wrestlers of group 1 (172 ± 4), but showed significant increase in sportsmen of group 2 (186 ± 4). Analysis of sporting achievements of the wrestlers was based on the total number of winning places in 6 sambo wrestling contests during the investigation period. This analysis showed that group 1 sportsmen got eight winning places, while group 2 wrestlers had fourteen. Main results are given in Table 1.

Table 1. HR dynamics, evaluation of recovery level after muscle loading and quantity of winning places in contests in the examined sportsmen

Wrestlers	At the outset of the study			At the end of the study		
	HR	Recovery level grade	Sports scores	HR	Recovery level grade	Sports scores
Group 1	166±8*	satisfactory *	-	172±4*	satisfactory*	8
Group 2	170±4*	satisfactory *	-	186±4**	good**	14**

Note. * - Inaccurately, ** - accuracy - $p < 0.05$

Discussion

In summary, it should be underlined that there was no unsatisfying cardiovascular response to test exercise load revealed in sambo wrestlers of both groups. This enables us to argue that the proposed methods of sambo wrestlers functional state controlling are highly effective, in terms of maintaining physical health at an adequate level. Our clinical findings indicate that the recovery period after test exercise load had no significant changes in group 1 sportsmen, while in group 2 sportsmen this period was significantly decreased ($p < 0,05$). Sambo wrestlers who used Professor Zavyalov's method of ECG recording and functional state assessment during their training, demonstrated more than 1 minute decreased recovery interval after exercise load within the period under examination. These results seem to be the key criteria of the level of sportsmen's functional readiness for high performance achievement.

Sambo wrestlers have a five minutes interval between bouts to recover strength. A significant difference between the study groups in terms of the number of top places got in sport competitions seems to be accounted for the decrease in recovery interval. Group 2 wrestlers got significantly more top places in sambo competitions than group 1 wrestlers. The increase in the second group wrestlers' average heart rate values accounts for a better adaptation of their heart muscle to exercise load. To reach the necessary tiredness criteria and demonstrate ischemic ST segment deviation with T-wave flattening the second group wrestlers had to increase both the volume and intensity of physical training.

It should be taken into account that the described ECG results are not always associated with a particular heart rate. However, in our situation sportsmen-participants of the study had a reasonably high heart rate while training themselves. This situation is not unusual. According to A. Zavyalov, many young adults at the age of 18 respond to physical load by a graduate increase in their heart rate up to 190 bpm and higher, while their ECG values do not give evidence of an acute fatigue (Zavyalov, 2013).

Conclusions

Although sambo wrestling is one of the most popular national sports in the Russian Federation and it has a long history of winning, the training process in this kind of wrestling requires a considerable improvement. Specialists believe that considerable changes should be introduced into the monitoring techniques and ways of assessment of the level of physical load that sportsmen have during their training before competitions. It was revealed that the absence of up-to-date, reliable, informative and effective techniques of sambo wrestlers' functional proficiency and performance ability assessment results in negative outcomes, manifested in the decrease of their organism's adaptative capabilities and their competitive performance. The solution of the problem of the monitoring and assessment of the level of sambo wrestlers' physical load in the training process may be provided through the use of the ECG-supported physical load controlling method during the course of training. Our research gives evidence of the effectiveness of the use of the ECG-supported physical load controlling method which contributes to the increase in sambo wrestlers' functional proficiency and performance ability, preservation and promotion of their physical health, and can serve as an objective criterion for training performance assessment.

Conflicts of interest: The authors declare that they have no conflict of interest.

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