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Research Article

Realization of Speed-strength Manifestations at Improvement of Metabolism of Energy of Muscle Contraction

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Abstract

The aim of the study is to: improve the speed-strength qualities of freestyle wrestlers and judokas; develop their endurance in anaerobic exercises; and increase lactate utilization during speed-strength exercises and during the recovery period during the improvement stage of athletic skill. Methods and organization of the study. Analysis and synthesis of scientific and methodological literary sources. Pedagogical observations, an experimental study, and physiological and biochemical (lactic acid (lactate) concentration levels in capillary blood) methods were used. A comparison of the effectiveness of speed-strength exercises, including wrestling techniques, and blood lactate levels during the recovery period. Freestyle wrestlers and judokas in the experimental group performed aerobic exercises during the recovery process with movement coordination similar to the exercise being trained. Wrestlers in the control group used passive rest to recover from anaerobic exercise. Study results and conclusions. As a result of performing control anaerobic exercises at the end of the experimental training session, subjects who used active rest for recovery demonstrated a significant positive improvement in their results. Moreover, blood lactate levels remained virtually unchanged during the first minutes, but starting from the third minute, lactate utilization significantly ($p<0.05$) improved compared to baseline. At the end of the experiment, wrestlers who used passive rest demonstrated significantly ($p<0.05$) lower performance in control exercises than wrestlers who used active rest, while their blood lactate levels increased significantly ($p<0.05$) compared to baseline.

Keywords

Athletes, Students, Freestyle and Judo Wrestlers, Resynthesis, Lactate

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1. Introduction

Increasing the result in sports activity remains the main direction of athletes' training process. One of the popular and demanded sports are martial arts, among which freestyle wrestlers and judo have been gaining scale for decades. Every year the number of people engaged in these sports increases, the level of their training increases, in which the key aspect in improving the result is the rationalisation of the training process.

The intensive search for new ways to improve the training process in combat sports is a significant impetus that contributes to the improvement of competitive performance.

When selecting means and methods of special physical training, as experts note, one should be guided by the principle of dynamic correspondence, i.e. they should be adequate to the competitive exercise [15].

Extensive experimental material presented in the works of individual authors shows that to improve the motor activity of an athlete in a chosen sport it is necessary to use such exercises, the performance of which would ensure the correspondence of motor coordination structures to the coordination features of the main competitive exercise. This correspondence is inherent in exercises, the performance of which simultaneously with the development of physical qualities improves sports technique, that is, it meets the principle of conjugate influence [1].

Along with the issues of conjugacy, the problem of variability is put forward, or, in other words, the application of optimal alternation of exercises, in the process of performing in which greater or lesser resistances are overcome in the conditions of competitive activity. In the use of the principle of variability we can see the possibility not only of creating conditions for the formation of the rhythm and speed structure of the main competitive exercise and filling this structure with force content, but also of improving energy supply during physical loads. The rationale for the latter is, to a certain extent, the fact that when performing motor actions of anaerobic character with their alternation with aerobic load, the activity of enzyme systems that stimulate the extraction of oxygen from the blood increases in the muscles. This phenomenon, as noted by experts, takes place only in the muscles involved in the work, i.e. it has a local character [5, 7].

Structural rearrangements of energy supply of muscle functioning under anaerobic conditions demonstrate adaptive reactions of the muscle system to oxygen deficiency. The validity of such a judgement is confirmed by the results of studies, which substantiate that working muscles are the most active place of ‘burning’ lactate concentration [10, 11, 13].

The studies conducted to date still do not provide sufficient information about pedagogical, physiological, biochemical regularities of performance enhancement of wrestlers at the stage of improving sportsmanship. Insufficiency of generalizing studies in sports science related fields of physical culture - biomechanics, physiology, biochemistry, pedagogy and other sciences in relation to the improvement of sportsmanship and, most importantly, insufficiency, and in some cases the lack of clear substantiated ideas about the main reasons for this or that influence of training exercises on the effectiveness of competitive activity.

In general, the prospect of improving the skills of freestyle and judo wrestlers is associated with the substantiation of the basic laws of building the training process, considering the interrelation and interdependence of pedagogical, biochemical parameters of training exercises. This is one of the main accepts of scientific relevance of the investigated problem and its novelty.

The analysis of results of pedagogical research on the problem of increase of physical fitness of sportsmen allows to conclude about dependence of high efficiency of this process on perfection of energy supply of functioning of work of muscles and muscular groups and connected with this process of restoration of an organism after physical loads of various intensity and duration of aerobic and anaerobic character. The search for rational ways to improve the training process from the standpoint of increasing physical fitness, including speed and strength qualities, seems to date far from complete. It is based, first, on the study and analysis of motor activity of athletes, including the determination of optimal alternations of loads of different intensities, providing an increase in the level of realisation of motor actions or speed of distance running without additional increase in by-products of ATP (Adenosine triphosphate) resynthesis, such as the concentration of lactate in the blood [12, 14].

When increasing speed and strength abilities in the performance of motor acts and in improving recovery after exertion, specialists consider many factors, which can be summarised in two main directions: improving the performance of functional systems of the organism.improving the energy of muscular activity.

The development of physical fitness, especially explosive strength, speed, dexterity, coordination of movements, strength qualities, as well as energy supply of muscle activity are usually priority in the process of training high-level athletes, including freestyle wrestlers and judokas.

It should be noted that at wrestlers at the stage of perfection of mastery functional capabilities of an organism are practically formed and close in individual plan to perfection.

From the point of view of energy supply of muscle activity of wrestlers, the solution of urgent problems of increasing speed and strength abilities, as well as their endurance is seen, first of all, in the improvement of energy metabolism of muscle activity, From the point of view of energy supply of muscle activity of wrestlers, the solution of urgent problems of increasing speed and strength abilities, as well as their endurance is seen, first of all, in the improvement of energy metabolism of muscle activity, including the absence of a

significant increase in the concentration of lactate and increase in the intensity of its utilisation directly at the moment of exercise.

These aspects of energy supply of muscle activity of wrestlers were the main direction of our research. In the opinion of some specialists, the increasing intensity of lactate concentration decreasesnow of speed and power load, as well as the creation of prerequisites for limiting its entry into the blood in the conditions of competitive activity of wrestlers, are overdue problems in the development of training process planning and optimisation of physical loads [2, 9].

Justification of the use of combinations of speed-force anaerobic and aerobic exercises with the interaction of the same muscles and muscle groups and their systematisation on the principles of didactics, allows to rationalise the training process of judoists and freestyle wrestlers. This is one of the main accepts of scientific relevance of the study.

The lack of attention to the improvement of metabolic functioning of muscles of martial artists is largely determined, in our opinion, by the lack of biochemical means of control in the training of wrestlers.

It follows from the literature that in improving such physical qualities as speed and strength, speed and power endurance, pushing back the time of fatigue in the performance of appropriate motor actions, with proper performance of functional systems of the body, including the CVS (cardiovascular system), nervous system and other vital organs, the most important is to improve the metabolism of energy supply of muscle work [2]. The increase of speed-force abilities and endurance in the performance of motor actions of alactate and glycolytic orientation has been substantiated in a number of works from the position of absence or insignificant increase in the growth of lactate concentration in capillary blood during the performance of exercises of increased intensity, as well as the level of growth of lactate utilisation during recovery after physical exertion of anaerobic character [3].

It is known that lactate during rest after exercise is utilised at different intensities in athletes in relation to their level of training and the magnitude of the workload performed [8]. This suggests the presence of different levels of lactate utilisation directly during motor actions, and with increasing athlete's fitness, the process of lactic acid utilisation at purposeful loads should increase.

Improvement of performance in the performance of speed and power motor actions in the absence of an increase in the concentration of lactic acid in the blood during the recovery period has been recorded in research works [9]. At the same time, it should be noted that the growth of the result in the realisation of movements of maximum or near maximum power in the absence of an increase in the concentration of lactate in the blood is seen to be the result of increased utilisation of glycolysis by-products in the muscles themselves [6].

We tried- toincrease the value of realisation of speed-force actions of freestyle wrestlers and judoists at practical absence of increase of concentration of lactic acid in capillary blood.

Considering the above stated, it was assumed that systematic performance of short-term maximal power exercises of speed-force orientation with exercises of the same coordination structure, but with aerobic intensity will serve to increase speed-force manifestations of freestyle wrestlers and judoists at increased intensity of lactate utilisation during the period of movement performance.

2. Methods and Organisation of the Study

In the process of the research the generally accepted means and methods were used: anthropometric measurements, testing, timekeeping, biochemistry methods, statistical processing of results.

The results were obtained in the process of experimental research with freestyle wrestlers and judoists of sports categories from the 2nd sports category to candidate master of sports, students at Moscow State University and Moscow State Pedagogical University, previously engaged in children's and youth sports schools.

The difference in training of wrestlers of control and experimental groups (CG (The controlgroup)and EG (The experimentalgroup)respectively) consisted only in the modes of rest (recovery) when performing loads related to the development of speed and strength abilities of a wrestler.

Passive rest was used by athletes CG for recovery in the intervals between overcoming intensive exercises. Wrestlers EG as a rest (recovery) repeated the same motor actions with intensity close to the aerobic threshold with a gradual increase in intensity (as training increases), towards the anaerobic threshold.

3. Results and Their Discussion

Reliable ($p < 0,05$) differences were found between the wrestlers EG and CG in the growth of performance in the performance of control speed-force exercises in the final stage of training relative to the initial positions. According to the average data of EG and CG subjects: 3.4cm and 1.7cm ($p<0.05$) in the jump up; 1.4m and 1.1m ($p<0.05$) in the throw of weighted medicine ball (5kg); 1.7m and 0.8m in the throw of medicine ball (2kg); ($p<0.05$); 15 flexion and extension of arms from a lying position on the ches in the supine position with clap under the chest - -3.8s and -2.2s ($p<0.05$); 15 straight leg raises from hanging to hand grip - -2.9s and -2.3s ($p<0.05$); 10 pull-ups on the bar - -1.3s and -1.1s ($p\geq0.05$); 10 dummy throws - -0.9s and -0.7s ($p\geq0.05$), respectively. At the same time, in all types of exercises, a reliable ($p < 0.05$) advantage of performance improvement in favour of the EG subjects was recorded. The predominant growth of performance of EG wrestlers in the final stage of training was

reflected in the increase (p< 0,05) of the AnT (Anaerobicthreshold) level, which, in our opinion, is a significant circumstance. The predominant increase in the performance of EG wrestlers in the final stage of training was reflected in their increase (p< 0.05) in the level of AnT, which, in our opinion, is a significant circumstance. Since the reliable growth of the recorded results, with an unreliable (p>0.05) change in the concentration of lactate in capillary blood at the first minutes of rest (recovery), allows us to speak about the connection of the increase in the level of AnT with the presence of improvement in their metabolism of energy supply of muscle work. At the same time, no changes in the level of AnT were found in CG athletes.

The performance of speed and strength exercises with greater efficiency at the end of the experiment, relative to its beginning, without a significant (unreliable (p≥0,05)) additional increase in the concentration of lactate in capillary blood, was the most important attribute of the rational construction of the training process of EG wrestlers.

Positive change (p<0,05) of results in all types of exercises of the control testing of speed and strength exercises and absence of changes in the concentration of lactate in blood at the first three minutes of recovery in EG athletes at the end of the pedagogical experiment allows us to speak about a positive rational restructuring of energy supply in their muscle work. As a whole about improvement of metabolism functioning of muscular apparatus work. Table 1, revealing the change of lactate concentration in blood after performing control exercises in the subjects before and at the end of the pedagogical experiment, is presented in confirmation.

The presented data allow us to assert the positive change of ATP resynthesis in the process of realisation of trained exercises.

At the end of training, the athletes of the CG had fewer positive changes in the results (compared to the athletes EG).

Table 1. *Blood lactate concentration after glycolytic exercise before and at the end of the training process by subjects of experimental (n=60) and control (n=60) groups (M±σ at a confidence level of 0.85).*

Group/ Time,Lactate	At the beginning of the experiment					At the end of the experiment				
	1min Mmol/l	3 min Mmol/l	5 min Mmol/l	7 min Mmol/l	9 min Mmol/l	1 min Mmol/l	3 min Mmol/l	5 min Mmol/l	7 min Mmol/l	9 min Mmol/l
EG	11,6±0,7	13,2±0,5	11,5±0,6	8,8±0,5	6,2±0,4	11,8±0,5	12,7±0,4	9,2±0,6	7,3±0,8	5,2±0,6
CG	11,4±0,6	13,1±0,6	11,4±0,7	8,9±0,7	6,1±0,8	13,4±0,6	14,6±0,5	12,8±0,7	10,1±0,9	8,6±0,5

From the reliable (p< 0.05) increase in lactate concentration at the 1st and 3rd minute of recovery after intensive performance of speed and power exercises, it follows that the growth of performance in them was provided due to the increase in glycolytic processes of ATP resynthesis. Consequently, passive rest between intensive exercises, the energy supply of which was mostly anaerobic, promotes the formation of dominance in the energy supply of muscle work by increasing the power of glycolytic processes. The results obtained by us, once again in confirmation of earlier studies, substantiate the low productivity of the increase in speed-force manifestations when passive rest is used for recovery after speed-force exercises [4].

Since the value of lactic acid concentration in blood has a physiological limit, training aimed at its further increase should be recognized as a limited (dead-end) way. In addition, as the results of the study have shown, increasing the performance in speed and strength exercises by increasing the power of glycolytic processes is not very effective.

4. Conclusion

The results presented and their discussion led to the following conclusions:

The use by freestyle wrestlers and judoists of exercises of low aerobic intensity with a gradual increase in their intensity, as sportsmanship grows, up to the level of ANP as recovery after intense motor activity of alactate and glycolytic orientation contributes to increased performance in the implementation of trained exercises, in the absence of significant changes in the concentration of lactic acid in the blood and the increase in the intensity of its utilisation during the recovery period.

The use by freestyle wrestlers and judoists of passive rest for recovery after performing speed-force exercises with maximum or near-maximum power contributes to relatively low efficiency of performance enhancement and a reliable increase in blood lactate concentration.

Abbreviations

ATP Adenosine Triphosphate
CVS Cardiovascular System
CG The ControlGroup
EG The ExperimentalGroup
AnT AnaerobicThreshold

Conflicts of Interest

The authors declare no conflicts of interest.

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