ORIGINAL ARTICLE

Dependence of work capacity recovery after strenuous training sessions upon individual predisposition of skilled wrestlers to work under different energy modes

Authors' Contribution:
A Study Design
B Data Collection
C Statistical Analysis
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Abstract

Background & Study Aim: It is known that a fatigue and recovery response underlies the efficient of elite athletes' training. Individualities of recovery response in skilled wrestlers training may relate to differ in capacities of anaerobic alactate, lactate and aerobic systems and in some important characteristics of special work capacity of athletes. On this basis relation between energy capacities and rate of special work capacity recovery after heavy training sessions of wrestler has been suggested. The aim of the study was the dependence of the recovery rate of special work capacity characteristics (6 hours after strenuous training sessions of different type) upon predisposition of skilled wrestlers to work in different energy regimes.

Material & Methods: A total of 31 free-style male wrestlers, aged 19-26 (mean 22.9), weighing 63–89 kg, of a national and international levels, with 5-13 years of competitive wrestling experience participated in the study. The recovery of special work capacity 6 hours after three common types of strenuous training sessions differing in preferential realization of anaerobic alactate, glycolytic (lactate) and aerobic energy sources were studied. The speed-strength and special endurance capacities wrestling tests were used. The specific speed-strength characteristics were evaluated by speed of some elements of technical actions (TA) during video registration and dynamic force assessment.

Results: A subjectively perceived (immediately after the session) heaviness of training load was extremely high and did not differ significantly for sessions of different training direction. Six hours after the training sessions, most of analyzed indices of special work capacity and TA were decreased relative to initial values. The decrease was related to the type of the session differing by preferential usage of power regimes of anaerobic alactate, anaerobic glycolytic (lactate) and aerobic character (energy mode). There existed connection between domination in wrestler of these or those aspects of energy capacities and degree of special work capacity and TA recovery after heavy training loads in sessions of different types.

Conclusion: The recovery of special work capacity characteristics six hours after the session turned to be the highest, when individual energy predisposition matched preferential orientation of training session. Practical significance of the study may consist in the advance of additional criteria for regimes of training load repetition with account for individual predisposition of wrestlers.

Keywords: combat sport • free-style wrestling • individualities • recovery rate • specific work capacity

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Special working capacity – characteristics of particular aspects of specialized physical fitness and some specific elements of technical actions.

Energy mode – characteristics of the relationship in metabolic capabilities of anaerobic glycolytic, phosphate and aerobic work energy supply systems for sports specific exercises.

Training session's type – session differing by preferential usage of power regimes of anaerobic alactate, anaerobic glycolytic (lactate) and aerobic character.

INTRODUCTION

Usage of high (maximal) loads as well as regulation of fatigue and recovery responses underlies the successful construction of elite athletes' training [1, 2]. At the precompetitive stage these aspects of training determine either positive or negative effect of training loads [3, 4], and form the basis for individualization of special endurance perfection [5, 6]. To that end, numerous different characteristics are taken into consideration. In this regard of tremendous importance is the control for physiological and biochemical information [2, 7–9]. Their selection is determined by specifics of physical exercise type used during training sessions. Efficiency of such control is determined by adequacy of controlled characteristics relative to the major factors of fatigue [10–13]. Changes of special work capacity after strenuous training sessions represent the important characteristic of fatigue [14, 15]. In this regard, the account for energy orientation of physical exercises is of importance. Special work capacity of wrestlers is determined by the efficiency of executing technical actions to a great extent. Therefore, the degree of recovery after training sessions may be estimated according to both speed characteristics of technical action performance and general quality of their execution [9, 10, 16]. Account for individual peculiarities of wrestlers represents an important aspect of the efficiency of these estimates. It has been already demonstrated that wrestlers differ in individual manner of wrestling. According to this manner, the types of wrestlers are distinguished [17, 18]. Both psychological peculiarities and individual predisposition to work in different energy regimes underlie this or that type [5, 19, 20].

It is known that athletes differ in the development level of each aspect of energy capacities, which is determined by innate traits in large part. Significant range of individual capacities of anaerobic alactate, lactate and aerobic systems of work energy supply has been demonstrated in homogeneous group of skilled wrestlers [20–23]. These differences influence individual inclinations of wrestler to a certain manner of technical-tactical actions in the course of competitive bouts. Three groups of wrestlers may be distinguished according to expressiveness criterion for power development of one of the aspects of work energy supply at relative independence of the indices of the development level of various aspects of energy capacities in these groups [23, 24]. For instance, wrestlers of "speed-strength" type are usually characterized by obviously higher levels of anaerobic alactate power in homogeneous groups of skilled wrestlers, whereas for wrestlers of "functional" type the highest levels of aerobic power are peculiar [6, 25]. Individual peculiarities of such type are related to specific activity of wrestlers during wrestling bouts (characteristics of attack and volume of technical actions), manner of wrestling (technical, functional and speed-strength) and indices of special physical fitness tests [5, 26]. That is, individual energy predisposition of wrestlers is associated with some important indices of their special work capacity. On this basis association between prevalence of these or those aspects of energy capacities in wrestler and specifics of fatigue and speed of special work capacity recovery after heavy training loads has been suggested. One may also assume that speed (degree) of recovery is linked with the content of training sessions, and, above all, with preferential energy orientation of their power regimes.

Hence, the aim of the study was the dependence of the recovery rate of special work capacity characteristics (6 hours after strenuous training sessions of different type) upon predisposition of skilled wrestlers to work in different energy regimes. Three common types of training sessions differing in preferential orientation of realization of anaerobic alactate lactate glycolytic and aerobic energy sources were studied. Practical significance of the study may consist in the development of additional criteria for regimes of training load repetition with account for individual predisposition of wrestlers.

MATERIAL AND METHODS

Subjects and experimental design

A total of 31 free-style male wrestlers, aged 19–26 (mean 22.9), weighing 63–89 kg, of a national and international levels, with 5–13 years of competitive wrestling experience participated in the study after giving informed consent. The studies were carried out during a 24-day training camp, a special preparatory period of the annual training cycle. The content of the study was approved by the local Commission for scientific study ethics. At the first stage of study, all subjects performed three types of ergometric tests: anaerobic alactate, anaerobic lactate and aerobic power estimation [23]**.** They were performed less than two days after the recovery microcycle in the form of control training sessions. Anaerobic tests were performed the day after the test of aerobic power. According to indices of each test, wrestlers were divided into three groups. Athletes with the highest indices in the anaerobic alactate test (70–100% of percentile zone) were included in the first group (n = 9, body mass 77.5 ±1.4 kg), those with the highest indices in the anaerobic lactate test – in the second group (n = 8, body mass 76.8 ±1.5 kg) and those with the highest indices in the aerobic test – in the third group (n = 7,

body mass 74.6 ±1.2 kg). There were no significant difference in body mass. Mean level of power output in the groups is presented in Table 1**.** Methods for determination of indicators for dividing into groups were previously reported [23]**.** Athletes whom were difficult to assign to one of the above groups were excluded from further analysis.

Table 1. Characteristics of anaerobic and aerobic power output in the groups of wrestlers.

Number of groups	Characteristics	Mean ±SD
1	Anaerobic alactic: working output for 10 c, J.kg^{-1} peak power, w.kg^{-1}	145.1 ± 6.9 15.9 ±1.1
2	Anaerobic lactic (glycolytic): working output for 30 c, J.kg-1 peak power, w.kg^{-1}	339 ±24.2 14.2 ±1.3
3	Aerobic power: VO2max, ml. kg^{-1}. min^{-1}	62.7 ±1.6

At the second stage of study the groups of wrestlers, who obviously differed in power characteristics of energy systems, performed high intensity training sessions of three standard types. They differed in preferential energy orientation of performed loads. Immediately after the training sessions the rating of training session perceived exertion was determined. The indices of the wrestling tests, as well as some other characteristics of specific physical fitness, were determined among wrestlers of the three groups one hour before and six hours after the training session. Differences in the degree of under-recovery (in %) of special work capacity characteristics relative to initial data were estimated in wrestlers of the aforementioned groups. Training sessions of 110-130 min duration were held during the first half of the day (10–12 a.m.). Measurements and tests were performed at 18–19 p.m. of the day of training session. These measurements were made in three successive microcycles of training. Training sessions were held under standard for all wrestlers conditions both in their content and in combination with other sessions. Two days before experimental training sessions were of off-loading character.

Training session's content

While choosing the content (types) of experimental training sessions, we have proceeded from the fact that specifics of wrestlers' special work capacity requires improvement of both different aspects of anaerobic (alactate and lactate) and aerobic capacities. Therefore, the effects of sessions, which significantly differed in specific weight of loads of various power regimes – anaerobic alactate (speed-strength loads – S), aerobic (endurance loads – E) and anaerobic glycolytic (special endurance loads – SE), were studied. A day of rest proceeded the above sessions. The content of sessions was determined together with the coaches of the given group of wrestlers and modelled in accordance with existing knowledge about preferential orientation of training exercises of different character [4, 10, 11]. About 65–70 % of training exercises in a session were performed in indicated three regimes of power.

The character of exercises in training session of speed-strength orientation (S) and the regime of work and rest of these sessions were focused on usage of separate exercises (6–12 s) and their series with maximum possible intensity, speed and power. That is, exercises of "explosive" character of energy expenditure were used. Exercises of special physical fitness of such type were concentrated in one session in volume, considered by experts according to pedagogical estimates as the high load [10, 17]. The level of capillary blood lactic acid immediately after (3–5 min) the main part of the session did not exceed 5.8–8.7 mmol.L^{1}.

The character of exercises in training session of preferential orientation at endurance (E) improvement was focused on such duration of executing exercise series, spurts and their combinations (1–4 min), which could provide achievement of close to maximum oxygen consumption. Blood lactate content immediately after the session (3–5 min) was in the range of 4.5–5.2 mmol.L^{1}. In this case, definite regimes of interval circuit method were used.

Exercise character during anaerobic glycolytic (special endurance – SE) type of training session was aimed at usage of mainly series of bouts in work regimes, which reproduced series of three 20-s "spurts" of maximal intensity, divided by reduced from 30 s to 10 s rest intervals and 1-min active rest after each series. The number of repetitions of these series was determined so that to provide less than 15–20 % decrease of load intensity in each spurt. Under these conditions the regimes of load power, provided by preferentially anaerobic glycolytic mechanisms of energy supply, were maintained. Blood lactate concentration immediately after these series of spurts (3rd min) was in the range of 10.3–16.4 mmol.L^{1}. In the course of repeating the series of spurts of such character the portion of aerobic components of energy supply gradually increased, which was indirectly indicated by elevation of mean value (with account for activity and rest) of HR. During the last spurts of such series,

mean HR constituted about 90% of maximal HR. Such work reproduced the content of the most typical load elements of competitive bouts.

Tests and measurements

Two special wrestling tests were used: 1. Test of speed-strength capacities consisting of 8 backward bending throws of wrestling dummy at maximal speed. Time of performing 8 throws and the quality of their execution were registered on the basis of average expert assessment of three specialists according to 5-point scale (186); 2. Complex test of special endurance, consisting of the series of dummy throws, which model wrestle: three repetitions of 5 throws within 40 s followed by 8 throws at maximal speed (spurts). Duration of spurts represented variable value, whereas dummy weight and number of throws performed in 40 s were constant. Time of performance of 8 throws and their quality in spurts were registered. Weight of dummy constituted 40–46 % of athlete body mass. Evaluation of special speed-strength characteristics of wrestlers was made according to speed of some elements of technical actions (TA). The following characteristics of TA (from onset to end of TA) were determined: time of simulating hip throw, time of simulation of taking opponent off balance, time of maximum effort reaching during performance of indicated TA. 3–5 min after the main parts of the session capillary blood lactate concentration was measured for control of training session orientation (LP-420, Dr. Lange). Speed of TA was determined during video registration of tests (AOS S-Pri plus high speed video camera, 1250/s). Dynamic force assessment (Real Power, Globus) was made possible to evaluate a time of peak of force achievement, rebuilding the natural pattern of muscular activation in the special type of dynamic work of wrestlers. For each measurement three repetitions were carried out, among them the best repetition was selected. A modified 0–10 Borg scale [27] was used for rating of training session perceived exertion scores 5–7 min after training sessions (PE).

Statistical analyse

Statistical analyses were performed to determine differences between groups and changes of the variable after training session in comparison to before training session using a statistical software package (STATISTICA 8). Data were assessed for normal distribution by Kolmogorov-Smirnov test. All presented data were found to be normally distributed; therefore, analysis was carried out using parametric statistical tests. A 2-way repeated-measures ANOVA was used to identify differences before and after training session within and between groups of different anaerobic alactic, lactic and aerobic power levels. Values were represented by means of ± standard deviations, and significance was set at the $p<0.05$ level.

RESULTS

Assessing perceived exertion (PE) of the training sessions showed (Table 2) a high degree of general stress of all types of activities and did not have significant differences when varying their training direction (types).

Table 2. Rating of perceived exertion scores (Borg scale) in different types of hard training sessions

Groups of energy predisposition	Type of training session			Significant of difference of PE, p
	A	E	SE	
1	9.11 ±1.03	9.13 ±1.23	9.38 ±1.41	A-E 0.301; A-SE 0.494; E-SE 0.526
2	9.30 ±1.12	8.99 ±1.31	9.23 ±1.32	A-E 0.107; A-SE 0.591; E-SE 0.228
3	9.01 ±1.04	9.09 ±1.28	9.39 ±1.43	A-E 0.506; A-SE 0.449; E-SE 0.327

Six hours after strenuous training sessions most of analyzed characteristics of special work capacity were decreased as compared to initial data. The main differences in the degree of changes of special work capacity indices between groups after training session with high load of speed-strength orientation consisted in less expressed fatigue in wrestlers of the 1 group with predisposition to high alactate power (Table 3). In group 2 only a tendency to less degree of fatigue under the influence of sessions of speed-strength orientation was observed ($p<0.10$). Work capacity in different wrestling tests tended to change to various extents after training session. For instance, in 8-throw test at maximum speed the work capacity of wrestlers of the 1 group decreased by only 4,6 %, whereas in group 2 and group 3 – by 9,7 % and 16,8 %, respectively. The quality of throws significantly decreased in group 1. However, it was less than in group 3. The highest reduction of throw quality was noted in group 3. Quite the opposite was observed in wrestling test of special endurance. The quality of throws in group 3 and group 2 showed less reduction than in group 1. Two of three indices of special endurance test in wrestlers of group 1 demonstrated higher decrease than in wrestlers of group 3. Speed of technical actions (TA) 6 hours after training session for speed-strength

improvement (see Table 3) in wrestlers predisposed to alactate character of energy supply (group 1) was the highest.

Speed of TA of the 1 group wrestlers decreased insignificantly (from 4.9 to 6.5 %). Significant differences were mainly observed between the 1 and the 3 group. In group 3 the decrease of speed of wrestlers' TA 6 hours after the session constituted 13.5–15.7%. Especially high differences in the degree of decrease were peculiar for time of achievement of effort peak during simulation of hip throw. Significant difference between wrestlers of the 2 and the 3 group was observed in this index.

Changes of recovery characteristics 6 hours after high load training session aimed at endurance improvement (E type) in wrestlers of groups with different predisposition to work in this or that power regime are presented in Table 4.

Six hours after training session of "E" type analyzed indices of work capacity in group 3 were the least decreased (as compared to initial ones). This refers to the most characteristics of work capacity of wrestlers of the given group, predisposed to performance of work in preferentially aerobic regimes. The highest differences between the 3 and the 1 group were observed in special endurance. According to time of executing 8 throws at maximum speed, athletes, predisposed to work in lactate regime of energy supply (group 2) had less shifts as compared to wrestlers of the 1 group. Higher degree of under-recovery in wrestlers, predisposed to alactate energy supply of work (group 1), was observed, above all, in work capacity indices in tests, which did not match the athlete type

Table 3. Changes of work capacity and speed of TA six hours after training session for speed-strength improvement (S) in wrestlers predisposed to work in different power regimes (group 1–3), M ±SD and percent of initial values (in brackets).

	Characteristics	Groups of energy predisposition			Significance of difference between groups
		1	2	3	
1	Time of 8 throws at maximum rate [s]	15.6 ±0.6 (95.4%)	18.2 ±0.7 (90.3%)*	20.8 ±0.6 (83.2%)*	1–2 1–3
2	Quality of throws in the test [points]	4.65±0.09 (88.2%)*	4.1 ±0.1 (86.2%)*	4.1±0.01 (83.4%)*	1–3
3	Total time in three "spurts" of special endurance test [s]	64.5±1.3 (92%)*	65.4±1.6 (91.5%)*	73.1±1.5 (94.5%)	
4	Quality of throws in the test [points]	4.1±0.08 (89.1%)*	4.05±0.1 (92.5%)*	4.01± 0.06 (93.1%)*	1–3
5	Time of simulating hip throw [s]	0.806±0.01 (95.1%)	0,850+0.02 (92.1%)*	0.960±0.02 (84.3%)*	1–2
6	Time of force peak achievement [s]	0.210+0.01 (94.0%)	0.235±0.01 (91.2%)*	0.265+0.01 (85.2%)*	1–3 2–3
7	Time of simulation of taking opponent off balance [s]	0.895±0.01 (93.5%)*	0.922±0.01 (92.3%)*	1.075+0.02 (86.1%)*	
8	Time of force peak reaching [s]	0.205±0.01 (93.9%)*	0.251±0.01 (89.2%)*	0.288±0.01 (86.5%)*	1–2 1–3

Group: 1 „alactic", 2 „lactic", 3 „aerobic" predisposition; * Significance of difference vs. initial values

Table 4. Changes of work capacity and speed of TA six hours after training session for endurance improvement (E) in wrestlers, predisposed to work in different power regimes (group 1–3), M ±SD and percent of initial values (in brackets).

	Characteristics	Groups of energy predisposition			Significance of difference between groups
		1	2	3	
1	Time of 8 throws at maximum rate [s]	16.6 ±0.5 (91.5%)*	17.3 ±0.6 (94.8%)	18.4 ±0.6 (93.7%)	1–2
2	Quality of throws in the test [points]	4.31 ±0.07 (91.5%)*	4.19 ±0.1 (87.5%)*	4.29 ±0.09 (90.2%)*	1–3
3	Total time in three "spurts" of the special endurance test [s]	65.9 ±1.0 (89.2%)*	65.7±1.4 (91.9%)*	68.3 ±1.4 (96.8%)	1–3
4	Quality of throws in the test [points]	3.9 ±0,07 (87.5%)*	4.19 ±0.07 93.7%)	4.25 ±0.06 (95.2%)	1–2 1–3
5	Time of simulating hip throws [s]	0.850 ±0,02 (87.6%)*	0.830 ±0.02 (93.0%)	0.895±0,02 (94.3%)*	1–2 2–3
6	Time of force peak achievement [s]	0.221 ±0.01 (89.1%)*	0.230 ±0.01 (92,8%)*	0.249±0.01 (95,1%)	1–3
7	Time of simulation of taking opponent off balance [s]	0.919 ±0.01 (90.2%)*	0.921 ±0,01 (91.9%)*	0.989 ±0.02 (94.8%)*	
8	Time of force peak reaching [s]	0.221 ±0.01 (89%)*	0.232 ±0.01 (92.8%)*	0.242 ±0.01 (96.4%)	1–2 1–3

Group: 1 „alactic", 2 „lactic", 3 „aerobic" predisposition; * significance of difference vs. initial values

of energy predisposition. At the same time, significant under-recovery in several other indices was also noted.

Six hours after training session of anaerobic glycolytic orientation (special endurance – SE) the largest differences in the degree of under-recovery (in % relative to values before the session) were observed between the 2 and the 1 group (Table 5).

During this type of training session (SE) the greatest number of significant differences between groups was revealed in wrestlers with predisposition to anaerobic lactate energy supply of work (group 2). Wrestlers of this group demonstrated the least shifts of special work capacity 6 hours after training session. The most evident differences were observed between wrestlers of the 1 and the 2 group. The highest degree of under-recovery in the 1 group was noted both in special endurance test and the majority of speed characteristics (in test of 8 throws at maximum rate and speed of TA). The highest degree of under-recovery in group 1 was also noted relative to group 3 in special endurance test and some indices of TA speed. It is noteworthy, those six hours after the session the absolute value of TA speed had remained higher in wrestlers of the 1 group, predisposed to work in alactate regime of energy expenditure, despite higher degree of under-recovery. The above was due to higher initial value of these characteristics.

DISCUSSION

The results of studies demonstrate that subjectively perceived (immediately after the session) heaviness of training load (PE) for sessions of different training direction was extremely high and did not differ significantly. Six hours after these training sessions, most of analyzed indices of special work capacity were decreased relative to initial values. There exists connection between domination in wrestler of these or those aspects of energy capacities and extent of special work capacity recovery after heavy training loads. This occurs during high load training sessions of different orientation. The recovery of special work capacity characteristics six hours after the session turned to be the highest, when individual energy predisposition matched preferential orientation of training session. This orientation of the session was evaluated

Table 5. Changes (in%) of special work capacity and speed of TA six hours after high load session of lactate glycolytic type, aimed at special endurance (SE) improvement in wrestlers, predisposed to work in different power regimes (1–3 group), M±SD

	Characteristics	Groups of energy predisposition			Significance of difference between groups
		1	2	3	
1	Time of 8 throws at maximum rate [s]	85.3 ±0.6*	94.1 ±0.7*	89.1 ±0.9*	1–2
2	Quality of throws in the test [points]	85.5 ±0.8*	92.5 ±0.7*	89.0 ±0.8*	
3	Total time in three "spurts" of special endurance test [s]	88.3 ±0.6*	94.5 ±0.7*	93.4 ±0.5*	1–2 1–3
4	Quality of throws in the test [points]	87.4 ±0.6*	95.4 ±0.6	92.3 ±0.7*	1–2
5	Time of simulating hip throw [s]	88.6 ±0.6*	93.3 ±0.6*	93.0 ±0.7*	1–2 1–3
6	Time of force peak achievement [s]	91.4 ±0.5*	93.1 ±0.6*	92.1 ±0.7*	
7	Time of simulation of taking opponent off balance [s]	91.5 ±0.7*	92.4 ±0.6*	93.2 ±0.7*	
8	Time of force peak reaching [s]	88.2 ±0.5*	93.6 ±0.6*	93.5 ±0.7*	1–2

Group: 1 "alactic", 2 "lactic", 3 "aerobic" predisposition; * significance of difference vs. initial values

according to preferential usage of power regimes of anaerobic alactate, anaerobic glycolytic (lactate) and aerobic character in it.

While analyzing the findings, we have proceeded from the assumption that the degree of reduction of special work capacity in skilled wrestlers 6 hours after strenuous training session reflects, above all, the degree of specific fatigue after different types of load. It is known that a freestyle wrestling match today is composed of three 2-minute rounds with a 30 s break. That is why wrestling has been described as an intermittent physical event which produces great strength and muscle power demands on both the upper and lower body, with high anaerobic energy metabolism requirements [13, 20, 22, 28, 29]. At the same time aerobic performance may be a basic requirement for wrestlers, although, it cannot be considered as a critical component of success in this sport [13, 20, 24, 28–31]. Therefore, wrestler's training related to the improvement of various aspects of energy supply of work. As far as the character of work during the training sessions may be different, one should aim at reflecting specific aspects of fatigue of various training loads. Preferential energy orientation of loads represents one of the basic characteristics of these differences. Account for load energy orientation is of particular significance during the period of their intensification [8, 9, 15]. The most intensive loads of training sessions are peculiar for precompetitive and competitive stages of annual cycle. Significant degree of fatigue in elite wrestlers after competitive loads have been reported [7, 9, 15]. Mean wrestling lactate concentration exceeded 17 mMol.l^{1} (15.1 ± 1.3 mMol.l^{1}). [10, 32, 33]. Values of lactate increased as competition progressed, and they were the highest at the end of the match [20, 32, 34]. Fatigue rating demonstrated a progressive rise. Without delay and sufficient recovery between exercise bouts and training sessions can improve performance by enhancing training quality and tolerance to the training load, as well as improving the athlete's adaptation to training [16, 33, 35]. Without proper recovery following multiple training sessions or competitions an athlete increases the risk for poorer performance. Performance demonstrated a progressive deterioration throughout the one-day tournament,

especially in the last two matches [9]. Muscle damage markers increased during the course of the tournament. Creatine kinase activity, CRP levels, IL-6 concentration, and leukocyte counts increased but testosterone declined progressively [9]. These results suggest that one-day wrestling competition loads may adversely affect their performance. The most pronounced changes were observed for the upper body anaerobic performance [22, 36]. There are indications that the degree of fatigue is associated with the characteristics of body composition, aerobic power, anaerobic power and strength [29, 35, 37].

The degree of under-recovery relative to initial values is taken into account for determining the content and time of the next training session [4, 14]. As far as training sessions of different training direction (type) are used in practice, the analysis of work capacity recovery speed should take into consideration the differences in training session content. In addition, training session types for improvement of speed-strength capacities, endurance and special endurance in sessions of competitive type are outlined.

An important aspect of such analysis of load effects is the account for individual peculiarities of athletes. Peculiarities of this kind are integrated by innate predisposition for work in different power regimes (and temporal, accordingly), to a large extent [1]. That is why, the effects of different type sessions were compared in groups of wrestlers with different individual energy predisposition to performance of work. In this respect application of high loads, which take into consideration wrestler's individual predisposition according to the content (according to preferential energy orientation), may be the important factor of individual regulation of training session repetition. This may permit to enhance training effects of these loads during their usage in training microcycles. The above is most distinctively manifested in loaded microcycles of different preferential orientation [5, 10]. It is important to bear in mind that competitive bouts of modern wrestling are characterized by the highest requirements for stable provision of work capacity at expressed anaerobic glycolytic energy supply [11, 30]. While designing experimental content of training sessions, we have proceeded from understanding that in practice the regimes of work with only preferential involvement of these or those mechanisms of work energy supply may be (and are) used. Therefore, in sessions used in studies only about two thirds of exercises were performed in energy regimes, set according to existing criteria. Comparison of special work capacity changes (including speed of TA) in wrestlers with different predisposition to the character of work energy supply has shown that for athletes with innate predisposition to "explosive" character of energy expenditure (group 1) the load of such orientation appears to be less than for wrestlers of other groups. The above is confirmed by the least degree of under-recovery during standard content of type "A" session for all groups. Predicating on the degree of decrease of special work capacity parameters, one may assume that this load represented the lower and the upper border of heavy load for wrestlers of the 1 and the 3 group, respectively.

Alteration of technical-tactical action efficiency is an important characteristic of fatigue degree for skilled wrestlers [16, 26]. One of the basic prerequisites for high efficiency of TA is the maintenance of their high speed as well as the speed of effort peak value achievement [15, 26, 28]. Obtained data about the degree of under-recovery of these characteristics may indicate that fatigue, related to performance of high load of speed-strength orientation by wrestlers, who are predisposed to such work fulfilment, causes less negative impact upon mechanisms of muscle contraction. On the contrary, performance of the same heavy load of speed-strength character by wrestlers, predisposed to aerobic energy supply of work, results in more significant changes of neuromuscular apparatus. It is expressed in higher decrease of speed characteristics of special TA six hours after the load.

The same type of differences has been observed between wrestlers with different predisposition to work energy supply during performance of training load, preferentially focused on endurance improvement. Summing up and averaging the degree of under-recovery of special work capacity indices after training session, focused on endurance (E type) improvement, demonstrated the highest degree of under-recovery in wrestlers, predisposed to work in alactate regime of energy supply (by 11.2 %). The lowest (by 6.0 %) decrease as compared to initial value was noted in the group of wrestlers, predisposed to work in aerobic regime (group 3). In wrestlers, predisposed to work in lactate regime of energy supply, the under-recovery of special work capacity indices constituted 7.6 % and was close to that, observed in wrestlers of the 3 group. High degree of under-recovery in wrestlers, predisposed to alactate energy supply of work, after training session of "E" type was observed not only in work capacity indices, being nonspecific for them in energy supply character, but in several other indices as well. This may be indicative of both specific and general fatigue.

Wrestlers with high level of aerobic power had advantage over athletes of other groups with respect to speed of recovery after training session of such type of energy orientation. In wrestlers of the given group the tendency to faster recovery was observed according to some indices during other types of training sessions as well. This confirms that aerobic power constitutes physiological basis of the whole match (tournament) characteristics of endurance in wrestlers [19, 24, 25, 38].

It is well known that at the stage of immediate preparation for competition the competitive type of training sessions is used [4, 10,17]. Analysis of its energy orientation indicates that it is close in the content to training session with dominance of anaerobic glycolytic energy supply used in the given study (SE type). In this case long periods of work at high blood lactate concentration are observed. The wrestlers are unable to sustain same level of activity through the match suggesting that they are utilizing too much energy from anaerobic glycolysis [2, 9, 11, 34] .The highest degree of under-recovery in wrestlers of the 1 group was revealed in speed characteristics of TA after strenuous training session, focused on special endurance ("SE" type) improvement. The figure 1 shows the degree of recovery after training sessions such as SE, which is the most widely used during an intense workout in the preseason and in season phases of preparation.

Significant differences in the degree of recovery occurred on a number of characteristics between the groups 1 and 2 (1, 2, 3, 4, 5 and 8) and between groups 1 and 3 (3, 4, 5, and 8). According to these indices wrestlers, predisposed to work in alactate regime, were the least advantageous (from the standpoint of readiness to perform special technical actions) as compared to wrestlers of other two groups. These differences were the most significant in group of wrestlers, predisposed to work in aerobic regime of energy supply. However, it should be underscored that wrestlers of this group (group1) were superior over those of other groups at higher degree of under-recovery (in %) in absolute characteristics of speed of TA 6 hours after the session. It is determined by apparent advantage of these wrestlers in initial indices of temporal parameters of TA. After training session of "SE" type speed characteristics of TA of the 1st group wrestlers approximated to analogous indices of the second group wrestlers, predisposed to lactate character of energy supply. Wrestlers with predisposition to anaerobic lactate energy supply of work (group 2) were characterized by the least decrease of special work capacity characteristics after training session, close to competitive one in its content. For instance, mean value of under-recovery for all analyzed indices in this group constituted 6.6 %. At the same time, it was 1.5–2 times higher in group 1 (12.4 %) and 3 (9.9 %). Differences between wrestlers of the 2 and the 3 group were less distinctive and did not reach the level of significance after averaging variances of all indices.

The given study has shown the advantage of skilled wrestlers with predisposition to anaerobic glycolytic type of energy supply over other wrestlers in speed of special work capacity recovery after training session close to the competitive one in its content. It may be related to the decrease of differences in the degree of recovery between groups of wrestlers after training session with high volume of loads of anaerobic glycolytic character ("SE" type). It is determined by ability of highly skilled wrestlers to work at high

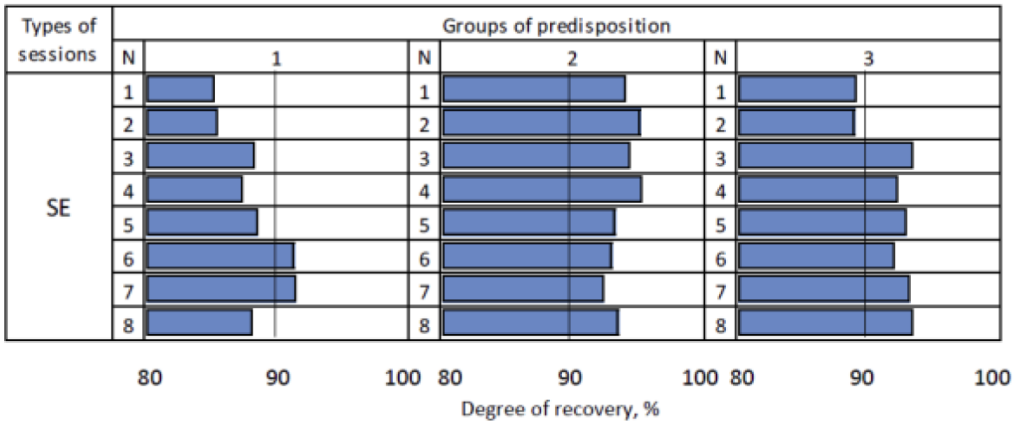

Figure 1. The degree (%) of recovery in special working capacity characteristics (1-8) of different energy predisposition wrestlers (group 1-3) six hours after strenuous training session competitive type (SE). Characteristics are shown in Table 5.

intensity of anaerobic glycolysis and high lactate content for longer periods. That is, elevation of the capacity for anaerobic glycolytic generation of energy has increasing importance for speed of recovery after specific loads of the competitive type. The highest enhancement of anaerobic capacity is commonly observed at the stage of immediate preparation for the major competitions [8, 10, 35]. It is most significantly increased in the course of especially focused training. The power of these processes, being innate, to a greater extent, appears to increase, to a lesser extent, as a result of training.

CONCLUSIONS

Therefore, presented data are indicative of individual differences in the degree of under-recovery of special work capacity indices 6 hours after standard training sessions with high loads. These differences were determined by individual predisposition to this or that character of work energy supply. Expressiveness of these differences depended on preferential orientation of training sessions. Speed characteristics of wrestlers' work capacity showed the highest decrease, and more especially in those cases, when wrestler's predisposition failed to match energy orientation of training session. The range of these differences constituted 4–16 %. While designing training microcycles with high load, it is imperative to take into consideration faster recovery of wrestlers in case of distinct match of preferential orientation of session to athlete individual predisposition to work in different power regimes.

Limitations of the given study are connected with the necessity of taking into account the degree of under recovery both 6 and 24 hours after training session, when the recovery is nearing completion. It is related to the necessity to determine differences in the kinetics of recovery responses as well as to the fact that repeated sessions are usually held after 24 hours. Therefore, the findings may be considered only as the initial stage of studying specificity and individuality of fatigue and characteristics of recovery after strenuous training sessions. Moreover should also be considered physiological indicators of the specifics of fatigue at different energy orientation training sessions.

COMPETING INTEREST

The authors declare that they have no competing interests.

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