Increasing the performance of swimmers specializing in sprinting and middle distances, under different recovery modes

UDC 796

Dr. Hab., Professor **G.A. Gilev**[1, 2]
PhD N.E. **Maksimov**[2]
PhD Yu.I. **Chernov**[2]
[1]Moscow Pedagogical State University, Moscow
[2]Moscow Polytechnic University, Moscow

Corresponding author: ga.gilev@mpgu.edu

Received by the editorial office on 24.05.2023

Abstract

Objective of the study was to increase the performance of highly qualified swimmers at distances from 50 to 400 m in the absence, practically, of additional by-products of glycolytic metabolism.

Methods and structure of the study. 28 highly qualified swimmers specializing in sprint and middle distances took part in the experiment. The difference between the subjects of the control and experimental groups was in the modes of recovery after intensive covering of distances. Athletes in the control group used a passive rest mode, and swimmers in the experimental group used swimming in an aerobic mode, without changing the method of movement.

Results and conclusions. The advantage of the active recovery mode in terms of lactate concentration upon completion of intensive distance covering and its utilization during the recovery period was recorded.

Keywords: *highly qualified swimmers, lactate concentration, recovery mode, performance, competitive activity.*

Introduction. One of the ways to increase performance at medium and partly short distances, according to the authors of research works, is to ensure the energy metabolism of competitive activity, which increases the oxidative capacity of energy supply to the muscles and muscle groups performing the movement [3, 7]

This problem is primarily associated with limited formation of lactic acid (lactate) in muscles during glycolytic resynthesis of adenosine triphosphate (ATP). Lactate, by acidifying the blood, limits the intensity of metabolic processes that carry out motor activity [5, 8, 9].

Therefore, the issue of increasing lactate utilization or, which is clear, decreasing the concentration of lactic acid in the blood directly in the process of performing working motor actions is on the agenda.

Since at the moment it is not possible to obtain data on the degree of lactate utilization at the time of performing working movements, an indirect indicator characterizing this phenomenon, in our opinion and other researchers, is the degree of intensity of lactate utilization in the first minutes of recovery (rest) after performing a load of a glycolytic nature [4, 6, 10].

Objective of the study was to increase the performance of highly qualified swimmers at distances from 100 to 400 m while increasing lactate utilization.

Methods and structure of the study. The following were used in the work: physiological and biochemical control, assessment of lactate concentration in the blood); temporary indicators of distance swimming; methods of mathematical statistics.

The pedagogical experiment involved 28 highly qualified swimmers specializing in one or more distances of 50, 100, 200 and 400 meters in various swimming methods. The experiment lasted about 5 months. The subjects were divided into two groups, equal in number and equivalent in terms of results at distances, indicators of general and special physical fitness.

All control tests were carried out at the beginning and at the end of the pedagogical experiment. The aerobic threshold, like the anaerobic threshold for athletes, was determined by performing the 5x200 m test with a stepwise increasing speed of overcoming 200-meter distances, up to the maximum possible result on the final repetition. At the completion of each 200-meter

segment, the level of lactate concentration in the blood was measured at the 3rd minute of rest. The break between swims was determined by the restoration of heart rate (HR) to the initial level (after warm-up). Based on the results of 200-meter segments and the concentration of lactic acid, graphs of lactate curves were determined for each athlete, with the help of which the values of aerobic and anaerobic thresholds were determined at the level of 2 and 4 mmol/l.

As an integral indicator, the subjects swam their competitive distances, recording the temporary result and the concentration of lactic acid in the blood at the 3rd minute of recovery. A 4 x 50 m test with a 15-second rest interval was also used to determine the results of the first and second half of the test and the total time to overcome the segments. The concentration of lactic acid in the blood in this test was determined at the end of the 1st, 3rd, 5th, 7th and 9th minutes of recovery. Heart rate was recorded in the first seconds after the tests were completed.

The specialized training regime for athletes, aimed at increasing speed endurance, consisted of covering distances mainly of a glycolytic nature. Their number of repetitions was regulated by a decrease in performance when covering the distance again by an amount within 1.8-2.5% of the best result in a given series. Rest between distances was determined by restoring heart rate to the warm-up level. Depending on the length of the distance and the stage of the experiment, the rest interval ranged from 45 s to 5 minutes. Training loads according to this algorithm were used 2-3 times a week.

The difference between the training regimes between the swimmers from the CG and the EG was that in the swimmers from the CG, recovery was carried out mainly in a passive mode in the absence of purposeful motor actions. Whereas the athletes from the EG, during the period between intensive overcoming training distances, used swimming in the same way in an aerobic mode as recovery. As their training increased, their swimming speed in the aerobic zone increased.

Results of the study and discussion. As a result of performing training loads, swimmers of the control and experimental groups showed improved performance at distances from 50 meters to 400 meters. At the same time, with an increase in the length of the distance, the advantage in increasing the performance of athletes from the EG relative to swimmers from the CG increased. Thus, with insignificant differences ($p>0.05$) in the time indicators for overcoming distances of 100, 200 and 400 meters at the beginning of the experiment, upon its completion, the results of the subjects from the EG and CG were fixed at the level: at the 100-meter distance - 55.42±0, 62 s and 56.68±0.58 s; at a distance of 200 meters – 124.30±1.15 s and 127.23±1.08 s; at a distance of 400 meters – 264.29±1.61 s and 268.12±1.55 s, respectively, with a significant difference in all cases ($p<0.05$).

The exception was overcoming a distance of 50 meters, at which the difference between the swimmers of the CG and the EG turned out to be unreliable ($p>0.05$) with a slight advantage in the average time of the swimmers of the CG. The results at this distance at the end of the experiment were 26.29±0.43 s and 26.33±0.34 s for athletes from the CG and EG, respectively.

Thus, the advantage of using alternating exercises in the training process, the energy supply of which is carried out mainly by the glycolytic route, with extensive aerobic exercises in the same method of swimming, is justified by the results obtained in the study for swimmers specializing in distances of 100, 200 and 400 meters.

Note that in swimmers from the EG, lactate utilization increased after completing all tested distances (from 50 to 400 meters). Moreover, in the first minutes after finishing at these distances, the difference in the level of lactate concentration in relation to the initial data at the beginning of the experiment was expressed by a difference in unreliable values ($p>0.05$).

In athletes from the CG, on the contrary, in the third minute after the finish at all tested distances, a significant increase in lactate concentration was found ($p<0.05$) at the end of the experiment relative to the corresponding data at its initial stage. There was no progress in lactic acid utilization at the end of the experiment. So, for example, at the 9th minute of recovery in swimmers from the CG at the end of the experiment, relative to the data at its beginning, the concentration of lactate in the blood was: at a distance of 50 meters - 3.5 ± 0.3 mmol/l and 3.3 ± 02 ($p> 0.05$); at a distance of 100 meters – 4.9±0.3 and 3.5±0.2 ($p<0.05$); at a distance of 200 meters – 5.6±0.3 and 5.1±0.2 ($p<0.05$); at a distance of 400 meters – 4.4±0.3 and 3.5±0.2 ($p<0.05$), respectively.

A significant indicator recorded in the experiment among athletes from the EG is a positive change in the level of the anaerobic threshold during training. This, judging by the work of scientists, is one of the most important facts in the progressive implementation of

the training process. Since an athlete at a higher level of the anaerobic threshold is able to achieve higher speeds along the distance without additional formation of by-products of blood acidification during glycolytic metabolism [10, 9, etc.].

Based on research works devoted to self-regulation and control of physiological functions during the performance of motor actions [1, etc.], we come to the conclusion that there is an increase in lactate utilization at the time of performing the exercise itself in the case when there is a reliably significant increase in performance, which was recorded in athletes from the EG on tested distances, without a significant additional increase in blood lactate concentration at the end of the exercise. This phenomenon is closely related to the intensity of lactate utilization during the recovery period upon completion of distances covered at the maximum possible speed, which is indirectly confirmed by the results of the study.

Considering the results obtained by the CG athletes who used passive rest between intense swimming distances, at distances from 50 to 400 meters, in conjunction with the value of lactate concentration at the 3rd minute of recovery, we come to the conclusion about the dominant role of increasing the concentration of lactic acid in improving their performance. On the one hand, this direction of the training process, as evidenced by the results obtained, is not effective enough in comparison with the results recorded among swimmers from the EG. On the other hand, increasing the concentration of lactate in the blood has significant limitations from a physiological point of view. In addition, as mentioned above, an increase in the concentration of lactate in the blood negatively affects the metabolism of energy supply to muscle activity.

Conclusions. It was revealed that the use of swimming in aerobic mode as a recovery in the coordination structure of the main exercise in between performing series of intense swimming of a glycolytic orientation leads to an increase in the effectiveness of overcoming distances of 50, 100, 200 and 400 meters by the main method of swimming in the absence of an additional increase in the concentration of lactate in the blood. At the same time, lactate utilization increases during the recovery period up to the 9th minute.

A significantly smaller increase in performance at the same distances was recorded than in point 1 with a significant increase in lactate concentration in the case of using passive rest in series of intense glycolytic exercises. The intensity of lactate utilization practically remains unchanged relative to the initial level at the beginning of the pedagogical experiment.

References

1. Anokhin P.K. Ocherki po fiziologii funktsionalnykh sistem. Academy of Medical Sciences of the USSR. Moscow: Meditsina publ., 1975. 447 p.
2. Gilev G.A., Gladkov V.N., Vladykina V.V., Pleshakov A.A. Povysheniye okislitelnoy sposobnosti rabochikh myshechnykh grupp pri vypolnenii uprazhneniy anaerobnoy napravlennosti. Teoriya i praktika fizicheskoy kultury. 2018. No. 7 (963). pp. 78-83
3. Gilev G.A., Maksimov N.E. Ispolzovaniye sochetaniy uprazhneniy razlichnoy intensivnosti v trenirovochnom protsesse plovtsov. Vestnik sportivnoy nauki. 2011. No. 2. pp. 12-15.
4. Smirnov M.R. Nauchnyye kontseptsii begovoy nagruzki v legkoy atletike. Doct. diss. (Hab.). Moscow, 1994. 308 p.
5. Shirkovets E.A., Ten A.M. Bioenergeticheskaya kharakteristika sorevnovatelnoy deyatelnosti plovtsov. Vestnik sportivnoy nauki. 2012. p. 21
6. Shirkovets E.A., Rybina I.L., Shustin B.N. Kompleksnaya otsenka kriteriyev spetsialnoy podgotovlennosti i adaptatsionnykh reaktsiy organizma vysokokvalifitsirovannykh sportsmenov. Teoriya i praktika fizicheskoy kultury. No. 2. 2017. pp. 74-76.
7. Bird S.R., Linden M., Hauley J.A. Acute changes to biomarkers as consequence of prolonged strenuous running. An Clin. Biochem. 2014. No. 51. pp. 137-150.
8. Glaister M., Stone M.H., Stewart A.M., Hughes M.G., Moir G.L. Aerobic and anaerobic correlates of multiple sprint cycling performance. J. Strength Cond. Res. 2006. Vol. 20. No. 4. pp. 792-798.
9. Faina M., Billat V., Squadrone R., De Angelis M., Koralsztein J.P., Dal Monte A. Anaerobic contribution to the time to exhaustion at the minimal exercise intensity at which maximal oxygen uptake occurs in elite cyclists, kayakists and swimmers. Eur. J. Appl. Physiol. Occup. Physiol. 1997. Vol.76. No. 1. pp. 13-20
10. Maglischo, E.W. Swimming Fastest. Champain, Illinois: Human Keenetic Publishers, 2003. 791 p.