Dynamics of indicators of physical fitness and economy as a factor of sports results of high-class biathlonists

UDC 796.012

P.E. Myakinchenko[1]
A.V. Adodin[1]
Dr. Hab. **E.B. Myakinchenko**[1]
[1]Federal Scientific Center of Physical Culture and Sport (VNIIFK), Moscow

Corresponding author: mpe_mail@mail.ru

Abstract

Objective of the study was to study the dynamics of indicators of physical fitness and economy in the context of differences in the characteristics of the competitive activity of high-class biathletes.

Methods and structure of the study. Four men and four women in "successful" and "unsuccessful" seasons according to the rating criterion in the World Cup studied the values and dynamics of 34 functional and motor indicators obtained from May to November of the preparatory period, as well as the dynamics of distance speed, last lap speed and accuracy shooting while standing during the competitive period.

Results and conclusions. In addition to the well-known ones, another criterion for the effectiveness of the training process has been identified: "the dynamics of the functional and motor abilities of athletes in the preparatory period." For most indicators, the dynamics should be linear or exponentially increasing. The difference and dynamics of the result in the competitive period is largely determined by the distance speed.

Keywords: *biathlon, sports result, adaptation, physical readiness.*

Introduction. The results of athletes in cyclic sports associated with the manifestation of endurance correlate with such factors as maximum oxygen consumption (VO2max), the percentage of aerobic/anaerobic threshold relative to VO2max, economy, and anaerobic power [6]. In addition, studies of recent decades have shown that strength and power training can play a significant role in increasing the endurance and aerobic abilities of athletes [7]. Traditionally, the criteria for the effectiveness of the training process in the preparatory period are indicators of the corresponding physiological capabilities and related motor abilities.

It is also generally accepted that the improvement of these indicators in the medium (months) and long-term (years) perspective is associated with the processes of morphofunctional specialization, that is, the adaptation of the body of athletes [2], which in turn is characterized by: complex interaction, different reactivity to the load, heterochrony in development, variability in terms of "retention" and loss of various aspects of adaptability. This, in turn, leads to the need to build a training process based on the periodization of loads, the use of means and methods of various directions [4].

However, if different aspects of increasing the listed capabilities/abilities and their impact on sports results have been the objects of numerous studies for decades, then the temporal patterns of the course of adaptation of the corresponding fitness factors have been studied rather poorly. At the same time, a recent study [5] suggests that the “optimal” organization of training loads of various directions during the preparatory period, compared with the “non-optimal” one, can in a certain way affect the dynamics of key indicators of biathletes’ fitness and will be associated with the final performance and the success of the key components of the competitive exercise.

Objective of the study was to study the dynamics of indicators of physical fitness and economy in

the context of differences in the characteristics of the competitive activity of high-class biathletes.

Methods and structure of the study. The work analyzed the data obtained during the stage complex surveys and examination of the competitive activity of the leaders of the sports team of Russia. In the period 2015-2021 according to the criterion of the average final rating in the Biathlon World Cup of four men and four women - team leaders - "successful" and "unsuccessful" seasons were identified. The “successful” seasons were 2015/2016 and 2019/2020 for women and 2015/2016 and 2021/2022 for men. “Unsuccessful” - 2016/2017 and 2017/2018 for women, 2018/2019 and 2019/2020 for men. In addition to the final rating, the performance dynamics of the athletes was determined from the 1st stage of the World Cup (SWC) to the main start (championship-W C), as well as the dynamics of distance speed, relative speed on the last lap and shooting accuracy, standing in sprint races according to the method described earlier [5]. The dynamics of 34 fitness indicators of the same athletes was determined by averaging the

data of tests conducted in May-June, July-August and September-November. The testing technique is described earlier [3]. Group differences were determined by the Mann-Whitney test.

Results and conclusions. It has been established that "successful" seasons differ from "unsuccessful" ones in terms of the average effectiveness of performances at the 1st-6th World Cup Stage and the World Championship (p=0.041), as well as in terms of distance speed (p=0.026). The speed of the last circle and the accuracy of shooting while standing did not differ (Fig. 1). Russian biathletes, both in "successful" and "unsuccessful" years, could not approach the main start in the best shape.

Examples of the dynamics of some indicators that reflect the main aspects of the preparedness of athletes are shown in Figure 2.

A comparative analysis of the data obtained showed that the preparatory period in "successful" years and in "unsuccessful" years was characterized, first of all, by clear differences in the dynamics of indicators, as well as higher values of the heart stroke volume index, oxygen pulse, oxygen consumption during handwork and threshold running power on the treadmill by the end of the preparatory period. Profitability had a negative trend and did not differ by the end of the prepara-

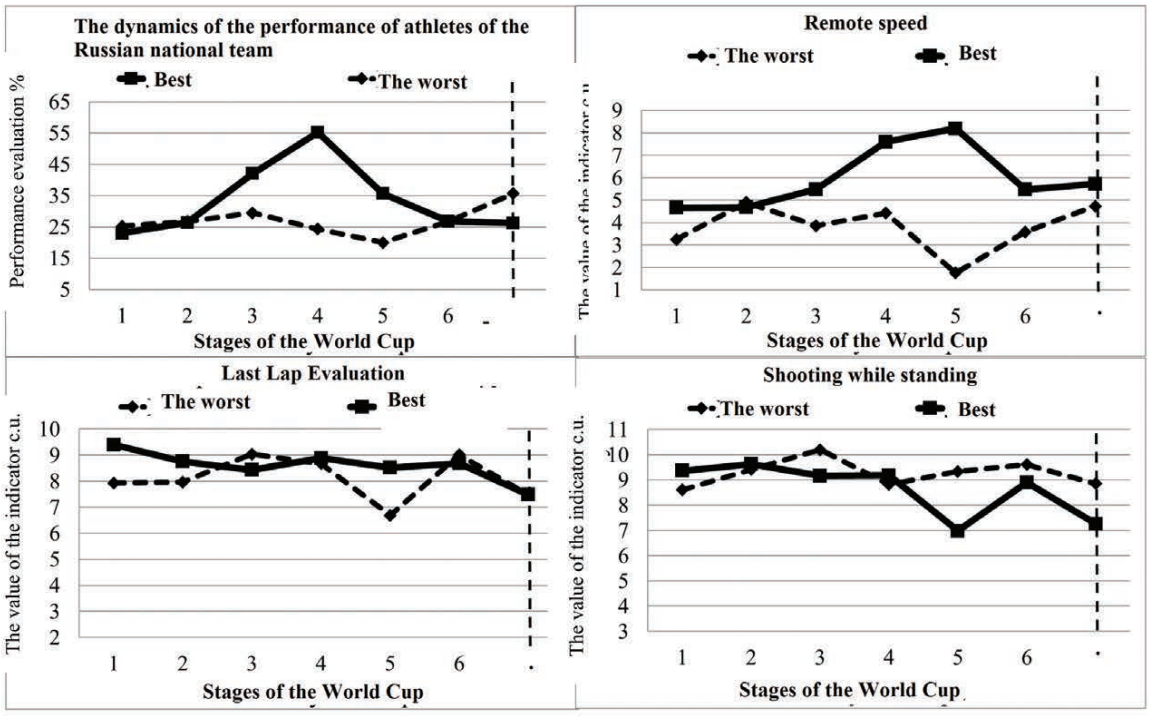

Figure 1. *Dynamics of performance and the most important components of a competitive exercise in "successful" (solid line) and "unsuccessful" years (dashed line) in four men and four women - the leaders of the Russian biathlon team*

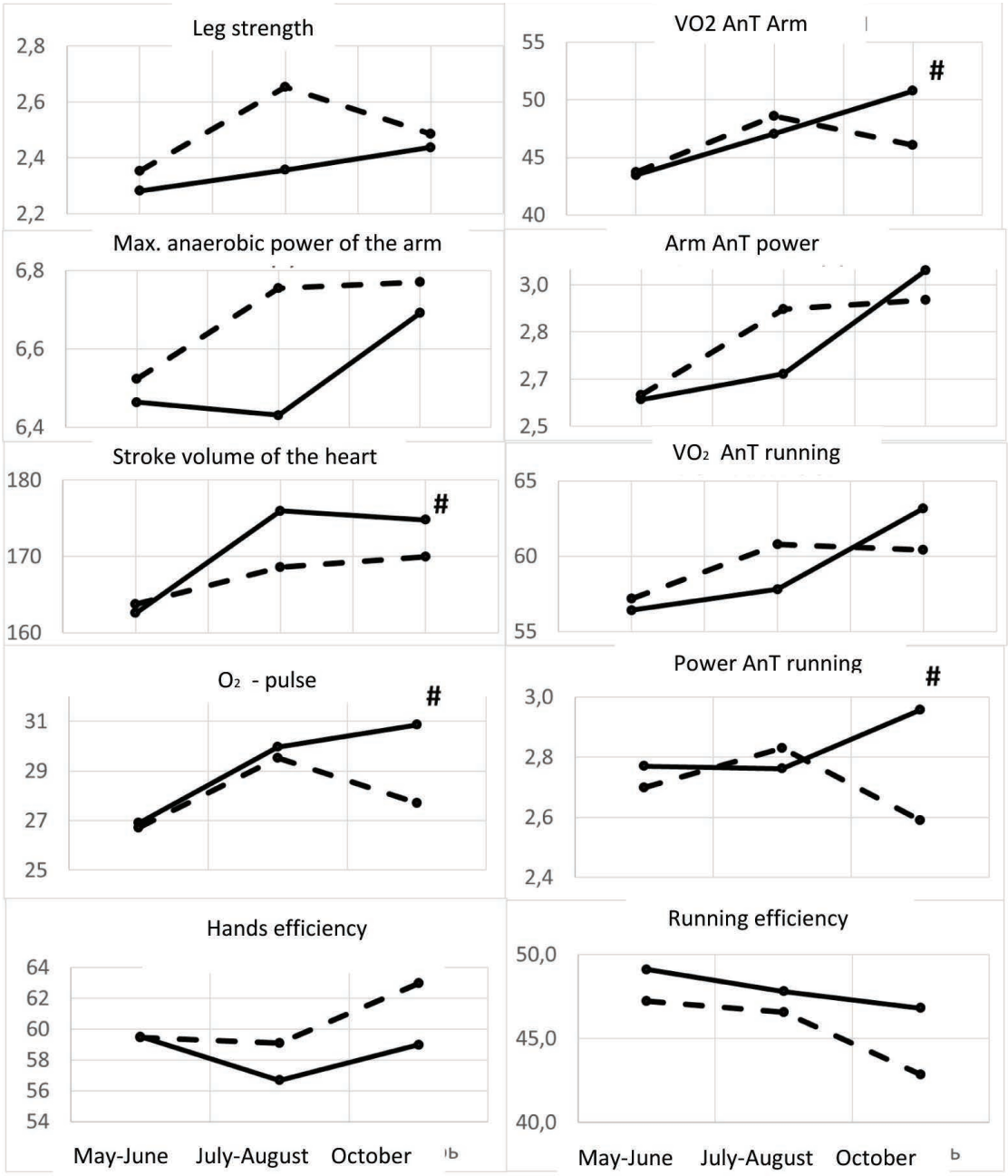

Figure 2. *The most characteristic examples of the dynamics of some average indicators in "successful" (solid line) and "unsuccessful" (dashed line) years for four men and four women - leaders of the Russian biathlon team*

tory period. The difference and dynamics of the result in the competitive period is determined only by the distance speed.

Conclusions. The data obtained allow us to suggest that in addition to the already known ones, another criterion for the effectiveness of the training process is the "dynamics of the key abilities of athletes in the preparatory period." Signs of "optimal dynamics" for power, speed-strength and aerobic performance of high-class biathletes can be considered their linear or exponentially increasing character; cardiorespiratory - the shape of a saturating curve. Distance speed was the most significant factor of sports result in the studied sample of subjects.

The work was carried out within the framework of the state task of the Federal Scientific Center of Physical Culture and Sport (VNIIFK), No. 777-00026-22-00 (subject No. 001-22/5).

References

1. Adodin N.V., Myakinchenko E.B., Zakharov G.G., Beleva N. Vzaimosvyaz parametrov sorevnovatelnoy deyatelnosti i pokazateley dinamiki fizicheskoy podgotovlennosti biatlonistov vysokogo klassa. [Interrelation of the parameters of perfomance and indicators of the dynamics of physical abilities among high-class biathletes.]. Teoriya i praktika fiz. kultury. 2021. No. 9. pp. 9-10.
2. Verkhoshansky Yu.V. Na puti k nauchnoy teorii I metodologii sportivnoy trenirovki [On the way to the scientific theory and methodology of sports training]. Teoriya i praktika fiz. kultury.1998. No. 2. pp. 21-27.
3. Kryuchkov A.S., Kaminsky Yu.M., Missina S.S., Adodin N.V. et al. Dinamika sokratitelnykh i aerobnykh vozmozhnostey skeletnykh myshts lyzhnikov-sprinterov vysokogo klassa pod vliyaniyem dvukh razlichnykh programm podgotovki [Dynamics of contractile and aerobic capabilities of the skeletal muscles of high-class XC sprinters under the influence of two different training programs]. Sovremennaya sistema sportivnoy podgotovki v biatlone [Modern sports training system in biathlon]. Proceedings national research-practical conference. 2020. pp. 72-109.
4. Matveev L.P. Problema periodizacii sportivnoy trenirovki [A problem of periodization of sports training]. Moscow: Fizkultura i sport publ., 247 p.
5. Fedoseev A.M., Adodin N.V., Myakinchenko P.E. et al. Vzaimosvyaz takticheskikh variantov prokhozhdeniya distantsii na tochnost strelby, distantsionnuyu skorost i itogovyy rezultat v gonke u biatlonistov vysokogo klassa [Interrelation of tactical options for passing the distance on shooting accuracy, distance speed and the final result in the race among high-class biathletes]. Vestnik sportivnoy nauki. 2018. No. 6. pp. 18-22.
6. Lundby C., Robach P. Performance enhancement: what are the physiological limits? Physiology (Bethesda). 2015. No. 30 (4). pp. 282-92.
7. Murlasits Z., Kneffel Z., Thalib L. The physiological effects of concurrent strength and endurance training sequence: a systematic review and meta-analysis. J. Sports Sci. 2018. Vol. 36. No. 11. pp. 1212-1219.