

Change in the results of middle-distance runners living at different heights above sea level

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Abstract. Purpose: to study the dynamics of the results of the competitive activity of runners at 1500 m, living in a plain and in a mountainous area, in a year-long preparation cycle. **Material and methods.** Study involved 20 qualified middle-distance runners, which were divided into two groups. The first group consisted of 10 runners at 1500 m, mainly living in the plain, the second group consisted of 10 runners at 1500 m, mainly living in the mountainous area. Athletes who took part in the experiment, trained according to one program. In the course of the research, the following **methods** were used: analysis and generalization of literary sources, experiment, analysis of competition protocols, methods of mathematical statistics. **Results:** the dynamics of the results of runners at 1500 m, living at different heights above sea level; revealed the positive effect of training in the middle altitude on the athletic result; time frame for showing the best results are established. **Conclusions:** 1. Analysis and generalization of the literature sources showed insufficient study of the dynamics of the sports results of runners at 1500 m, reside at different altitudes above sea level. 2. Obtained data indicate that runners living on the plain show higher and stable results during the competition period than athletes living in highlands. 3. Analysis of competitive activities showed that runners at 1500 m, living on the plain, the best results are shown on the 4th day after descent from the mountains, and athletes living in the highlands - on the 80th.

Keywords: result, competitive activity, runners at 1500 m.

Introduction.

One of the main trends in the development of modern sports is its professionalization. This process is especially intense in track and field athletics (Platonov, 2005; Platonov, Bubka, Bulatova et al., 2009). Professionalization and commercialization of track and field athletics has had a significant impact on the various components of the athlete training system. A system of competitions, developed in athletics, underwent a significant transformation. Due to competition on the personal invitation and prestigious tournament has expanded calendar of competitions (Kolesov, 2003; Platonov, 2004; Kozlova, 2012).

Problem of training and competitive activity of athletes in mountainous areas and after descent to the plain is of considerable interest in connection with the growth of results in various types of athletics (Pohlitz, 1986, Reiss, 1998; Frese, Eisenkolb, Schmidt et al., 2008; Bay Syuy Yuy , 2010). One of the reasons for this interest is the increase in the number of competitions, including those held in the mid-mountain and even highlands (IAAF Calendar).

Studies of the influence of hypoxia as one of the factors of successful preparation for competitions and an effective means of mobilizing the body's functional reserves, and transferring it to a new higher level of adaptation for participation in competitions in the plain are held since the XIX Olympic Games in Mexico. Since then, many specialists (Suslov, Gippenreyter, 2000, Gustomyasov, 2007; Rovniy, Pasko, Grebeniuk, 2016; Rovniy, Pasko, Martyrosyan, 2017; Rovniy, Pasko, Stepanenko, Grebeniuk, 2017) studied the problem of training in mountain conditions and conditions of artificial hypoxia, but this mainly concerned athletes living on the plain.

Competitive activity of athletes is the main indicator of the effectiveness of their training (Platonov, 2008).. Sporting result in any sport, including track and field athletics, according to Platonov, 2004, directly depends on the qualitative management of the training of athletes and includes the rational structure and content of macro-, meso-, microcycles, ratio and distribution of training aids in structural formations, the effective organization and conduct of centralized training camps, a balanced food system, the provision of services for rehabilitation, regular activities aimed at assessing the various aspects of the preparedness of athletes.

At the same time, the study of special literature indicates that there is practically no information on the dynamics of the results of runners at 1500 m, living at different heights above sea level, in a one-year training cycle.

Material & methods

Purpose. Purpose of the study: to study the dynamics of the results of the competitive activity of 1500 m runners living in the plain and in the mountainous terrain, in the annual training cycle.

Methods. Research methods: theoretical analysis and generalization of literary sources, experiment, analysis of competition protocols, methods of mathematical statistics.

Object. The study involved 20 middle-distance runners, which were divided into two groups. The first group consisted of 10 runners at 1500 m, mainly living in the plain, the second - 10 runners at 1500 m, mainly living in the highlands.

Procedure. The structure and content of the training program for the training of athletes was the same for both groups. The program for the preparation of runners at 1500 m included the stages of mountain training in mid-mountain conditions.

In order to determine the optimal timing of the best results, one of the conditions for the study was the compulsory participation of athletes in all pre-specified competitions.

Results of the study.

The analysis of the results of the competition makes it possible to determine the dynamics of them in the competitive period among athletes, mainly living at different heights above sea level.

The results of runners at 1500 m, living at different heights above sea level, are presented in Table 1.

Table 1. Results of runners at 1500 m, living at different heights above sea level

No i.o.	Timing of results	Runners living on the plain $X \pm \sigma$ (n = 10)	Runners living in the mountains $X \pm \sigma$ (n = 10)	t	p
1.	At the beginning of the experiment	232,13±4,5	230,87±6,44	0,48	>0,05
2.	27.03.14	231,69±3,48	232,43±3,68	0,44	>0,05
3.	28.04.14	229,25±3,47	232,65±3,91	1,95	>0,05
4.	21.05.14	227,47±2,96	230,79±3,68	2,1	<0,05
5.	21.06.14	228,24±3,69	231,54±4,07	1,79	>0,05
6.	15.07.14	229,82±3,2	230,63±4,07	0,47	>0,05
7.	7.08.14	228,98±2,38	229,70±4,05	0,46	>0,05
8.	4.09.14	232,69±6,5	230,68±4,8	0,75	>0,05

The table shows the results of changing the unequal competitive activity in athletes, mainly living at different altitudes above sea level. For example, before the experiment, the results of runners predominantly residing in the mountainous terrain were slightly higher than those of the athletes who predominantly lived on the plain, but no significant differences were observed between them ($p > 0,05$). Comparison of the following results of competitive activities of athletes revealed the reliability of differences between them at the beginning of the stage of the main competitions ($p < 0,05$), the results of runners at 1500 m, predominantly living on the plains, substantially better.

Considering the results of the athletes who predominantly live on the plain, it should be pointed out that before the first competitions of the stage of the main competitions inclusive, they constantly increased, and then were of a relatively stable nature. Only at the end of the competitive period was observed a sharp decrease in them. The result shown in September (at the end of the competition period) was lower than the result recorded at the beginning of the study. Highest results were shown by athletes on day 4 after descent from the mountains.

Study of the results of runners at 1500 m, mainly living in mountain conditions, indicates their varied nature throughout the competition period. So, the results of the athletes at the stage of direct preparation for the main competitions were lower, shown by them at the beginning of the study. On day 4 after descent from the mountains (after the third training camp), the results of the runners fluctuated at the level shown by them at the beginning of the study. During the competitive period sports results of the subjects were within 3.51,54 – 3.49,7 seconds. The most significant results were recorded in these athletes on the 80th day after descent from the mountains (3.49,7 s).

Analyzing the data in Figure 1, it should be pointed out that the increase in the results of 1500 m runners, mainly living on the plain, is undulating.

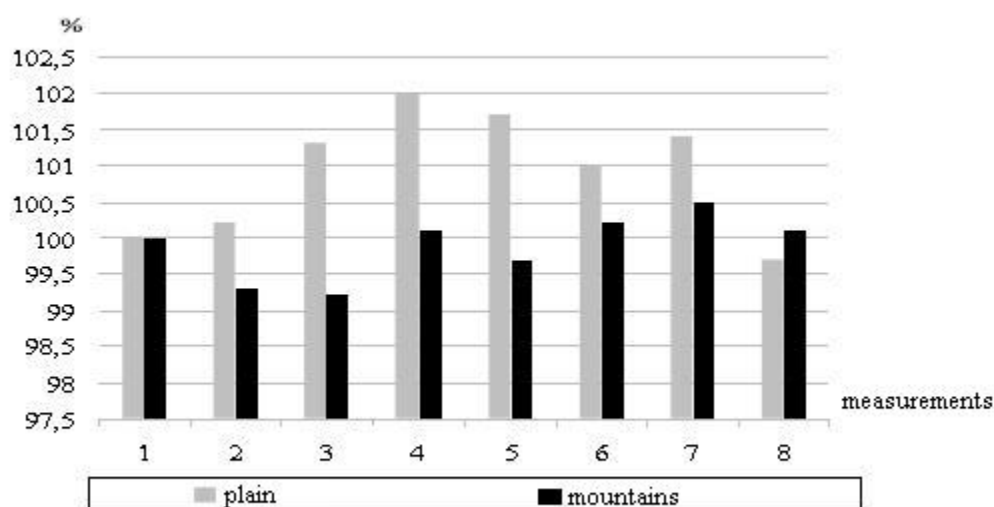


Fig. 1. Dynamics of the results of competitions of runners at 1500 m, living at different heights above sea level, in a year-old macrocycle, (%)

Timing of results:

1 – result at the beginning of the study; 2 – 27.03.14; 3 – 28.04.14; 4 – 21.05.14; 5 – 21.06.14; 6 – 15.07.14; 7 – 7.08.14; 8 – 4.09.14

Thus, the most significant increase in the result, at 1,06%, was observed in April. In general, to the first competitions of the stage of the main competitions (May), inclusive, the increase in results was 2,03%. In the second and third competitions of the stage of the main competitions, the results decreased by 0,34% and 0,69% respectively. In the competitions that took place on the 80th day after descent from the mountains, the results of the runners, although insignificantly, increased. The increase was 0,36%. In the last competitions of the season there was a sharp decrease in the results, which is probably connected with both a decrease in the aftereffect of mining training, and with the inability to keep at a sufficient level the indices of special endurance.

Runners at 1500 m, mainly living in mountainous conditions, also showed a wavy change in the results during the entire competition period.

It should be noted that these athletes during the stage of direct preparation for the main competitions had a decrease in results compared to the beginning of the study, which amounted to 0,76%. In the first competitions of the stage of the main competitions, the runners of this group experienced the greatest increase in results – 0,81%, but against the background of a significant previous decrease, the athletes could not show the best results of the season. In the competitions held on the 35th day after the descent from the mountains, the athletes' results decreased by 0,32%, and in the next two competitions - they increased by 0,39% and 0,4% respectively. In the last competitions of the season, the results of the athletes have decreased, although not as significantly as in runners predominantly living on the plain.

The analysis of the individual results of the athletes showed that the runners who predominantly lived on the plain, personal achievements of the season established in May (3 athletes) and June (4 athletes), on days 4 and 35 after descent from the mountains, respectively. This can be explained by the fact that after the end of training in mountain conditions, the body of athletes is in a state of higher performance than before climbing the mountains. As indicated by Bogush, Reznichenko, Kuvaldina, 2015, increasing the aerobic capacity of athletes under the influence of mountain climate contributes to more efficient oxidation-reduction processes in the body, faster elimination of anaerobic metabolism products in muscles after work, which, in turn, training work and, as a result, a high sports result.

Considering the results of runners predominantly residing in the mountainous area, it should be pointed out that the best results of the season were shown by them, mainly at the end of the competition period (5 athletes), on the 80th day (August) after descent from the mountains. In our opinion, this is due to the processes of acclimatization that occur in the body of these athletes during their stay on the plain, in unusual climatic conditions.

Thus, the same construction and content of the training process of runners at medium distances, predominantly living at different altitudes above sea level, have different effects on the results of their competitive activities.

Discussion.

Specialists (Platonov, 2004, Petrenko, Menshih, Yurchuk et al., 2012; Samolenko & Apaichev, 2014; Klochko & Baikina, 2015; Ryibina, 2016) indicate that the stay in the mountains affects the quality and sustainability of performance during speeches athletes in competitions. The longer stay of athletes in the middle mountains or the more often they train in such conditions – the higher and stable results are shown at competitions both under similar conditions and in the conditions of the plain.

In preparing for participation in competitions on the plain, stay in the mountains is used as an additional means, on the degree of influence of which the physiological changes that occur in the athlete's body after a certain time after descent from the mountains depend (Ryibina, 2016). Specialists consider (Nikitushkin, Maksimenko, Suslov, 1988) that the most favorable terms of participation in competitions are 18-25 days after returning to the plain. At the same time Khomenkov (1987) points out that high results can be shown by athletes on day 3-6 after descent from the mountains.

The results of our study confirm the opinion of specialists and indicate that qualified runners for medium distances living on the plain had better results on the 4th day after descent from the mountains. The data obtained during the study prove that athletes living on the plain, when using training in mountain conditions are able to show relatively stable results in competitions during the entire competition period.

Episodic studies on the reaction of the body of athletes predominantly living in different climatic conditions, including at different altitudes above sea level, do not provide an opportunity to create a holistic view of the effect of training in mountain conditions on the level of their preparedness and, as a result, on the result of a competitive activities (Chapman, Stray-Gundersen & Levine, 1998; Bai Xu Yu, 2010; Pupyreva, 2011; Shesterova, Tu Yanhao, 2015, 2017). A study of the dynamics of the results of qualified runners at medium distances living in mountainous conditions made it possible to establish that their changes are undulating. It should be noted that the athletes of this group of the best results of competitive activity reached on the 80th day after descent from the mountains. The results of the research show that the proposed training program with the inclusion of training in mountain conditions, to a lesser extent, affects the results of the competitive activity of athletes predominantly residing in the mountainous terrain, the results of which have practically not changed.

It is proved that the longer athletes are in mid-mountain conditions – the higher the quality and stability of working capacity during performances, since the principle of preparation is reduced to the acquisition of sustainable long-term adaptation to conditions close to those in which athletes will perform. When preparing for competitions in a flat terrain, staying in the mountains is used as a form of additional stress, from the optimal value of which physiological shifts that contribute to improving athletic skill at a certain time after descent to the plain depend, which supports the opinion Samolenko & Apaichev, 2014; Ryibina, 2016.

Conclusion:

Analysis and generalization of literary sources showed that the dynamics of the results of runners at medium distances, living at different heights above sea level, was practically not studied in the competitive period of the annual cycle of preparation.

Obtained data indicate that runners living on the plain show higher and stable results during the competition period than athletes living in mountainous conditions.

Analysis of competitive activities showed that runners at 1500 m, living on the plain, the best results are shown on the 4th day after descent from the mountains, and athletes living in the highlands – on the 80th.

Further studies of the problem are related to the training of qualified athletes living at different altitudes above sea level, using training in mountain conditions, taking into account the duration and intensity of the competition calendar.

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Conflict of interest. Authors state that there is no conflict of interest.

References.

- Bay Syuy Yuy. (2010). Issledovanie srokov spuska s gor i uchastiya v sorevnovaniyah na ravnine skorohodov. [Study of the timing of descent from the mountains and participation in competitions on the plain of skiers] *Nauka i tehnika fizicheskoy kul'turyi v Guychzhou*, 3, 39-42.
- Bogush, V. L., Reznichenko, A. I., Kuvaldina, J. V. (2015). Izmenenie aerobnyih vozmozhnostey organizma pri trenirovke v srednegore. [Change in aerobic ability of the body during training in the middle mountains]. *Aktualni problemy fizychnoho vykhovannia i sportu v suchasnykh umovakh*, Materialy I Mizhnarodnoi naukovo-praktychnoi konferentsii. Dnipropetrovsk.
- Chapman, R. F., Stray-Gundersen, J., Levine, B. D. (1998). Individual variation in response to altitude training. *Journal of Applied Physiology*, 85, 1448-1456.
- Frese, F., Eisenkolb E., Schmidt, W. F. (2008). Effects of repetitive training at low altitude on erythropoiesis in

- elite 400 m and 800 m runners. *ACSM 55th Annual Meeting Indianapolis: Internet resource* 2008. Retrieved from <http://coachsci.sdsu.edu/csa/vol144/frese.htm>
- Gustomyasov, A. A. (2007). *Osobennosti funktsionalnogo sostoyaniya kardiorespiratornoy sistemy voleibolistok, prozhivayuschih v usloviyah srednegorya*. [Features of the functional state of the cardio-respiratory system of volleyball players living in mid-mountain conditions]. (PhD biol. science thesis). Chelyabinskiy gosudarstvenniy pedagogicheskiy universitet, Chelyabinsk.
- IAAF Calendar. Retrieved from <https://www.iaaf.org/competition/calendar>
- Homenkov, L. S. (1987). *Kniga trenera po legkoy atletike* [Book of trainer on track-and-field]. (3rd ed.). Moskva: Fizkultura i sport.
- Klochko, L. I., Baikina, N. H. (2015). Ratsionalna pobudova trenovalnogo protsesu naisyl'nishykh bahunok marafonu v umovakh serednohiria y vysokohiria. [Rational construction of the training process of the qualified female runners-marathons in mid-mountain and high-mountain conditions]. *Slobozhanskyi naukovo-sportyvnyi visnyk*, 3 (47), 47-51.
- Kozlova, Ye. K. (2013). Sovremennaya sistema sorevnovaniy i sorevnovatel'naya deyatelnost sportsmenov vysokey kvalifikatsii v usloviyah professionalizatsii legkoy atletiki. [Modern system of competitions and competitive activity of athletes of high qualification in conditions of professionalization of track and field athletics]. *Nauka v olimpiyskom sporte*, 2, 31-36.
- Nikitushkin, V. G., Maksimenko, G. N., Suslov, F. P. (1988). *Podgotovka yunyih begunov*. [Preparation of young runners]. Kiev: Zdorovia.
- Petrenko, Yu. O., Menshykh, O. E., Yurchuk, S. M., Vasiliev S. H. (2012). *Pratsezdatsnist liudyny v ekstremalnykh umovakh navkolyshnoho seredovyshcha*. [Ability to work in extreme environments]. Cherkasy: ChNU imeni Bohdana Khmelnytskoho.
- Platonov, V. N. (2004). *Sistema podgotovki sportsmenov v olimpiyskom sporte. Obschaya teoriya i prakticheskie prilozheniya*. [System of training in the Olympic sport. General theory and practical applications]. Kiev: Olimpiyskaya literatura.
- Platonov, V. N. (2008). Tratado geral de treinamento desportivo. *Sao Paulo: Phorte*, 730-753.
- Pohlitz, L. (1986). Praktische Einfahrungen im Hohentraining mit Mittelstrecklerinnen. *Leistungssport*, 2, 23-26.
- Pupyreva, E. D. (2011). *Vliyanie eksperimentalnoy i prirodnoy gipoksii na funktsionalnyie rezervyi organizma i fizicheskuyu rabotosposobnost sportsmenov*. [The influence of experimental and natural hypoxia on the functional reserves of the body and the physical performance of athletes]. (PhD biol. science thesis). Ulyanovskiy gosudarstvenniy pedagogicheskiy universitet, Ulyanovsk.
- Reiss, M. (1998). Hauptrichtungen des Einsatzes und der Methodik des Hohentraining in den Ausdauersportarten. *Lestungssport*, 4, 21-28.
- Rovniy, A., Pasko, V., Grebeniuk, O. (2016). Adaptation of reformation of physiological functions of the organism of the 400 m hurdlers during hypoxic training. *Journal of Physical Education and Sport*, 16 (4), 1340-1344.
- Rovniy, A., Pasko, V., Martyrosyan, A. (2017). [Adaptation of the cardiorespiratory system to hypoxic actions of the rugby players depending on the playing position](#). *Journal of Physical Education and Sport (JPES)*, 17 (2), 804-809.
- Rovniy, A., Pasko, V., Stepanenko, D., Grebeniuk, O. (2017). [Hypoxic capacity as the basis for sport efficiency achievements in the men's 400-meter hurdling](#). *Journal of Physical Education and Sport*, 17 (1), 2017. 300-305.
- Ryibina, I. L. (2016). Osobennosti metabolicheskikh izmeneniy pri adaptatsii organizma sportsmenov tsiklicheskih vidov sporta k trenirovochnym nagruzkam v usloviyah srednegornoy podgotovki. [Features of the metabolic changes in the body's adaptation of cyclic sports athletes to the training loads in the conditions of the mid-mountain training]. *Pedagogiko-psihologicheskie i mediko-biologicheskie problemy fizicheskoy kultury i sporta*, 1 (38), 231-234.
- Samolenko, T. V., Apaychev, A. V. (2014). Teoreticheskie aspekty podgotovki sportsmenok vysokey kvalifikatsii v bege na srednie distantsii v usloviyah srednegorya. [Theoretical aspects of the preparation of high-qualified athletes in running at medium distances in mid-mountain conditions]. *Psihologiya i pedagogika: sovremennye metodiki i innovatsii, opyt prakticheskogo primeneniya*, 7, 93-100.
- Shesterova, L. Ye., Tu Yanhao. (2015). Dynamics of physical readiness of middle distance runners living in different climates. *Slobozhanskyi herald of science and sport*, 4, 52-54.
- Shesterova, L. Ye., Tu Yanhao. (2017). Dinamika biohimicheskikh i fiziologicheskikh pokazateley begunov na srednie distantsii pod vliyaniem trenirovki v gorniyh usloviyah. [Dynamics of biochemical and physiological indicators of runners at medium distances under the influence of training in mountain conditions]. *Naukovyi chasopys Natsionalnoho pedahohichnoho universytetu imeni M. P. Drahomanova: Naukovo-pedahohichni problemy fizichnoi kultury / fizychna kultura i sport*, 7 (89), 44-50.
- Suslov, F. P., Gippenreyter, E. B. (2000). *Podgotovka sportsmenov v gorniyh usloviyah*. [Training athletes in the mountains conditions]. Moskva: Terra- sport, Olimpiya Press.