

THE DYNAMICS OF SPECIAL EFFICIENCY OF SPORTSMEN, WHO SPECIALIZE IN MIDDLE DISTANCE RUNNING

Olha Roda

East European National University named after Lesya Ukrainka

Roda O., (2014) *The dynamics of special efficiency of sportsmen, who specialize in middle distance running*, Health Problems of Civilization 1 (8), p. 18-23

Summary: In sports training man tries to broaden the boundaries of his own capacities and the physical efficiency is an informative index, which defines a set of properties of the organism and, in the first place, the efficiency of blood flow and breathing mechanisms. In the article the impact of training load on the bodies of athletes, who specialize in middle distance running is analyzed and the dynamics of special efficiency, physiological mechanisms, responsible for the quality of athletes' endurance, is determined.

The dynamics of female athletes' special efficiency manifestation has cyclical character and depends on the hormonal status change influence on the athletes' body during the biological cycle. Special efficiency of male athletes has tendency of gradual results growth, which is explained by the functional possibilities change, resulted by the effective influence of training loads on their body.

The highest efficiency has been found in the second and fourth phases, the lowest one - in the third and especially in the first and fifth phases of MC. This is due to the increased functionality of the cardiovascular system and the effectiveness of power-ensuring in the second and fourth phases and its decrease in the first and fifth phases of MC, leading to stress of adaptation processes of women's bodies during these phases. As for men, their dynamics of special efficiency tended to gradual increase of the results, that, we think, can be explained by the growth of functional capabilities of the cardiovascular system and the effectiveness of power-ensuring on account of effective influence of training loads upon their organism.

Key words: heart rates, menstrual cycle, lactate

Introduction

The relevant problem of the athletes' preparation process is the justification of special efficiency and regulatory characteristics of the main functional parameters specific criteria system. With their help one can evaluate the physical loads' adaptation affectivity and also the functional possibilities' dynamics at stages of preparation.

Physical performance is a key factor in determining athletic achievements (Karpman et al. 1988). One should notice, that the term "efficiency" is interpreted in different ways, so basic research in this area were carried by G. Lehmann (1967), who considered physical efficiency as the body's ability to maximum of work. Other researchers understand physical efficiency as the willingness to make motor actions (Israel 1983) or as the ability of body to perform maximum physical work in any manifestation (Anokhin 1975), or as the ability to develop maximum power and economically spend it, reaching the goal (Viru, Kyrge 1983).

The fitness of athlete is characterized by the level of its special physical efficiency, which can be predicted by physiological functions' indexes in both – states of relative calm and states of dosed physical loads. There is a linear relationship between the power of the work and HR. Such dependence is kept to the level of heart rate – 170 beats/min. It characterizes optimal in efficiency cardio-respiratory system mode (Bondarenko 2010).

Physical performance is the most important aspect of fitness, conditioned by the state of morphological-functional changes of the main physiological body systems. In sports medicine the concept of general and special physical efficiency is highlighted. The long-term work of muscles is limited by shipping them oxygen, so the overall physical efficiency is largely determined by cardio-respiratory capacity, which, in turn, is determined by morphological-functional state of the cardiovascular and respiratory systems and neurohumoral influences on them (Anokhin 1975).

Special physical efficiency characterizes the possibility of athlete to perform in given kind of sport. For its evaluation specific load characteristics, typical for this kind of sport, are used. The level of general and special physical efficiency of the same athlete may differ substantially (Karpman et al. 1988). The manifestation of special endurance depends on some physiological and psychological factors. The main physiological factor is the anaerobic

Address for correspondence: Olga Roda, 43025 Łuck, Vinnichenka Street, 18/29, Ukraina,
e-mail: olya.roda@mail.ru, phone +38 (66) 057-85-92

Tables: 2 Figures: 2 References: 16 Full-text PDF www.hpc.edu.pl **Copyright** © Pope John Paul II State School of Higher Education In Biała Podlaska, Sidorska 95/97, 21-500 Biała Podlaska **Indexation:** Index Copernicus, Polish Ministry of Science and Higher Education.
This is an open-access article distributed under the terms of the Creative Commons Attribution Non-commercial License (<http://creativecommons.org/licenses/by-nc/3.0/>), which permits use, distribution, and reproduction in any medium, provided the original work is properly cited, the use is non-commercial and is otherwise in compliance with the license.

possibilities of the athlete. Anaerobic capacities of the organism are determined by two correlated biochemical mechanisms: creatine-phosphatic (energy release due to phosphorus compounds) and glycolytic (energy release due to splitting of muscle glycogen). Special efficiency depends on the ability of the neuromuscular system, on the rate of intramuscular energy resources consumption, on the technique of motor action possession and the level of other motor skills' development.

The basis of functional training of middle distance runners is the endurance training, determined primarily by its aerobic and anaerobic opportunities. The main sources of energy production while endurance works are aerobic and anaerobic glycolytic reactions. They are characterized by energy release speed, terms, acceptable to use of fats, carbohydrates, glycogen, ATP, KTF and allowable metabolic changes in the body. Physiological basis of aerobic endurance is body's ability to ensure a share of energy in the process and contribute to the survivability of the organism after work of any length and capacity, ensuring speedy removal of metabolic exchange products (Zelichenok et al. 2000). Anaerobic glycolytic energy source plays a crucial role in efficiency supporting in maximal intensity exercises, duration up to 15–20 seconds. Anaerobic glycolytic sources are central to the process of work energy supply, continuing from 20 to 5–6 minutes (Korobov, Volkov 1983).

The aim of the article

The aim of the article is to analyze the survey results of leading scientists in the field of training load on the athletes' body and determining the dynamics of special efficiency, physiological mechanisms, responsible for quality endurance of athletes, who specialize in middle distance running.

Methods of investigation

Analysis of literature sources; to determine the dynamics of special efficiency of athletes, who specialize in middle distance running, we held 5 control 4x400 m races, women studies were conducted during the MC, and men studies – during mesocycle, along with women; with the aim of determining the concentration of lactate, the blood was taken from the phalange with the one-time scarifier. Lactate was determined using test strips BM–Lactate Lactate number 25 for the device Akkutrend Plus. Simultaneously the heart rate was monitored via Pulsometers Polar S610i.

Survey results analysis

Nature has granted women with complex physiological processes that are unique to women: menstrual function and pregnancy, which provide basic biological purpose of female body – the ability to procreate, procreation (Shakhlina 2000). It is also important to consider that athletes have to participate in correspondent competition despite the state, conditioned by the peculiarities of female body.

Studies, conducted in various kinds of sports, show that special efficiency varies depending on the phases of MC (Virus 1983, Efimova 1993). Throughout the whole period of modern sports existence, the evaluation of women sports efficiency in various MC phases causes contradictory points of view (Radzievskii, Shakhlina et al. 1997). Consideration of MC phases enables more efficient performance of various scopes of works, exercises that promote the upbringing of necessary physical qualities. Using knowledge of the female body hormonal status characteristics during MC for the construction of the training process, increase of the estrogen production may play a similar role to improve efficiency as introduction of exogenous anabolic steroids. Thus, women possess a higher performance during postmenstrual and postovulatory phase and lower – during premenstrual, menstrual and ovulate phase of the menstrual cycle (Virus 1981).

Disregarding the characteristics of cyclic changes in female athletes' body, restrictions in ingestions in precontest mesocycle can lead to disruption of adaptation and development of prepathologic conditions and diseases, before all, in reproductive system. Leading mechanisms of these disorders may be imbalances in the hypothalamus-pituitary-adrenal-ovarian advantage of androgen effects (Nehanevich 2010).

A lot of factors influence the level of women sporting achievements of women: age, biorhythmical, functional, adaptive, reproductive, physiological and others. As E. Ivanchenko (2001) states, the basic structural unit in the construction of the women training process must be mesocycle (set of 3–5 Microcycles), ie one menstrual cycle (MC). Since the nature and duration of MC flow is individual and not for all it may consist of five cycle phases, the cycles are recouped from the first day of the previous cycle to the first day of the next MC. For most women it lasts 27–29 days (Optimal length is 28 days), it can vary from 21 to 35 days, and sometimes – up to 42 days (Hmil et al. 1999). Most athletes train during menstruation with some limitation, because of their health deteriorates.

Many studies (Radzievsky 1990, Shakhlina 1999, Kalytka 2001, Soboleva 1999) found that the efficiency of athletes of different specializations and display of their physical qualities during MC may change. In premenstrual, menstrual and ovulation phases sports results deteriorate, and postovulatory and postmenstrual phase results for most athletes are the highest.

According to L.G. Shakhlina (1999), for the functioning of women body oxygen transporting system optimal is postmenstrual and postovulatory phase of the cycle, during other phases the voltage in the respiratory and cardiovascular systems is noticed.

According to the Kalytka S.V. (2000) athletic result in competition in menstruation phase is 7.5%, average – 85%, worse – 7.5%, a special efficiency increases during postovulatory, postmenstrual and ovulation phases and remains reduced in premenstrual and, especially, menstrual phases. Heart rate increased starting from postovulatory phase and reaches its highest values in the premenstrual phase.

Majority of researches, dedicated to the study of the sports activity influence on the body, treatment and methods of training were performed on male athletes, so their coach results are often mechanically transferred to the construction of the women training process, which is not justified, and sometimes even not safe at all.

Although, it is proven (Kraus 1994, Shakhlina 1999, Kalytka 2001) that not at all phases of the biological cycle women athletes can perform certain training loads. (Besides, competition calendar can not predict the variety of specific biological cycles of athletes – as its total duration and the timing of the individual phases).

We have investigated that the dynamics of special efficiency manifestation for women is cyclical in nature and depends on the influence of hormonal status on athletes' body during the MC. The highest efficiency was found in Phase II and IV, the lowest – in the third and, especially, in phase I and V of the MC (Fig. 1).

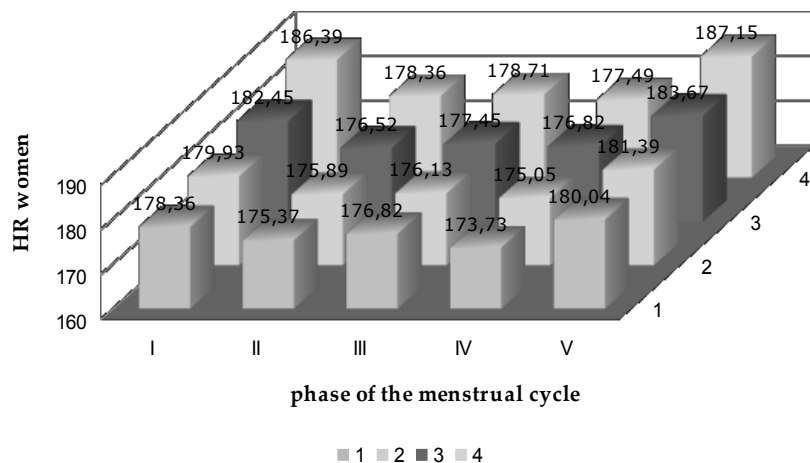


Figure 1. The dynamics of HR for women, who specialize in middle distance running, during MC

The dynamics of special efficiency for men had a tendency of graduate results growth, which, to our mind, can be explained by the growth of fitness, resulting from the training loads effective influence on the men body. (Fig. 2)

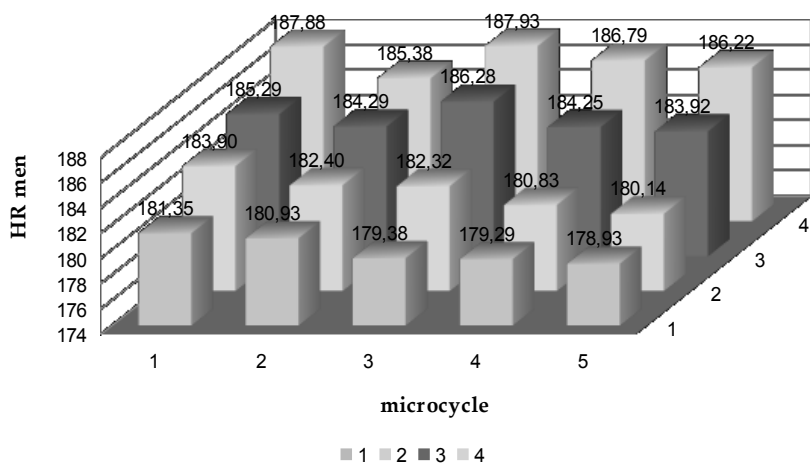


Figure 2. The dynamics of HR for men, who specialize in middle distance running, during mezocycle

One of the most informative criteria, which characterizes the adaptation of CVS to the physical loads is HR. We figured out, that while overcoming the distances, the highest HR indexes for women were fixed in II, III and IV phases, the lowest – in I and V phases of the MC. This means, that in II, III and IV phases functional possibilities of CVS are higher, comparing to I and V phases (table 1).

Table 1. The dynamics of special efficiency and the functioning state of women athletes, who specialize in middle distance running, during the MC

Parameters	№	Index									
		I phase of the MC	σ	II phase of the MC	σ	III phase of the MC	σ	IV phase of the MC	σ	V phase of the MC	σ
Time	1	81,35	3,70	75,28	3,27	78,49	3,15	74,24	3,54	82,84	3,48
	2	81,02	2,48	74,61	2,62	76,89	3,01	73,52	3,26	82,15	3,45
	3	80,84	3,02	73,64	3,42	76,02	3,52	73,05	3,47	81,01	3,72
	4	81,90	3,83	72,98	3,28	75,36	3,41	72,17	3,25	81,98	3,84
HR	1	178,36	4,23	175,37	4,62	176,82	4,79	173,73	5,37	180,04	6,38
	2	179,93	3,93	175,89	3,85	176,13	4,37	175,05	4,82	181,39	6,73
	3	182,45	4,16	176,52	5,38	177,45	4,12	176,82	5,37	183,67	7,43
	4	186,39	4,78	178,36	4,84	178,71	5,28	177,49	5,52	187,15	6,82
Lactate	1	7,68	1,37	6,83	1,45	6,93	1,37	5,87	1,23	7,93	1,35
	2	8,89	1,83	8,24	1,73	8,03	1,59	7,83	1,46	8,99	1,73
	3	10,58	2,03	9,05	2,30	9,10	2,38	8,92	2,35	10,89	2,15
	4	13,42	2,94	9,94	2,45	10,38	2,49	9,17	2,83	14,03	2,49

*Author's calculation

For men, heart rate indexes gradually decreased during mesocycle that, we believe, points to increase of the functionality of CVS-related training impact.

To evaluate the intensity of the load and energy contribution of anaerobic processes in the work we determined the concentration of lactate in the blood after overcoming of each segment of the test.

Thus, the highest concentration of lactate in the blood of women was recorded in phase I and V, the lowest – in the second, third and fourth phase of the MC. This indicates stress adaptation processes of the athletes' body in dealing with distances in phase I and V of the MC.

Concentrations of lactate in the blood of men have been consistently high and did not differ significantly during mesocycle, which may be associated with participation of mainly anaerobic energy production sources while ensuring of distance overcoming (table 2).

Table 2. The dynamics of specific efficiency and functional state of male athletes, who specialize in middle distance running, during mesocycle

Parameters	№	Index									
		1	σ	2	σ	3	σ	4	σ	5	σ
Time	1	60,36	3,60	60,29	2,93	60,59	2,98	60,38	2,58	60,15	2,48
	2	60,01	3,41	60,21	3,26	60,19	3,28	60,25	2,49	60,11	2,93
	3	61,27	2,89	60,92	3,31	60,02	3,63	60,01	3,41	59,92	3,45
	4	60,45	3,02	60,78	3,52	59,47	3,82	59,26	3,73	59,15	3,52
HR	1	181,35	4,31	180,93	4,79	179,38	5,18	179,29	5,83	178,93	5,48
	2	183,90	6,38	182,40	5,38	182,32	6,03	180,83	6,32	180,14	6,14
	3	185,29	5,27	184,29	5,24	186,28	5,13	184,25	4,93	183,92	5,22
	4	187,88	6,49	185,38	6,39	187,93	6,11	186,79	5,39	186,22	6,55
Lactate	1	6,89	1,62	7,02	1,34	6,05	1,48	5,99	1,33	6,13	1,72
	2	8,27	1,93	8,10	1,83	8,02	1,36	7,52	1,49	7,48	1,89
	3	10,12	2,37	9,76	2,89	10,14	1,99	9,48	2,04	9,41	2,57
	4	14,58	2,84	13,48	2,99	14,46	2,38	14,50	2,91	14,07	2,86

*Author's calculation

Energy consumption in running middle distances is covered almost equally by aerobic processes, associated with the absorption of oxygen and anaerobic processes that occur without oxygen. This largely determines task training stayers, the body of which should have significant aerobic capacity. Middle distance runners should have a high level of special efficiency; in other words, to have the ability to run the full distance to the maximally high pace, often during changeable running speed (acceleration at the start, spurts at a distance, fast finish). The basis for the formation of special efficiency is physical or power force of runner, his overall endurance and speed. To overcome 800 or 1500m at the high rate, the athlete must have strong muscles, supple and strong ties and movable joints.

Thus, we have found, that the dynamics of display of special efficiency of women is cyclical by nature and depends upon the influence of hormonal changes in athletes' bodies during their MC. The highest efficiency has been found in the second and fourth phases, the lowest one - in the third and especially in the first and fifth phases of MC. This is due to the increased functionality of the cardiovascular system and the effectiveness of power-ensuring in the second and fourth phases and its decrease in the first and fifth phases of MC, leading to stress of adaptation processes of women's bodies during these phases. As for men, their dynamics of special efficiency tended to gradual increase of the results, that, we think, can be explained by the growth of functional capabilities of the cardiovascular system and the effectiveness of power-ensuring on account of effective influence of training loads upon their organism.

Conclusions

1. Sports outcome depends on the level of fitness, body composition and functioning of all body systems, which, in turn, depend on the hormonal status of the organism, which has a significant difference between men and women.

2. The dynamics of special efficiency manifestation for women is cyclical in nature and depends on the influence of hormonal status on the athletes' body during the MC. The highest efficiency was found in the second and fourth phases, the lowest – in the third and, especially, in phase I and V of the MC. This is due to the increased functionality of the body in the second and fourth phase and its decrease in phase I and V of the MC.

3. For men, the dynamics of special efficiency tended to gradual results growth that, we believe, can be explained by the growth of functional possibilities, resulted from the effective influence of training loads on their body.

References:

1. Анохин П. К. (1975), Очерки по физиологии функциональных систем, М: Медицина, 447.
2. Бондаренко, А. Е. (2010), Физиология спорта: практическое пособие для студентов 3 курса специальности. А.Е. Бондаренко, Т. А. Ворочай, В. В. Солошик; Мин-во обр. РБ, Гомельский государственный университет им. Ф. Скорины, «УО ГГУ им. Ф. Скорины», 86.
3. Виру, А. А., Кырге, П. К. (1983), Гормоны и спортивная работоспособность, М: Физкультура и спорт, 158.
4. Ефимова, И. В., Будыка, Е. В. (1993), Адаптационные возможности организма студенток в разные фазы овариально-менструального цикла. Физиология человека, Т. 19, no. 1, 112–118.
5. Зеличенко, В.Б., Никитушкин, В.Г., Губа, В.П. (2000), Легкая атлетика: Критерии отбора, М: Терра-Спорт, 238.
6. Калитка, С. В. (2001), Особливості побудови тренувального процесу жінок, які спеціалізуються в спортивній ходьбі: дис. на здобуття наук. ступеня канд. наук з фіз. вих. і спорту: спец. 24.00.01 "Олімпійський і професійний спорт", 24.
7. Карпман, В. Л., Белоцерковский, З. В., Гудков, И. А. (1988), Тестирование в спорте, М: Физкультура и спорт, 4–10.
8. Коробов, А.И., Волков, Н.И. (1983), Бег на средние дистанции. Факторы результативности, Легкая атлетика, no. 11, 6–8.
9. Краус Т. А. (1994), Построение тренировочного процесса в скоростно-силовых видах легкой атлетики с учетом ОМЦ: Автореф. канд. дис.: 24.
10. Неханевич, О.Б. (2010), Репродуктивна функція спортсменок, які займаються важкою атлетикою та тхеквондо, Мофологія, Т. IV, no. 1, 33–39.

11. Радзиевский, А. Р., Шахлина, Л. Г., Яценко, З. Р., Степанова, Т. П. (1990), Физиологическое обоснование управления спортивной тренировкой женщин с учетом фаз менструального цикла, Теория и практика физической культуры, 47–50.
12. Соболева, Т. С. (1999), О проблемах женского спорта. Теория и практика физической культуры, no. 6, 56–63.
13. Хміль, С. В. (1999), Гінекологія, К, "Укрмедкнига", 538.
14. Шахлина, Л. Г. (2000), Женщины на рубеже третьего тысячелетия. Наука в олимпийском спорте, 10–21.
15. Шахлина, Л. Г. (1999), Проблема полового диморфизма в спорте высших достижений, Теория и практика физ. культуры, no. 6, 51–55.
16. Шубина, И. Ф. (1997), Планирование тренировочного процесса в женской спортивной ходьбе на этапе специальной подготовки: Автореф. дис. ... к. пед. наук., Омск: 25.

Submitted: 28.06.2013

Accepted: 08.08.2013