Scientific foundations of sports training planning: a new methodological approach

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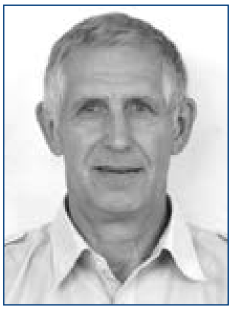

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Abstract

Objective of the study was to theoretically substantiate the application of the theory of oscillations in optimizing the planning of the training process.

Results and conclusions. The author argues that the generally recognized dynamics of the phases of the sports form does not correspond to the conditions for the implementation of the optimal (best among many others) options for the development of the physical abilities of the body of athletes, but is the result of the historically established practice of planning sports training. A theoretical substantiation of the use of the theory of fluctuations in the planning of the training process is given, in particular, taking into account the supercompensatory phenomenon in the functional state of the athlete's body.

Keywords: *training, sports form, optimal planning.*

Introduction. The problem of planning is one of the most important in the theory and practice of sports and is associated by specialists with the frequency of sports training and the achievement of optimal sports form, as a natural basis for planning.

The study of the currently available statistical, theoretical and experimental arguments gives grounds for the assertion that the generally recognized dynamics of the phases of the sports form does not correspond to the conditions for the implementation of the optimal (best among many others) option for the development of the physical abilities of the body of athletes, but is the result of historically established practice sports training planning.

Thus, the question arises: “Is there another way to solve the problem of optimizing the planning of athletes’ training?” As an affirmative answer to the question posed, a reasoned theoretical justification for using the theory of oscillations in planning the training process, in particular, taking into account the supercompensatory phenomenon in the functional state of the athlete’s body, is proposed [5].

Objective of the study was to theoretically substantiate the application of the theory of oscillations in optimizing the planning of the training process.

Results of the study and their discussion. An analysis of the publications of specialists shows that in the field of theory and methodology of sports, they record a large number of cycles of various nature and duration. In the systems of sports training L.P. Matveeva [7], Yu.V. Verkhoshansky [2], A.P. Bondarchuk [1], V.B. Issurin [4] and other specialists, the integrity of the training process is ensured on the basis of a certain structure of cycles, in particular, biological ones. Taking into account the length of time within which certain links of the training process are formed, there are, for example, microcycles, mesocycles, macrocycles, a large training cycle, etc. The lack of unified methodological principles for the analysis of cyclic wave processes leads to theories of physical education and sports to a paradoxical fact: in one subject area there are several concepts at the same time, offering the optimal solution to the same problem.

The factual content of the modern theory and practice of physical education and sports contains the potential for the implementation of the goal. Let's consider this possibility.

In the light of the general methodological principle of systematicity in the development of human abilities, it is necessary to observe the effect of layering each subsequent lesson on the traces of the previous one. It is known that the regular basis of this principle is the experimentally established phenomenon - supercompensation. The spatio-temporal dynamics of this process is a damped oscillation [3, 8], that is, it is possible, on the basis of the generally recognized laws of oscillatory processes, to theoretically analyze various options for the dynamics (development) of a damped process under various initial conditions for the action of a perturbing factor [5].

From the point of view of the theory of oscillations, the phenomenon - supercompensation, can be considered as a sequential alternation of two processes (phases) (Fig. 1).

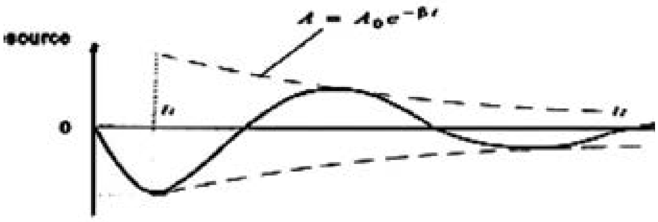


Figure 1. *Dynamics of the recovery process in the human body*

First, on the time interval [t0, t1], a driving force acts on the organism and takes it out of the state of equilibrium.

Secondly, after the end of the driving force on the time interval [t1, t2], the state of the organism performs a free damped oscillation. From the moment the free damped oscillation ends, the organism returns to its original state.

In real life, in particular, in the process of sports training, the frequency of repetition of physical impact is commensurate with the duration of the phase of free damped oscillation of the state of the organism. In this regard, we can consider several options for the subsequent dynamics of the rhythm of the state of the body.

1. *Progressive changes in the structure of the rhythm of the system.*

Let us assume that a driving force F(t) periodically acts on an open oscillatory system with a constant frequency. Let us consider the case when the moment of application of the driving force F(t) falls on the ascending wave of the damped process, and the current values of the system parameters exceed their initial level, that is, in the first half of the phase of the supercompensation phenomenon. In the zero cycle, the system is brought out of equilibrium by the force F(t) (Fig. 2).

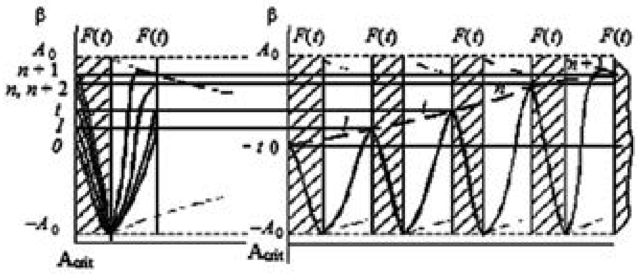


Figure 2. *Dynamics of the rhythm of the system when a periodic driving force is applied in the interval from T/4 to T/2 of the ascending wave of the damped process*

The process of increasing the amplitude of the rhythm and reducing the period of its oscillations will proceed from cycle to cycle until the moment of application of the driving force coincides with the half-period of the free damped oscillation of the system (the maximum of the overcompensation phenomenon), that is, for it the condition will be fulfilled - the resonant effect of the load on the oscillatory system. In the future, the amplitude and period of the oscillation of the system at the moment of application of the driving force from cycle to cycle will undergo only small fluctuations relative to the given state of the system (a consequence of the laws of damped oscillation).

An analysis of the dynamics of the "drawing" of an oscillatory system into the rhythm of oscillations by the driving force of a constant frequency gives grounds for fixing the following consequences.

1. As the system is drawn into the rhythm of oscillations of the driving force, the amplitude of the rhythm increases asymptotically, that is, the development of the system in a given region of space will be characterized as *asymptotically increasing.*

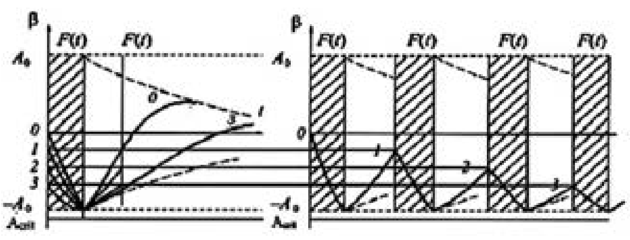
2. If the moment of application of the driving force coincides with the maximum of the wave of the damping process (the maximum of supercompensation), the development of the oscillatory system stops and this state of relative equilibrium can be indefinitely if the amplitude of the driving force and its repetition frequency are maintained constant in time.

The first consequence, where the asymptotic development of the oscillatory system is realized, from the point of view of the content of the concept of "sports form", can be considered as the phase of "formation" of the sports form according to L.P. Matveev [7], according to A.P. Bondarchuk [1] and V.B. Issurin [4], as a phase of "development" of sports form.

The second consequence assumes the end of development and the beginning of the preservation of the state of the system, which will correspond to the beginning of the phase of maintaining the sports form.

2. Regressive changes in the structure of the rhythm, when the physical impact falls on the phase of under-recovery.

Let us consider the case when a driving force F(t) acts periodically on an open oscillatory system with a constant frequency. At the same time, the moment of force application falls on that part of the ascending wave of the damped process, when the current values of the system parameters do not exceed their initial level, according to the terminology of the theory of sports, the phase of under-recovery. In the zero cycle, the driving force brings the system out of equilibrium (Fig. 3).



a b

Figure 3. *Regressive changes in the rhythm structure of the state of the body:*

a – comparative dynamics of damped processes in cycles 0–3 (coordinates of the beginning cycles are superimposed on each other); b - dynamics of the regressive process

In accordance with the laws of the theory of oscillations, the process of reducing the amplitude of the rhythm and increasing the period of its oscillations will proceed until the current value of the parameters of the organism reaches the critical limits for a given person, beyond which the state of the organism loses its qualitative certainty. If the influence of the driving force is removed in the subcritical region of the system state, then a free damped oscillation (recovery) will occur in the body.

In the regressive version of the dynamics of the development of an oscillatory system, the third consequence can be distinguished:

- the laws of the theory of oscillations reflect the presence of not only higher static characteristics of the body (initial level) before the onset of the driving force than after its removal, but also the dynamic characteristics of the body, which will be reduced in the new state (see Fig. 3 , a, cycles 0 and 3). This is due to the fact that the amplitude of each subsequent cycle will asymptotically decrease by an amount equal to:

This third consequence of the action of the laws of the theory of oscillations contradicts the axiom of the optimality of planning the development of a sports form (a type of strategy for adapting the body to physical activity, typical for athletes in speed-strength sports) in the concept of Yu.V. Verkhoshansky [2] and the axiom of V.B. Issurin [4] - "a certain sequence of highly concentrated training loads." In accordance with these axioms, if several successive loads fall on the phase of under-restoration of the functional state of various organs and systems, then this option of load planning gives a greater effect. The failure of the axiom is proved, on the one hand, by its contradiction to the laws of damped oscillation. On the other hand, it is shown by the results of the experiment [6].

3. The optimal variant of progressive changes in the structure of the rhythm of the system.

The process of progressive development of the system with the imposition of a driving force on the interval will begin if the oscillation frequency and the amplitude of the driving force increase from cycle to cycle. In this case, the maximum growth rates of the system parameters over time will be maintained if the magnitude of the change in the frequency of the oscillation of the driving force is such that the driving force will act on the system in time with its rhythmic oscillations (Fig. 4). This is the fourth consequence of the action of the laws of the theory of oscillations.

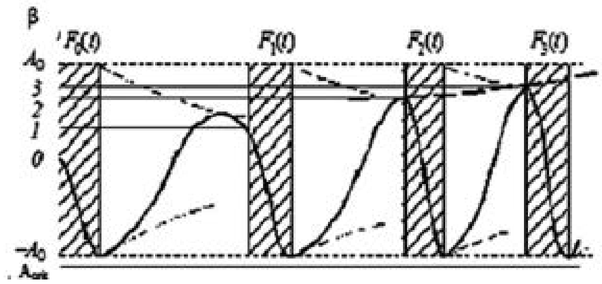


Figure 4. *Dynamics of the system under the imposition of a periodic driving force*

variable oscillation frequency in the interval from T / 2 to 3/4 T of the downward wave

damped process

This variant of the dynamics of the development of an oscillatory system under the action of a driving force must be considered when planning the relationship between the training load and the duration of rest in the preparation of athletes, as the most effective, that is, the optimal variant.

Consider the reasons that do not allow in the practice of sports to implement the best option for planning the dynamics of the state of athletes.

Usually, the volumes of the training load and the growth of sports results in sports with recorded achievements (athletics, swimming, speed skating, cycling, etc.) are fixed. Coaches know the volume of exercises performed over a certain period of time and the increase in the result. It is generally accepted that the situation is normal in which training loads increase continuously, and the growth rate of performance decreases. According to V.B. Issurin [4], this natural decrease is determined primarily by biological adaptation to the applied training effects. Yu.V. Verkhoshansky believes that "the adaptation process, both at the compensatory and long-term levels of its expression, cannot continue indefinitely ... therefore, the dynamics of the latter in time is described by a monotonically decreasing parabola" [2, p. 36].

The points of view of specialists presented above contradict the fourth consequence of the theory of oscillations. In accordance with the laws of damped oscillations, indicators of the state of the body (the level of physical, functional readiness) can, under certain conditions, asymptotically increase up to a certain genetically determined limit for each athlete (see Fig. 4). This is a fundamentally important theoretical argument both in assessing the objectivity of the opinion of specialists, and, accordingly, the conceptual provisions of one or another concept of training athletes.

Conclusions. In the real practice of sports, a monotonically decreasing dynamics of a sports result is fixed both at the level of the sports form cycle formation and in the long term. The reasons for this are the following factors:

- in the training process, the conditions of the second consequence of the action of the laws of the theory of oscillations are preserved, that is, the magnitude of the training impact and its repetition frequency remain constant in time. The situation is aggravated if the measure of the training load is reduced;

- in the training process, the fourth consequence is violated, which requires not only to increase the strength of the physical impact at each subsequent lesson, but also to adjust the start time of the next lesson, taking into account the reduction in the duration of the cycles of the recovery process. If in the real practice of training athletes the first condition is still somehow observed, then the second condition is to correct the beginning of the training session, taking into account the dynamics of the phase of the super-compensation phenomenon with a rigidly fixed time grid of training sessions within the boundaries (day, microcycle, mesocycle and etc.) - not executed.

References

1. Bondarchuk A.P. Periodizatsiya sportivnoy trenirovki [Periodization of sports training]. Kyiv: Olimpiyskaya literature publ., 2005. 332 p.
2. Verkhoshansky Yu.V. Osnovy spetsialnoy fizicheskoy podgotovki sportsmenov [Fundamentals of special physical training of athletes]. Moscow: Fizkultura i sport publ., 1988. 327 p.
3. Viener N. Kibernetika [Cybernetics]. Moscow, 1958. 232 p.
4. Issurin V.B. Blokovaya periodizatsiya sportivnoy trenirovki [Block periodization of sports training]. Moscow: Sovetskiy sport publ., 2010. 288 p.
5. Kizko A.P. Sovershenstvovaniye sistemy upravleniya funktsionalnoy podgotovkoy sportsmenov na osnove prichinno-sledstvennykh zakonomernostey (na primere lyzhnykh gonok) [Improving the control system for the functional training of athletes based on cause-and-effect patterns (on the example of cross-country skiing)]. Novosibirsk: NGTU publ., 2009. 400 p.
6. Kizko A.P., Nechunaeva E.E. Printsip vremennoy kontsentratsii deystviya nagruzki [The principle of temporary concentration of the action of the load]. Aktualnyye voprosy fizicheskoy kultury i sporta [Topical issues of physical culture and sports]. Proceedings International scientific-practical conference, (April 28-29): in 2 vols. Vol. 1. Tomsk: TGPU publ., 2009. pp.143-146.
7. Matveev L.P. Problemy periodizatsii sportivnoy trenirovki [Problems of periodization of sports training]. 2nd ed. Moscow: Fizkultura i sport publ., 1965. 243 p.
8. Yakovlev N.N., Korobkov A.V., Yananis S.V. Fiziologicheskiye i biokhimiche-skiye osnovy teorii i metodiki sportivnoy trenirovki [Physiological and biochemical foundations of the theory and methodology of sports training]. Moscow: Fizkultura i sport publ., 1960. 390 p.