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The models of strength-oriented loads periodization in mesocycles of training high-class racing skiers

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Abstract: Effective training process programming requires expedient periodization of differently orientated training loads. Information sources give the schemes of macrocycles creation for high-class racing skiers (RS), however, there is almost no information concerning the models of mesocycles creation at the stages of the preparatory period. That is why the aim of the research work was to create the model of strength-oriented loads periodization in mesocycles of training RS. ***Materials and research methods.*** Every day we gathered the results of the training loads among 11 RS, the leaders of the national sports teams of Russia (men and women) in terms of the centralized training and handled information with weekly gradation since May till September during the period since 2018 till 2020. All kinds of the loads are classified in accordance with three regimens of distant cyclic and 6 regimens of strength-oriented training. ***Results***. At all stages of the preparatory period RS used the model of mesocycles according to 3+1 scheme, where 3 is "loading" and 1 is "unloading" microcycles. The duration of microcycles is 5-9 days. The scheme of the cyclic loads mesocycle, including aerobic-strength oriented method, was 3+1. The mesocycle of strength-oriented training was created according to 2+2 scheme. In the loading microcycles of strength-oriented mesocycle all regimens of power loads were combined with high volumes of low intensity cyclic load. However, the most specific high-intensity cyclic exercises were planned during the 3rd microcycle and were combined only with the supporting volumes of strength-oriented exercises. Starting from the involving till special-preparatory stage we gradually decreased the volumes of the exercises, fulfilled in slow "hypertrophic" and "maximal power" regimens, but increased the volumes of the exercises in high-intensity and quick regimens of muscles contraction. In terms of middle mountains we used relatively big volumes of high-intensity ("maximal power") slow regimens, but considerably smaller volumes of explosive and speed-strength oriented exercises. ***Conclusion.*** Received in the research work schemes of mesocycles creation taking into account the contingent of the respondents can be considered as "models" of periodization, which reflect the regularities of mesocycles planning at the stages of the preparatory period in modern cross-country skiing.
Keywords: strength-oriented training, combination of the training regimens, elite athletes, microcycles, national sports team, aerobic exercises.

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Introduction

Strength-oriented trainings are the important part of training highly-qualified athlete es in cyclic kinds of sport, as practice and most research results show positive influence of strength-oriented training on effectiveness and sports result [7]. At the same time, apart from an adequate choice of means and methods, strength oriented training should be effectively involved into general periodization of the training process [2, 7].

The most popular model of the training process periodization was created by L.P. Matveev. It provides three kinds of cycles determination in a continuous training process. They have different duration: macro-, meso- and microcycles. According to such concept each cycle should have own aim and structure. For example, macrocycle should have the duration from 6 to 12 months and realize the aim of a long-term planning. It should include the preparatory, competitive and rehabilitation periods. They are divided into the stages or mesocycles. Mesocycle can include three and more microcycles

with duration of one month. The following types of mesocycles are defined: 1) involving – for the beginning of the preparatory period; 2) basic – the main type in preparatory period, which according to the content can be general-preparatory or special-preparatory, according to influence – developing or stabilizing; 3) control-preparatory – transient phase from the basic to competitive mesocycle; 4) pre-competitive is directed toward training for competitive period or the main start (if it is one); 5) competitive and 6) rehabilitation or transient. Mesocycle can include 2-3 microcycles of high-intensity trainings. They are followed by 1-3 rehabilitation microcycles.

The sequence of different types microcycles in a mesocycle is conditioned by the objectives of the training process [5]. The most popular model of strength-oriented training periodization, in terms of the ideas of L.P. Matveev, but without differentiation according to kinds of sport, includes the following stages: anatomic adaptation (ligamentous-tendinous apparatus), hypertrophy (muscle fibers), maximal power (owing to neuronal component of strength oriented abilities), conversion (power "base" transformation into specific for this kind of sport abilities improvement), maximal and "special" power support, gradual strength-oriented trainings suspension while getting closer to the main start and rehabilitation [1].

The concept of the training process periodization was developed in the works by Yu.V. Verkhoshanskiy during "block system" creation [2]. In particular, by the example of speed-strength oriented kinds of sport he underlined the idea of two-phase planning of mesocycles or the training stages ("blocks") according to the variant "load (overload)"-"unloading (partial or complete)" – in order to get cumulative effect ("supercompensation") [3]. Moreover, we formulated the principle, which can be defined as "successive overload with unidirectional specific loads" in terms of a microcycle [2]. In other words in each successive mesocycle we used more specific training means for a directed maximal morpho-functional specialization of an organism achievement by the beginning of the competitive period in accordance with the demands claimed on it by a competitive exercise. In spite of external distancing, the same ideas had A.P. Bondarchuk. He offered to use competitive exercise the whole year and strict orientation to individual terms of introduction into physical fitness according to each kind of the loads or exercises.

In western countries the problem of periodization caused many research works [8]. As a result there appeared different kinds of "periodizations": "block", "linear" with the varieties of "standard", "step-like", "reverse" variants of the load planning. As the alternative to a "linear" periodization "nonlinear" or "wavelike" periodization is offered. During it the load is planned with greater variability in a way that the frequency of the repetitions, approaches, lessons the volume and intensity of the loads can change each training/week/microcycle. Also "fractal" model is offered. There one and the same model of the cycles structure in case of "volume" and "intensity" reverse dependency, strictly preserves at macro-, meso- and micro levels. The structure of mesocycles is traditionally discussed in terms of "load"-"unload" concept [1].

However, in our opinion, in spite of the studied variants of "periodizations" diversity, no new conceptual ideas, apart from described in native literature, were mentioned. It should be noted that during theoretical, overview, experimental or inclusive (case-study) research works organization in most cases the problem of periodization was studied at the level of big (macro-) cycles of training. The structure and especially the questions of the loads combination in terms of mesocycles is not studied enough, except the specific stage of direct training for the main start ("peaking"). It is completely connected with cross-country skiing. Only in some works scientists discuss weekly loads distribution in terms of the training stages [10]. In this connection the aim of the present research work was to reveal the regularities of the structure and to create the model of the training mesocycles at the stages of the preparatory period on the basis of studying the volume of the training means distribution among racing skiers in the national teams of Russia.

Materials and methods

Respondents. Real athletes from the national cross-country skiing team of Russia (n=11) (women and men)- leaders of the teams according to FIS rating took part in the research. They trained during the period since 2018 till 2020 under the direction of different training collectives of the centralized training. Before the beginning of the research all respondents signed the consent to use personal (anonymous) data in scientific research. For the analysis we selected information about the athletes. They had regular medical check-up, didn't have injuries, serious diseases and took an active part in competitions of a national and international level.

Training loads collection. In the training camps the loads were registered by the experienced specialists according to the methodology, created for the work with the athletes of the national teams [4, 9]. Information about the loads was registered every day in an electronic table in concordance with the created classification of the exercises with 39 indices. During the independent training the results were registered in personal diaries and then handled by the same personnel.

The content and distribution of the load analysis

revealed that the duration of the training camps during the preparatory period was 20,3+2,1 days. After it went the period of home training with the average duration 8,4+1,2 days. In each gathering it was possible to define three microcycles, their real duration was within the period of 5-9 days. Taking this results into account we decided to make the duration of each microcycle 7 days, including the microcycle of home training (between the cams). The duration of it was within the range of 6-10 days. The target duration of each mesocycle was 28 days. Volumes recalculation inside each microcycle was realized according to the following methodology. The first day of the microcycle was the day after "rest". Then the average volume of each means of training was calculated. If real duration of the microcycle was less than 7 days, the average day volume was added to a real volume of a microcycle in accordance with the missing amount of days, if it was less- subtracted according to the same principle. Such procedure was necessary for the microcycles comparison inside mesocycles, and mesocycles (calculated for other stages and years of training) between each other.

In home training the first day was the day of the flight (training camp-home), the last day was also the day of the flight (home (or Moscow)- the place of the training camp). The volume of the whole days, including the flight, was 7 days.

For the present research all registered parameters of the load were classified in accordance with 6 training regimens [6]:

1) "strength oriented endurance" + "hypertrophy oxidative muscle fibers" – recurrent strength oriented training, fulfilled either in low speed and low intensity regimen (LSLI, <70%)

2) "hypertrophy" to the limit in the attempt) or the average speed, but low intensity (<50% – "circular training" not to the limit);

3) "hypertrophy" – regimen of low speed and the average intensity (LSAI, 70-85%), fulfilled either to the limit or till considerable speed of muscles contraction decrease in an effort;

4) maximal power – the regimen of a low speed and high intensity (LSHI, >85%), fulfilled till the beginning of speed decrease of muscles contraction in an effort;

5) speed-strength oriented load to legs muscles– regimen of high speed and high intensity (HSHI), including sprint and jumps, fulfilled not to the limit in an attempt;

6) explosive and quick power– regimens of high speed and high intensity (HSHI, 50-85%RM) and high speed and low intensity (HSLI, 30-50%), fulfilled not to the limit in an attempt.

7) aerobic-strength oriented method (ASM) – regimen of a cyclic load (running, ski imitation, ski, rowing, bicycle), fulfilled with low speed, but high intensity of muscles contraction (LSHI), fulfilled with the interval or continuously in cross-country or with an additional resistance and duration of "working" interval 60-180 seconds.

The volume of the load was registered either in hours (general volume of power load and ASM), or in attempts (differentiated regimens) and was averaged among all athletes (men and women). In order to compare in terms of mesocycle the loads of strength orientation with the volume of cyclic loads, the latter was registered according to 5 intensity zones system, but calculated according to three zones system [9].

In order to compare the schemes of mesocycles creation each training mesocycle was included into one of the following stages of training: involving (April-May), general-preparatory (June, July), middle mountains (as a rule, August), special-preparatory (September).

Results and discussion

Picture 1 presents weekly distribution of general volume of strength oriented loads and cyclic loads of different intensity at the stages of preparatory period. The results show that cyclic loads in terms of mesocycle are used according to the scheme of 3 loading + 1 unloading microcycle. Low intensity loads (1-3 zones) have the tendency to concentrate in the 1st and the 2nd microcycles, high intensity loads- in the 2nd and the 3rd microcycles. In other words it is a "classic" scheme of "quantity transfer into quality". During the unloading cycle the loads in the 1st and the 2nd zones preserve at the level of 46% from the level of the loading ones. And the volume of the work with more intensive regimens (the 3rd-5th zones) decreases till 29%.

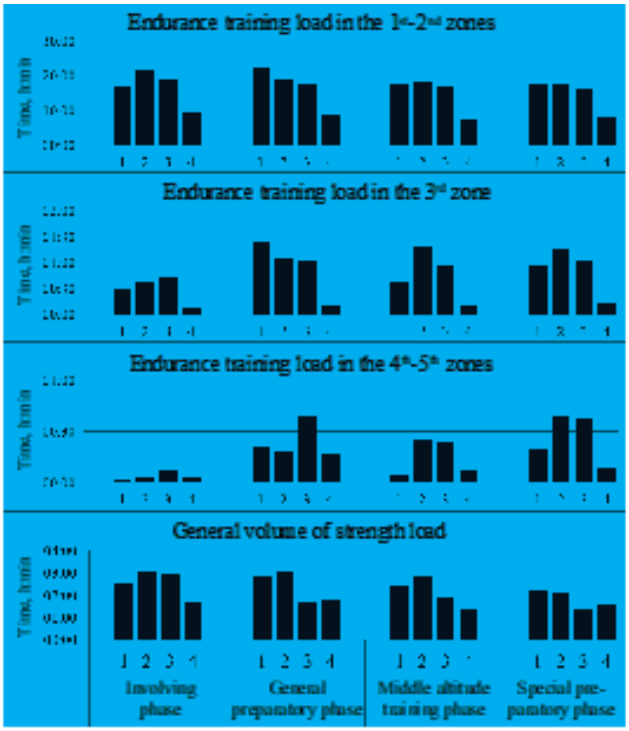

Fig. 1. Weekly distribution of the cyclic loads of different intensity volumes and general volume of strength oriented load at the stages of preparatory period among high-class racing skiers

In contrast to cyclic, the volume oa strength oriented load is used according to the scheme 2 loading + 2 unloading microcycles except the involving stage. Another difference is in the fact that the volumes of strength oriented training decrease in "unloading" phase of a mesocycle doesn't exceed in the average 32%. At the same time in the 4th microcycle the volume of strength oriented load preserves the level of the 3rd one.

Fig. 1 also shows that at general- and special-preparatory stages maximal "spreading" of high-intensity cyclic and general volume of all kinds of strength oriented loads is seen in the 3rd microcycle – at the end of the loading phase of a mesocycle.

Picture 2 presents weekly distribution of strength oriented load with differentiation according to the regimen of its fulfillment at the stages of the preparatory period.

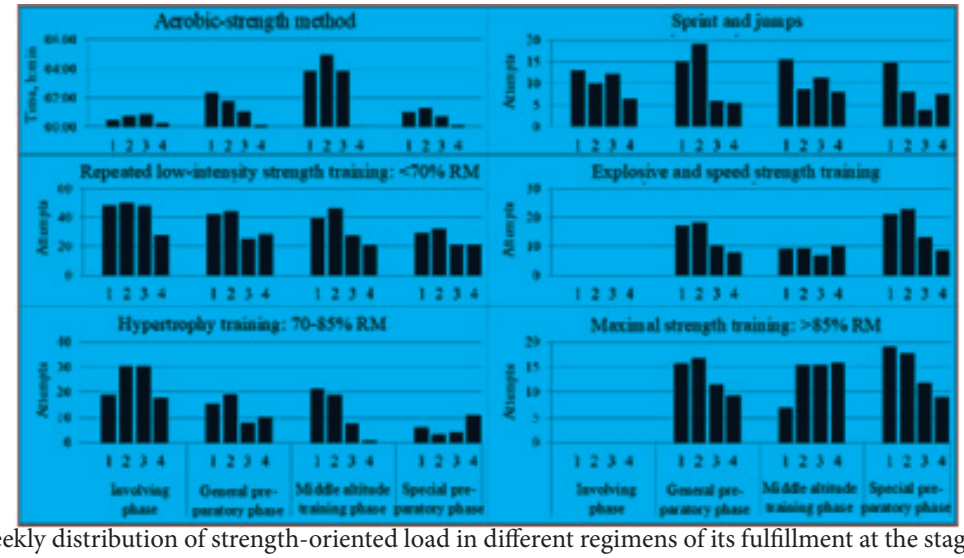

Fig. 2. Weekly distribution of strength-oriented load in different regimens of its fulfillment at the stages of preparatory period among high-class racing skiers

The results show that the scheme of different regimens of the load distribution in terms of mesocycles differs from stage to stage. At the involving stage we use the greatest volumes of the main "hypertrophic" regimens (LSLI and LSAI regimens) according to the scheme 3+1, and significantly big volumes of sprint and jumps according to the same scheme (3+1). At further stages the volume of hypertrophic regimens has the tendency to decrease and is used according to the scheme 2+2. The volumes of sprint and jumps are preserved at a steady level and are used according to scheme 2+2.

The regimens of strength oriented training, which provide "neuromuscular component of strength oriented abilities" training (HSLI and HSHI), not muscles hypertrophy, are not used during the involving stage. Further these regimens are used according to scheme 2+2 at general-preparatory and special-preparatory stages. In other words, all main regimens of strength oriented training at these stages are concentrated at the beginning of mesocycles, are used according to scheme 2+2.

At middle mountains stage we pay attention first of all to reciprocal distribution of slow "hypertrophic regimens", concentrated in the 1st and the 2nd microcycles, and quick intensive ones. They have the tendency to increase in the 3rd and the 4th microcycles; secondly, maximal volumes of training "for a maximal power" and minimal volumes of training "explosive" and "quick" power are used at this stage.

Cyclic aerobic-strength oriented method is used according to the scheme 3+1 and is widely used in terms of middle mountains.

Summary

The schemes analysis of the training loads distribution in terms of mesocycles at an involving, general preparatory, middle mountains and special-preparatory stages of the preparatory period among elite racing skiers helped to come to the following conclusion:

1) modern racing skiers in most cases use 30 days mesocycles during the preparatory period according to the scheme 3+1. 3 microcycles are the loading and are realized during the training camps and one (home training) is unloading one;

2) the distribution of the different orientation loads in terms of mesocycles is realized according to the scheme 3+1 for cyclic and 2+2 for and strength oriented loads (except the involving stage, where 3+1 scheme is used (Fig. 1).

Such scheme of mesocycles provides the effect of "supercompensation" [3], it is used in order to help athletes to recover by the beginning of the next mesocycle and had higher level of working capacity after morphofunctional transformations, caused by the loads of a mesocycle. It should be noted that modern coaches consider it sufficient to use one microcycle (6-10 days) for rehabilitation after the cyclic loads, including the flights to the place of the training camp; at the same time, the rehabilitation after the concentrated strength-oriented loads should last no less than two microcycles (14-16 days) in terms of "supporting" strength oriented trainings fulfillment with the volume no less than 2/3 from the loading microcycles. It probably helps to solve the problems with strength oriented abilities development and support at all stages of the preparatory period;

3) modern coaches of the elite racing skiers in terms of microcycles of one and the same mesocycle combine great volumes of slow regimens of the cyclic training (1-3 zones) and maximal volumes of any regimens of strength oriented training (pictures 1 and 2). At the same time coaches try to "divide" according to microcycles strength oriented loads and the loads fulfilled in the most specific high-intensive regimen of the cyclic training (in the 4th-5th zones). It is used at the end of the mesocycle (the 3rd microcycle). Most of all they divide intensive cyclic loads and strength oriented loads, fulfilled in "slow hypertrophic regimens". They are planned at the beginning of the mesocycle (the 1st-2nd microcycles);

4) strength oriented trainings distribution at the stages of the preparatory period first of all provides (at the involving stage) slow hypertrophic regimens use, then (at general- and special-preparatory stages) – more intensive and "quick" regimens. It in general corresponds with the principle of the load increase specificity by Yu.V. Verkhoshanski [2] and the concept of strength oriented load periodization by T. Bompa [1]. However, at the level of one mesocycle both "slow" and "intensive" regimens, including sprint, speed-strength oriented and explosive exercises , are concentrated in one and the same (as a rule, in the 1st and the 2nd) microcycles at all stages of training. Probably in order to avoid athletes "slowing-down";

5) during the preparatory period the greatest volumes of strength oriented training with "maximal power" and the volumes of a cyclic aerobic-strength oriented method, but the smallest volumes for "explosive" and "quick" strength are used at the stage of middle mountains training. In other words in middle mountains coaches permit using great volumes of high-intensity means of strength-oriented training, but only in case of relatively slow speed of muscles contraction.

Conclusion

Analysis of differently oriented load volumes distribution in terms of mesocycles revealed clear structuring of mesocycles according to the scheme 3+1. However, strength oriented loads, apart from

aerobic-strength oriented method, are distributed according to the scheme 2+2. In the loading part of strength-oriented mesocycle coaches combine all kinds of strength-oriented loads and high volumes of low-intensity cyclic load. However, the most specific high-intensity cyclic exercises were planned during the 3rd microcycle and were combined only with the supporting volumes of strength-oriented exercises. The schemes of mesocycles creation, presented by Fig. 1 and 2, taking into account the fact that they show average statistical results of the elite skiers group. They trained during several years under the direction of different coaches, can be considered as the "models". They reflect the regularities of planning mesocycles in modern cross-country skiing.

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