



COMPARATIVE ANALYSIS OF TRAINING MEANS IN THE BEGINNING OF THE PREPARATION PERIOD WITH ELITE WOMEN BIATHLETES

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ABSTRACT

The present study deals with the ratio of training means (general and specific) in biathlon. For the purposes of the research, a comparative analysis of the training means was made in the beginning of the training period in two successive years. The study also presents the results from the functional diagnostics, made by means of a laboratory spiroergometric test. The **subjects** of the research are (n=8) women from the Bulgarian National Team in Biathlon. The applied **methods** include: Comparative analysis of the training indicators; Testing – Body Weight (KG), % Body Fat (BF), % Active Muscle Mass (AMM); Minutes (min); Wmax, Wmax/kg, VO2max, VO2max/kg. Variation analysis, T-test for dependent samples. Functional diagnostics was made during the first introductory training camp of the national team – in two subsequent years. The **results** from the laboratory test of the competitors in biathlon showed an increase in the most important indicators: Wmax by 22.14 W on average, and VO2max by 178,57 ml/min on average. An improvement in the other important indicators was also observed – the Active Muscle Mass was increased by 1,49 % on average, and the Body Mass indicator was decreased by 2,58 % on average. **Conclusion:** Applying training means and methods (cycling, ski rollers, special strength endurance – SSE and general strength training – GST) in 2022 led to the improvement of all indicators in functional diagnostics in comparison to the training means and methods used in 2021.

Key words: biathlon, preparation period, spiroergometric test, training process

INTRODUCTION

The periodization of the training process finds its more concrete form in the mesocycles, which are characterized by the average waves of the adaptation processes. Mesocycles represent relatively complete stages of the training process, and each one is usually composed of 2 – 6 week microcycles (1-4).

Building the training process on the basis of mesocycles facilitates its systematization, the possibility of optimal dynamics of the training

load, an appropriate ratio of the means and methods of preparation, and a rational sequence of their use. It also helps to ensure an appropriate correspondence between the training and the competition loads, as well as the recreation methods needed, in order to achieve continuity in the development of individual qualities and skills, and to form different aspects of sport preparation. In contemporary sport theory and practice there is no unified system of the various mesocycles, as well as a unified conceptual apparatus. A clear idea of their essential meaning could be received through the absolute and the relative values of completed work (4).

The main task in the introductory mesocycles is the preparation of athletes for a gradual increase in the total load at the expense of the volume of work. A certain amount of special preparation

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exercises is also used for increasing the capacity of the athlete's body for subsequent work.

According to some specialists (4), the length of the introductory mesocycles in a single-cycle periodization is about 15-20 days. Their length also depends on the functional condition of the athlete. In exceptional cases, connected with long interruptions of the training process (injuries, pregnancy, etc.), the introductory mesocycles could continue for up to 6-8 weeks.

Many American coaches plan the introductory mesocycles not at the beginning of the preparation period, but at the end of the transition period. In the USA, a long transition period (45 days) is traditionally planned. Part of it is intended for recreation and the other part, between 2 and 4 weeks, for introductory training work.

Some authors (5) suggest a training load around 25 % of the maximum. Others (3) recommend that, in case the duration of the introductory mesocycle is 3 weeks, the total volume of loading in the first week should be around 25 – 30 %, while for the second and third week, respectively, it should be 50 – 60 % then 60 – 70 %, also in the first mesocycle, the volume of the load should be small or average.

A completely different ratio of total loading in the preparation of elite biathletes is presented by another specialist (6). In his opinion, it should be up to 120 training hours.

The choice of methods and means in the introductory mesocycles also has implications for the subsequent development of the athletes' conditioning abilities.

More and more specialists in the field share the opinion that physical training work is of significant importance for the development of the aerobic functions of an athlete's body (7, 8).

According to a researcher (9), planning the training loads in the preparation period reflects the characteristics of the applied means, methods, volume and intensity of the load aimed at the development of physical qualities, taking into account research results, the athletes' individual training diaries, annual training plans, etc.

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Another specialist (10) argues, that the changes in the structure and content of the training process over time have a regular character, they are distinguished by their periodic manifestation reflecting the dynamics of the training impact - the type, degree and focus of its separate elements.

In terms of methodology, the problem of the choice of training means in the initial preparation phase of biathletes appears to be very important currently. Its closer study would allow to determine the most efficient training means currently.

Hypothesis: It is presumed that the application of up-to-date training means, aimed at increasing the total training load in the course of building the training process, would have a positive effect in improving the functional capabilities of elite biathletes.

For *the aim* of the research, a comparative analysis of the training tools and of the intensity of loading at the beginning of the preparation period was made.

According to the aim of the research, the following *tasks* were defined:

1. To compare and analyze the general and specific indicators of the two introductory mesocycles.
2. To compare and analyze the results of the completed laboratory spiroergometric test.

MATERIAL AND METHODS

The subjects of the research are (n=8) women from the Bulgarian National Team in Biathlon. The experimental study was conducted after the introductory training camps of the National Team in two subsequent years. Two sport camps were organized in the two experimental seasons – the first one at the training center in Borovetz, Rila mountain from 07 June to 28 June 2021, and the second - from 06 June to 27 June 2022 at the High Mountain Sports Center “Belmeken”, each one of them lasting for three weeks.

The basic tasks included athletes' recreation and the development of aerobic capacity, strength endurance and general strength training. They involve three microcycles each: introductory, developmental, developmental. That kind of

combination is typical for the development of basic endurance.

The *object* of the present research is the training load at the beginning of the preparation period, and the *topic* of the study is the choice of training means used in the preparation of elite women biathletes.

In the course of the study, the following *methods* were used: Analysis of specialized literature on the problem; Comparative analysis of the training indicators; Purposeful pedagogical observation of the training process; Pedagogical experiment; Testing – to establish the effect of the training load, a laboratory spiroergometric test was used for determining the functional and morphological changes in the bodies of the biathletes. Data on

the following indicators were taken: Body Weight (KG), Body FAT/% (BF), Active Muscle Mass/% (AMM); Minutes (min); Wmax, Wmax/kg, VO2max, VO2max/kg. The test was conducted using a standard methodology of the Department for Coordination and Control of Sport Preparation (3), also Variation analysis and T-test for dependent samples were made. The results were processed by means of an SPSS statistical program.

(Table 1) and (Table 2) present the training means in the two subsequent years.

The training load was conducted entirely in aerobic regime of work – zone 1, zone 2 and zone 3, to the anaerobic threshold (An T) of energy provision.

Table 1. Percentage ratio of training means in the introductory mesocycles in 2021

General			Specific		
Means	Hours	%	Means	Hours	%
Running	16	30,2	Skiing	-	-
Cycling	17	32,1	Rollers	15	28,3
General strength training	-	-	Special strength training	2	3,8
General physical preparation	3	5,7	Total	53	100

Table 2. Percentage ratio of training means in the introductory mesocycles in 2022

General			Specific		
Means	Hours	%	Means	Hours	%
Running	2	3,2	Skiing	-	-
Cycling	36	57,1	Rollers	16	25,4
General strength training	6	9,5	Special strength training	3	4,8
General physical preparation	-	-	Total	63	100

From the indicated percentage ratios, it can be noted that in 2022 there is an increase in percentage with cycling, as a training means, by around 25 % in comparison to the results in 2021. The same regularity is observed in strength training for general strength preparation (GSP) at the expense of the general physical preparation (GPhP) in 2021. Also the general training load in the two mesocycles is increased by 10 hours in 2022.

RESULTS

Before presenting the analysis, it is necessary to make a preliminary clarification, which will give us an opportunity for objective interpretation of

the acquired results, and to derive the regularities and recommendations, respectively.

It has to be noted, that all subjects of the research are elite competitors from the Bulgarian National Team in Biathlon, practically representing the general population of subjects in the research.

The results from the laboratory test of the competitors, completed twice – after the introductory mesocycles in the two subsequent years, are presented in (Table 3) and in (Table 4) – mean values and variability of the parameters, and in (Table 5) – a comparative analysis.

Table 3. Mean values and variability of the studied parameters of the National Team in Biathlon – women in 2021

Indicators	Measuring Units	R	Min	Max	X	S	V%
Body Weight	Kg	16,7	50,8	67,5	57,37	6,35	11,1
Body FAT	%	6	11,8	17,8	14,98	2,24	15
Active Muscle Mass	%	6,1	40,1	46,2	43,31	2,08	4,8
Minutes	Min	6,3	8	14,3	11,1	2,33	21
Wmax	W	130	160	290	223,57	46,8	21
Wmax/kg	W/kg	1,33	3,15	4,48	3,99	0,53	13,3
VO2max	ml/min	1550	2450	4000	3042,85	549,95	18,1
VO2max/kg	ml/kg/min	14,07	47,66	61,73	53,73	4,35	8,1

Table 4. Mean values and variability of the studied parameters of the National Team in Biathlon – women in 2022

Indicators	Measuring Units	R	Min	Max	X	S	V%
Body Weight	kg	14,8	50	64,8	55,98	5,91	10,6
Body FAT	%	5	10,7	15,7	12,4	1,61	13
Active Muscle Mass	%	6,8	41	47,8	44,8	1,93	4,3
Minutes	min	5,3	10	15,3	12,11	1,93	16
Wmax	W	110	200	310	245,71	39,31	16
Wmax/kg	W/kg	0,9	3,83	4,73	4,31	0,32	7,5
VO2max	ml/min	1500	2650	4150	3221,42	528,37	16,5
VO2max/kg	ml/kg/min	13,36	50	63,36	56,23	4	7,2

Table 5. Comparative analysis – before and after the experiment

Indicators	X	S	t	alfa
Body Weight	1,39	1,15	3,173	0,019
Body FAT	2,58	1,85	3,693	0,01
Active Muscle Mass	-1,49	0,99	-3,948	0,008
Minutes	-1,01	0,71	-3,751	0,009
Wmax	22,14	11,85	-4,943	0,003
Wmax/kg	-0,32	0,28	-2,902	0,027
VO2max	-178,57	63,62	-7,426	0,003
VO2max/kg	-2,5	1,02	-6,481	0,001

With the first indicator Body Weight, there is a decrease of the mean value in the second study by about 1,5 kg but the difference is not statistically confirmed. It can be observed in Figure 1. that with both tests homogeneity in the weight of the studied biathletes is almost the same, $V=11,1\%$

in 2018 and $V=10,6\%$ in the next year. The minimum difference is due to the specifics of the training effects, which are with greater continuity – aerobic type.

The results from the following two indicators, closely connected with the first one – the

percentage of Body FAT and the percentage of Muscle Mass, show that there is a decrease in Body FAT ($\Delta=2,58$) at the expense of the increase in the percentage of Muscle Mass ($\Delta=1,49$). With the first of these two, the difference is not statistically significant ($t=3,69$, $\alpha=0,01$), while with the second, it is statistically significant ($t=-$

$3,94$, $\alpha=0,008$). The explanation is in the hard work done in strength training. With the percentage of Body FAT, the coefficient of variation is $V=15\%$ – in the first study, and in the second study it is $V=13\%$, which is an evidence of the approximate homogeneity of the sample (**Figure 1**).

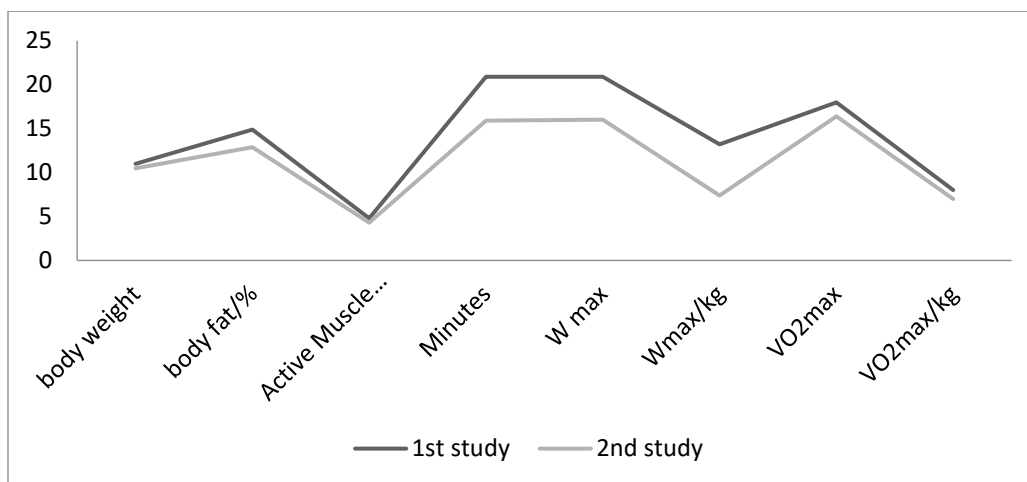


Figure 1. Comparative analysis of the coefficient of variation of the studied biathletes

The mean value of the maximum power of load (W_{max}) reached by the competitors in biathlon in the first study is $\bar{X} = 223,57 \pm 46,8$ W, and in the following year it is higher by 22,14 W, $\bar{X} = 245,71 \pm 39,31$ W. The difference is statistically significant, and it informs us of an increase in the aerobic and strength capacities of the women biathletes.

With the next indicator – the maximum power of load reached per kilogram of weight (W_{max}/kg), derived from the analyzed one (W_{max}) related to body weight, a minimal absolute improvement is observed $\Delta = -0,32$ W/kg. The two indicators, together with the ones to be analyzed next, provide information about the total functional capacity of the body of the competitors.

Statistically reliable improvement of the results is also observed in the last two indicators, which most strongly reflect the essence of the training work performed during the second study. In the first study, the mean value for maximum oxygen consumption (VO_{2max}) is $\bar{X} = 3042,85 \pm 549,95$ ml/min⁻¹, while in the second one – $\bar{X} = 3221,42 \pm 528,37$ ml/min⁻¹ and statistically significant difference – $t = -7,426$, $\alpha = 0.003$. With the most informative indicator in relation to the

level of development of aerobic capacities – the maximum oxygen consumption per kilogram of weight (VO_{2max}/kg), there is a difference of $-2,5$ ml/kg/min⁻¹ and also a statistically reliable difference $t = -6,481$ and $\alpha = 0,001$. The coefficient of variation at VO_{2max}/kg is 8 % in the first study, and 7 % in the second study, as for most of the analyzed indicators, the coefficients of variation show values which are an expression of the high level of homogeneity of elite female competitors in biathlon.

DISCUSSION

From the above mentioned, it can be summarized that the training load performed during the introductory mesocycle before the second study influenced the development of the functional capabilities of the studied biathletes in one direction. We can assume, that general preparation to some extent eliminates the individual differences connected with aerobic abilities, however, its effect should not be overestimated. This negative conclusion refers to the necessity of individual approach to each competitor regarding the training process in the preparation period, especially when it concerns highly qualified athletes. A fairly high level of sports achievements of the studied persons is

observed, i.e. their sports results are close to the zone of the so-called "top saturation level" of the function. On this basis we can conclude, that there are no great differences between the studies, which is a proof of the non-linear and heterochronic character of the adaptation changes in the human body. This means that even minimal functional changes as a result of the applied training load should be counted as real achievements, although in some cases, they are not supported by the required statistical reliability, or high coefficients of variation are observed, i.e. we have to bear in mind, that the criterion which determines the functional condition of the athletes, is not a cumulative expression of the achievement itself in a concrete type of sport.

CONCLUSION

In the process of the conducted research it was established that the training means predominantly used (cycling, ski rollers, special strength endurance and general strength endurance) in 2022 led to improvement of all indicators from the conducted functional diagnostics in comparison with the training means used in 2021 during the introductory mesocycles.

The level of work capacity at equal loading has a pronouncedly individual character. It is determined by the adaptation abilities of the competitors, which requires the use of individual parameters of the training load and different methodological approaches for inducing adaptive changes in the body. In biathlon such training approach in the introductory mesocycle is used almost with all leading teams in the world. This type of training during the introductory mesocycle helps for the recovery of aerobic and strength capabilities as a result of the decreased training load in the transition period, and to prepare the body for the upcoming maximum training loads in the following cycles of the training process. From the conducted pedagogical experiment, the importance of employing introductory mesocycles in biathlon was established, as a factor for inducing new adaptation changes in elite biathletes.

RECOMMENDATIONS

We suggest that the Bulgarian Biathlon Federation includes the constructed model of an

introductory mesocycle in the sport preparation of elite athletes at the beginning of the preparation period of the training process.

The proposed training load, presented as a percentage of training means in the introductory mesocycle, can be incorporated in the training programs of elite Bulgarian biathletes.

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