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Body Composition and Performance in Cross Country Skiing

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ABSTRACT

The aim of the study is to demonstrate the relationship between volume and intensity of work that the cross country ski during the macrocycle training and supplementation, and changes in body composition. This work is based on analysis of source materials, obtained from conducted individually by the athlete registration process of training, maximal exercise test results and the results of measurements of body composition performed in the laboratory functional studies. The highest results in terms of oxygen uptake test obtained during the second measurement. VO2 max reached the 3.2 l / min and 54 mL / kg / min VO2 on the threshold LT 49 ml / kg / min,% VO2 max on the threshold LT - 90.7. The maximum values of blood lactate level in the course of further tests were progressive 8.4 mmol / l 4.33 mmol / l and 9.39 mmol / l. The fat within the macrocycle decreased by 2.6% (1.8 kg). The lowest value was recorded adipose tissue after a period of preparation of the main (measurement of 22/08/2013) and amounted to 8.2% (4.8 kg). The effect of endurance training in an increase of the ceiling of oxygen and lactate threshold shift towards higher loads. Has reduced the level of adipose tissue, which may be the result of physical exertion, but carried supplementation based on building lean body mass at the expense of body fat. This is a translation of my authorship the original source, which was publicated in an edition of the Scientific Publishing Sophia in 2015[1]. It aims to increase the accessibility of the text.

[1] N. Grzebisz. Zarządzanie treningiem i suplementacją a parametry wydolnościowe i skład masy ciała u biegaczki narciarskiej . Wybrane aspekty zarządzania a jakość życia / red. nauk. Ireneusz Miciuła. Wydawnictwo Naukowe Sophia, Katowice 2015. - S. 156-168

***Keywords*:** cross-country skiing; parameters such cardiovascular; body composition; acidification; supplementation

1. INTRODUCTION

Sports training is a long process, whose activities are directed at achieving the championship. The word process here refers to all phenomena and changes accompanying the player and trainers during the various stages of training, so in the mental as well as physical. During many years of work they are shaped by technical ability, tactical, motor, and mental Player [1]. Cross-country skiing is a discipline mainly endurance, requiring the player activation of almost all muscle groups [2]. During training and competition energy sources are used alternately formed by the reaction of oxygen, mixed and anaerobic [3,4].

Indicators of training an athlete used for control purposes are measurement results acidification of the body and the size of maximal oxygen uptake (VO2 max). High tolerance disorders of homeostasis during physical work affects the ability to achieve high athletic performance during the start of the annual training cycle [5]. The aim of this study was to demonstrate the impact of training and supplemnetation the ability to exercise in endurance sports and body composition, particularly on the level of body fat.

2. MATERIAL AND METHODS

The study was a member of the national team in the Polish Ski Association ski races, held a master class International. She was 25 years old and she has 15 years training experience. Starts the season included the distances from 1,500 meters (sprints) 50 km transmission.

The work is based on analysis of source materials acquired the run individually by the competitor recording the training process and results of tests endurance and body composition measurements carried 06/11/2013, 08/22/2013 and 07/02/2014 in the workshop functional tests in AWF Katowice. The logs included training volume and intensity of loads, their

specificity due to the measures Training and quantity control training and competing in competitions, holidays and training during each month.

Laboratory tests conducted in the laboratory exercise Physical Education in Katowice. Test method was used progressive. The tests were conducted in 3 periods:

And the study took place at the beginning of the preparatory period for the season 2013/2014, the second study - the mesocycle preparation, in August 2013, the third test - the rest after season.

Body composition was measured using scales Tanita Body Composition Analyzer BODY IN 220 consisting of 8-point tactile electrode system. The survey was carried out before the start of each exercise. Measurements: weight, water content, minerals, vitamins, body fat (% and kg) and SMM (Slimm mass muscle in % and kg) indicators WHR (waist this hip ratio) and BMI (body mass index).

After completing the measurements of resting athlete joined the exercise test.

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Stress Tests were performed on a treadmill using HP COSMOS CPET equipment: MetaLyzer 3b-R2. The output load was speed of 6 km / h and incline of the treadmill initial 1.50. Every 3 minutes increased speed for another 2 km / h, with an interval of 30 seconds to draw blood. After completion of the test at 16 km / h followed by change of incline every minute 10 and started a last attempt, continuing to refuse. Attempting continued to refuse

athletes. During the interval made the collection of capillary blood from the fingertip in order to determine the concentration of lactate (LA) in the blood with the analyzer Biosen C-line Clinic (EKF-diagnostic GmbH). Before starting an exercise test parameters were determined rest of the test. To determine the resting blood lactate level (pHsp) determined its level before and after the exercise test. The rest were monitored: heart rate (HRsp), blood pressure, minute ventilation (VE) and the volume of oxygen consumption (VO2). After completing the measurements of resting athlete joined the exercise test. During exercise measured the following parameters: terminator (km / h), the load on the threshold of anaerobic - LT (km / h), cardiac output lungs - VO2 max (L / min), maximal minute oxygen uptake - VO2max (ml / kg / min), minute oxygen uptake on the threshold of change oxygen - VO2 on the threshold LT (ml / kg / min), the percentage of maximal minute oxygen uptake on the threshold of change oxygen - % VO2 max on the threshold LT, the maximum minute ventilation of the lungs - VEMAX (l / min). ratio respiratory exchange – RER max (VCO 2 / VO 2), maximum heart rate - HRmax (thigh / min), the heart rate at the threshold of alternating aerobic - HR LT (ud / min), stroke volume - O2 / HR (ml) , changes in the acidification acidification maximum - LA max (mmol / l), concentration change ΔLA lactate (mmol / l) and a change of acidity after 12 minutes after the end of exercise ΔLA res 12 '.

3. RESULTS

The results, which reached a competitor in another laboratory in which the test was performed on a treadmill to refuse and size blood acidity and body composition are shown in Tables 1-3.

Table 1. The values of strength parameters obtained by the cross country ski in the course of a step test on a treadmill.

The strength parameters assay progressive	11.06.2013	22.08.2013	2.07.2014
End load (km / h)	16<1,5^{0}- 1:30 min	16<4,0^{0}	16<4,0^{0}
Load threshold LT (km / h)	12	14<1,5	14<1,5
VO2 max (l/min)	2,9	3,2	3,1
VO2 max (ml/kg/min)	47	54	53
VO2 on the threshold LT (ml / kg / min)	41	49	48
%VO2 max on the threshold LT	87	90,7	90
VE max (l/min),	108	127	110
RER max (VCO_2/VO_2)	1,03	1,06	1,05
HR max (ud/min)	194	192	197

HR na LT (ud/min)	183	179	187
O_2/HR (ml)	14,9	16,6	15,7

LT - lactate threshold, VO2 max - maximal oxygen uptake minute, VEMAX a maximal minute ventilation of the lungs, RER max - the maximum respiratory exchange rate, HR max - maximum heart rate, HR - heart rate

Table 2. The concentrations of lactate in the blood obtained by cross country ski in the course of a step test on a treadmill.

Parameters acidification assay maximum	11.06.2013	22.08.2013	2.07.2014
LA max (mmol/l)	8,4	4,33*	9,39
ΔLA (mmol/l)	7,03	3,7*	8,39
ΔLA res 12’	-3,16	-1,97*	-2,84

LA - the concentration of lactate in the blood, ΔLA - change in the concentration of lactate in the blood, res – rest

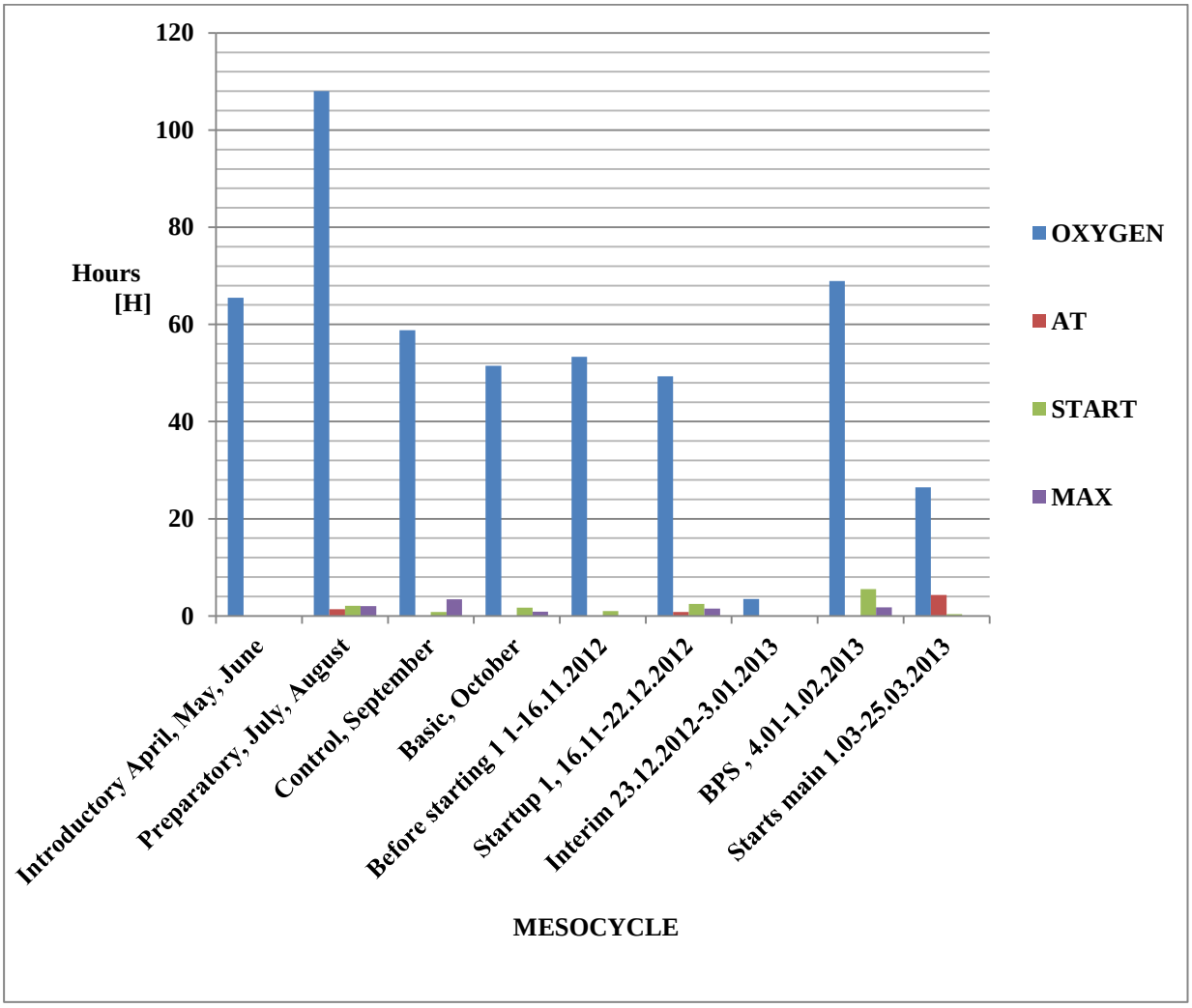
Table 3. Values of body composition and anthropometric indices obtained by cross country ski in the course of the study of body composition.

The parameters of body composition and anthropometric indicators in the study of body composition	11.06.2013	22.08.2013	2.07.2014
Body weight (kg)	61	59.3	58.9
BMI (kg/m^2)	21.6	21	20.9
WHR	0.77	0.74	0.74
Water (l)	38,1	40,1	37,8
Protein (kg)	10,2	10,8	10,2
Minerals (kg)	3,55	3,63	3,52
Fat tissue (%)	15,1	8,2	12,5
Fat tissue(kg)	9,2	4,8	7,4
Skeletal muscle (%)	47,4	51,6	48,7
Skeletal muscle (kg)	28,9	30,6	28,7

BMI - body mass index, WHR - the ratio of hip circumference to waist circumference,% - percentage

Figure 1 illustrates a summary of the hours of work in the various zones of intensity mesocycles within a year, they made a contestant. The largest number of training hours was made are oxygen. Maximum load and abaut thershold used in each mesocycles excluding induction and transition.

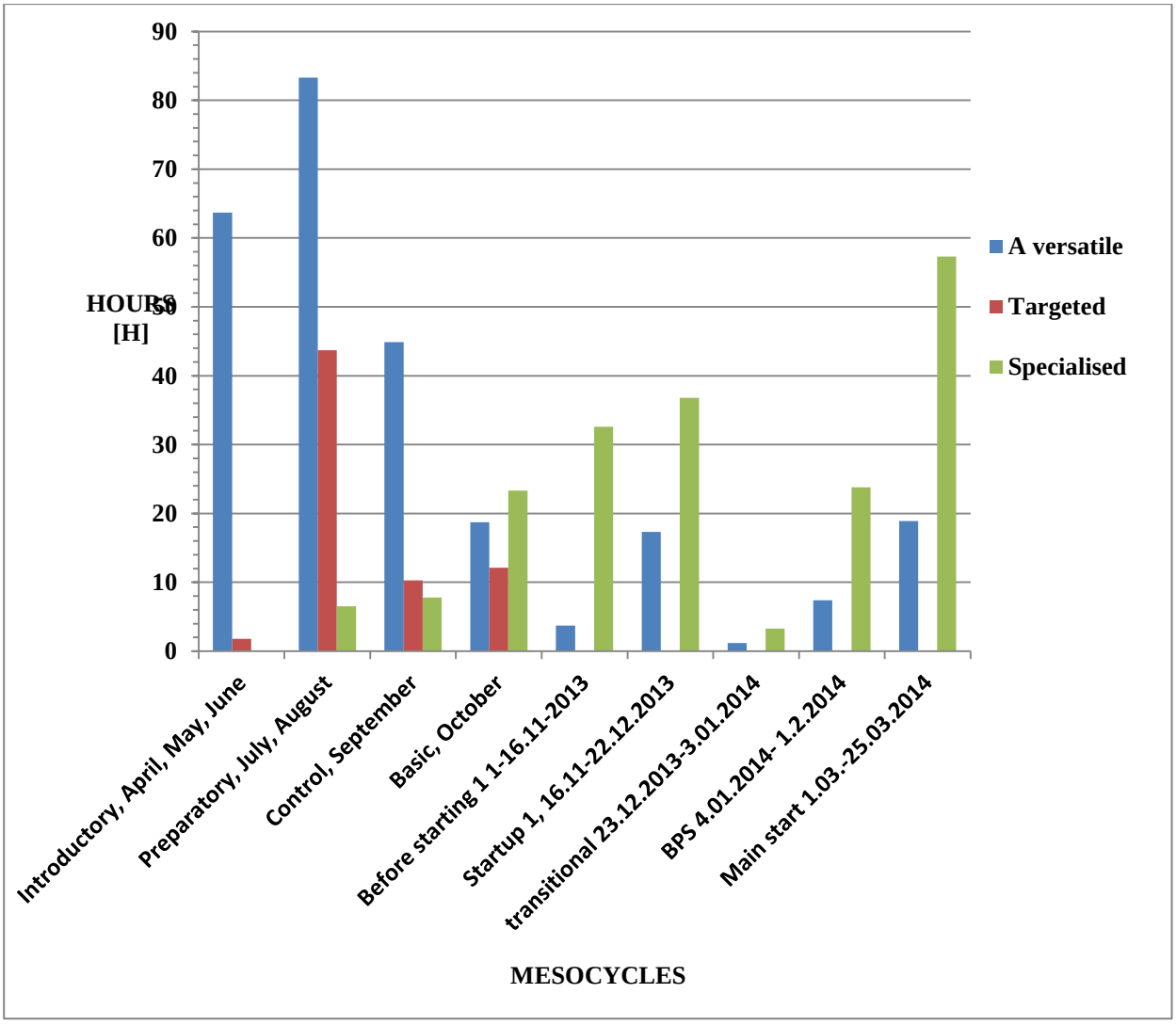
The greatest value of maximum effort recorded in mesocycles major competitions, which significantly influenced the course of 50 km and the specifics of its preparation. Number of hours in the zone runway was strictly dependent on the amount and length of distance competitions, and therefore the highest values recorded during the preparatory (take-offs on roller skis), a startup I and BPS, which was supposed to use supercompensation in training and achieving peak performance.



OXYGEN - aerobic exercise, AT - effort abaut thershold, START - starting effort, MAX - maximum effort, BPS - Direct the preparation of startup

Figure 1. Number of hours of individual zones of intensity in mesocycles within a year at the ski runners

Figure 2 shows the load while various measures of training at the ski runners. The lowest number of hours recorded in work-oriented (ski rollers and imitation). Mesocycle introducing preparatory and control characterized by the highest share of jobs comprehensive (running and bike). During mesocycles introduced the basic specialist training (skis and all exercises performed on skis), representing an approximate value of hours, similar to comprehensive training. Further mesocycle was dominated by the work of a specialist, which closely associated the preparation specialist for the season and the same starts. In any mesocycles, however, introduced a comprehensive training in order to maintain motor skills.



BPS - Direct the preparation of startup

Figure 2. Loads in individual protective measures training at the ski runners

Table 4 shows the results, which reached a contestant in the season.

Table 4. Results in competitions.

Type of competition	Type of effort	Position
Senior National Championships	sprint cl 5 km f 15 km f Team sprint 50 cl	4 12 - 3 6
Continental Cup	Sprint Sprint 10 km f Sprint 5 km cl	26 20 17 8 5

cl – classic style, f – free style

Supplements have been taking contestant is presented in Table 4. These include nutrient from the group of amino acids, carbohydrates, vitamins, minerals and dietary fat burning. These supplements are responsible for energy loss supplement and maintain homeostasis in the body [6].

In an endurance sport like cross-country skiing where large groups of muscles are used often over several hours each day. It is imperative that the athlete re-supplies the body with adequate amounts calories to balance the large expenditures during training. Energy turnovers as large as 20 $MJ \cdot day^{-1}$ (megajouls per day) in females and 35 $MJ \cdot day^{-1}$ in males were measured in Swedish national team cross-country skiers during an altitude training camp. Some of the skiers had problems consuming enough food to compensate for these huge energy expenditures. However, over a one-week period, which included a day of reduced training, the athletes were able to eat enough to reach caloric balance. Therefore, it is important to be aware of the caloric deficit that may develop during intensive training periods and also try to eat well on days with less or no training [7].

Table 5. Applied supplements.

Supplement	**Dosage of training days**	**Dosage of on days off**
BCAA	6 g 45 min before training	2 g on an empty stomach 2 g before bedtime
Vitamin C	5x per day 100- 200 mg After main meals	5 x per day 100- 200 mg After main meals

carbohydrate conditio ner	50 g after training	absence
isotonic drink	200 ml which 20 min during exercise	absence
L carnitine	1g on an empty stomach 1g 20 min before the last meal pre-training (approx. 3 hours before exercise)	1g on an empty stomach 1 g in the evening
Caffeine	240 mg per kg ideal body weight 45 min before the workout	absence
glutamine	5 g after training 2-3 g before bedtime	2-3 g on an empty stomach 2-3 g before bedtime
HMB	1 g on an empty stomach 1 g before the midday meal 1g before the evening meal, or before bedtime	1 g on an empty stomach 1 g before the midday meal 1g before the evening meal, or before bedtime
Conditioner carbohydrate - protein (40 -50% protein)	35 g during day 50 g 30 min after training	2 x 35 during day
Bicarbonate of soda	300 mg / kg body weight 2 hours before the workout	

4. DISCUSSION

The aim of the study was to analyze selected indicators endurance, lactate levels and body composition within the macrocycle at the ski runners. The main changes concerned the aspect of end load (km / h), the load on the threshold LT (km / h), VO2 max, HR LT, acidification and changes in body fat levels.

The relationship between prolonged physical effort and the concentration of glycogen and the level of acidity indicates a reduction in the concentration of these metabolites while increasing the load terminal [8]. Abaut threshold endurance training and can increase lactate threshold and VO2 max [9]. In athletes reported such changes in the value of the lactate threshold of 183 to 187 / minute and VO2max of 47 to 53 l / min / kg. According to F. Evertsen, Medbø, J. and I. Bonen [10] the level of oxygen consumption from the best ski runners, while 5-month training period did not change significantly and amounted to 58.3 +/- 0.9. Norwegian researchers give the opportunity to 8% VO2 max value changes in time [11, 12]. The change from 47 to 53 l / min / kg in the study runner ski represents 12%. It is much greater than that provided by the above-mentioned authors.

Only Stöggl and Sperlich [13] in their study indicate changes at the similar level (11.7 ± 8.4% (60.6 ± 8.3-67.4 ± 7.7 mL • min^{-1} • kg^{-1}) using the methods of interval during the 9-week training period in advanced players. The study authors mentioned above, as well as the practice of sports confirm that VO2 max has a significant impact on the level of strength [14]. However, the actual value of the VO2 max is not a precondition of high performance sport, because a person can use to work at VO2 max only for 5-8 minutes and longer exercise effort forced to lower its intensity. Therefore, significant importance is the ability to use a large part of VO2 max during exercise [15]. This feature is more susceptible to train a than oxygen uptake. The increase in the percentage use of VO2 max is the main effect of endurance training, contributing significantly to the improvement of strength. Leading players well They tolerate physical efforts at the level of intensity up to 95% VO2 max [16,17]. In the test there was a 12% increase in VO2 max and the length of the sample performed at the time and speed. Repeating the result in terms of capacity and the length tolerance test of the second and third tests in relation to the first and improved level of capacity in the third sample as compared to the tests performed a year ago provide to increase the ability of the players and higher output at the start of the next macrocycle [18,19].

Ettema, Hans-Christer Holmberg and Sandbakk [12] report that ski racers exhibit a high possibility of a low and a mixed zone of intensity. The athlete showed similar opportunities. Changes lactate threshold reached only at a speed of 12 km / h (and test), then tolerance has increased to 14 km / h at inclination of the treadmill 1.5°. The increase in the LT makes the subsequent use of substitutes stress, such as glycogen and phosphocreatine, and derive a resource characteristic for the aerobic exercise (fatty acids), which in turn increases the body's exercise capacity [20].

Sports training should reduce your maximum heart rate, and increase lactate threshold changes. In the study upsurge was observed in both parameters. Lower values of maximum heart rate during the first and second test result may be too early termination under the terms of physiological effort [21]. Growth towards higher value of this ratio may indicate that properly conducted endurance training. Lactate threshold shift towards higher value indicates an increased tolerance of the body's homeostasis disorders during submaximal efforts [22]. With the ability to incur more debt aerobic athlete can achieve better results when competitive sports [23].

Endurance training results in reduced production and concentration of lactate muscle [24,25]. Training load during July and August could result in a very good adaptation of the body to the effort the players. Acidification of the maximum in the second test was in excess of a threshold change of lactate, i.e. 4.33 mmol / L. In June figure was 8.4, and the third study, 9.39 mmol / L. These values are lower than in studies by other authors [10, 26], which may be a positive effect of high-altitude training, conducted prior to the test [27].

In studies Sperlich and Stoogl [13] demonstrated reductions in body weight surveyed cyclists, runners, triathletes and cross-country skiing 3.7% +/- 3%, during the 9-week training cycle. The research group belonged to active players, of VO2 max at 62.6 ± 7.1 mL • min^{-1} • kg^{-1}. The authors of the 9-week training cycle studied the changes in the parameter area endurance and body composition using 4 different types of training: high-volume training (HVT) training of high volume and low intensity "threshold-training" (THR) training abaut threshold, high -intensity interval training (HIIT) and polarized interval training (POL), or a combination of the three. It has been shown weight loss only using interval training (Campos). Cross country ski between the first and second study performed work mainly in the

zone of oxygen during the preparatory macrocycle [28]. Selected workouts were interspersed with the interval abaut thershold also work to stimulate the body and adapt to the maximum load, though many was the work done in the area of oxygen. Body weight of the test runners fell by almost 3%. Significant changes have occurred in the level of body fat (15.1% - 8.2%) [26]. Lean body mass increased from 47.4% to 51.6%. These results are not consistent with the statement Sperlich and Stoogl [13] a similar evolution taking place only at the interval training. To confirm the determination of additional research would be needed on a larger number of competitors. Furthermore, those authors suggest the negative effect of weight loss on the immune system [29,30]. Our findings agree with the observations from the study competitor, which in high season has often been susceptible to infection. The reduction of body fat to the physiological limits may also contribute to an increase in disease [31,32]. The values in the study fell sharply after the summer, characterized by the greatest burden from 15.1% in June to 8.2% in August surveys. After the season adipose tissue runners rose to 12.5%, which was influenced also used supplementation [33,34].

5. CONCLUSIONS

- As a result of the analysis, during the annual training cycle experienced an improvement in the major parameters which favorably affect the functioning of the cardio-respiratory system of the ski runners.
- The effect of endurance training in an increase of the ceiling of oxygen and lactate threshold shift towards higher loads.
- Applied training loads have improved exercise capacity in the study through an increase in the analyzed indicators, mainly VO2 max and lactate threshold VO2. This demonstrates the effectiveness of the training conducted in the annual cycle.
- Body composition has decreased, mainly through the reduction of adipose tissue, which could improve VO2 max.
- Impact of changes in body composition, beyond effort, was also supplementation and high altitude training.

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