THE EFFECT OF AN INCREASED VOLUME OF TRAINING FOR SKI ORIENTEERING OVER THE SUMMER ORIENTEERING PERFORMANCE

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Abstract: Objectiv: Elite orienteers must run or ski in different types of terrain at the highest tempo which will still allow them an error free course without lost time. Orienteering tasks are the same for both types of orienteering and up to a point, training for both can be beneficial for the overall performance. This paper examines the relationship between the performance of the athletes specialized in summer orienteering and the volume of training specific to ski orienteering.

Methodes: The analysis has been done on statistical data collected from 56 athletes members of the Romamian National Team in the 2005-2006 competition seazon (data collected for physical fitness optimization) and the specifics of the competition preparedness in the 2015-2016 season from 8 athletes, members of national teams. In the latter time frame,

I have analyzed the effects of an increased volume of training specific to ski orienteering.

Results: The increased volume of training for ski orienteering and simultaneously decreasing the training volume specific for summer orienteering resulted in a significant decrease in performance during the first part of the 2016 competition season due to a reduction in average speed.

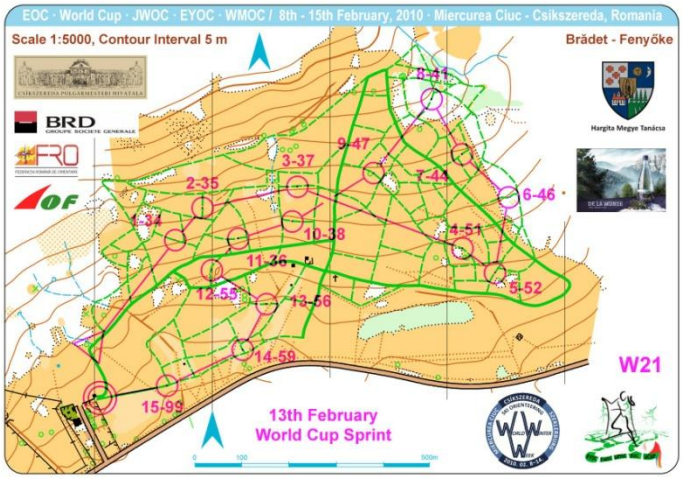
Conclusions: This study proves that using training methods specific for ski orienteering has a positive effect in performance for the summer orienteering competitions IF the percentage of these methods does not surpass a certain threshold. Going over this threshold will significantly decrease the speed during the early summer orienteering seson.

Key words: Performance, ski orienteering, volume methods; regression;

Introduction

Ski orienteering, is an endurance sport with International events that include World Championships, European Championships and World Cup events. Ski Orienteering will be introduced for the first time at 2019 Winter Universiade and it has good chances to be introduced at the Winter Olympics as well. This sport combines cross country skiing abilities with orienteering skills. The key to success is the ability to read the map and chose without hesitation the best routes between controls while skiing at a high rate of speed. The classic ski orienteering formula is:

Intelligence x Physical Strength x Skiing Ability



Oja P, Laukkanen RM, Kukkonen-Harjula TK, Vuori IM, Pasanen ME, Niittymäki SP, Solakivi T. [1] in the study ,,Training effects of cross-country skiing and running on maximal aerobic cycle performance and on blood lipids" suggested that training by cross-country skiing and running of the same

duration and intensity at each session for 9-10 weeks improved equally the cardiorespiratory fitness of untrained middle-aged men.

Foster C1, Hector LL, Welsh R, Schrager M, Green MA, Snyder AC [2] in "Effects of specific versus cross-training on running performance" suggest that despite the principle of specificity of training, athletes may improve performance in one mode of exercise by training using another mode. To test this hypothesis they studied 30 well-trained individuals (10 men, 20 women) in a randomized longitudinal trail. Subjects were evaluated before and after 8 weeks of enhanced training (+10%/week), accomplished by adding either running or swimming to baseline running, versus continued baseline running.The authors concluded that "The data suggest that muscularly non-similar XT may contribute to improved running performance but not to the same degree as increased specific training."

In medium and long distance orienteering events, the speed of elite athletes depends on the fitness level of each competitor, but more importantly on the biomechanics of running. By increasing the volume of training methods specific for cross-country skiing and ski orienteering, and dramatically reducing the volume of running in winter, the running biomechanics and the stride frequency are being changed.

The first part of the study will analyze the relevance that the training methods specific to cross-country skiing - parts of the training system - have on the performance level in the running competitions. The analysis was conducted based on statistical information relative to the members of the Romanian national team, in the 2005-2006 competition season. Every sport has its own training workout specifics. Certainly, in addition to training, there are other factors that may impact performance levels (i.e. the competitive experience, the race strategy, innate skills, psychological strength, overall moral state, health, gear, etc.).

For the first part, a graphical analysis was done for the combination of independent variables, coupled with the dependent variables, followed by the regression method which consisted of the construction of linear models for regression for each of the two dependent variables (race speed), in combination with the independent variables and a free term. The analysis will consider the degree of relevance the training methods specific to cross-country skiing - parts of the training system - have on the performance levels in running events.

For the second part, we will analyze athletes' performance after increasing the training methods specific to cross-country skiing above a certain level, volume increased due to athletes' participation at the world ski orienteering championships and cups.

All models have been tested in terms of validity with analysis of variance (ANOVA) method, using the F-test, and it's been confirmed that we are dealing with valid models.

Methods and data source

The analyzed data is based on the author's Minoiu V. [3] and coach's measurements performed on 2005-2006 national teams, athletes of different ages and genders (42 men, 37 women) and eight members of the national teams in 2015-2016 competition season. As a result, the database consists of 40-record data base. The independent variables for which information was collected are as follows: gender, distance (in kilometers), maximum heart rate, average heart rate, and 25 training methods.

From the quantitative methodology point of view, this study will begin with the presentation of the correlation matrix between the analyzed variables. The next section will be dedicated to building regression models to illustrate the relevance (or irrelevance) that different training methods had on the performance levels obtained.

To test how the analyzed variables interact to each other, the correlation method has been applied in a first stage. Thus a correlation matrix was created. The simple linear correlation coefficient of Pearson (r) was used for analysis, due to the fact that the variables involved were mainly quantitative variables. The default threshold of statistical significance was set at 1% and 5%. We find that the dependent variables are highly correlated with each other and, as a consequence, to avoid the effect of multi-colinearity in the regression models that we are going to build, each dependent variable will be analyzed separately. In the correlation table, we will retain the attention in this analysis only through the way the performance variables (speed test 1 and test 2) are correlated (or not) with training methods. At the analysis stage using the

regression method, we will include in our models all methods of training.

2.1. Regression Method

This step consists of constructing linear regression methods for each of the two dependent variables (race speed) in combination with groups of independent variables and a free term. The models are expressed by this formula:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 ... + \beta_n X_n + \varepsilon$$

Where

Y denotes the four independent variables

β_0 *is the free term*

X_1 *is the first independent variable*

X_2 *is the second independent variable*

X_3 *is the third independent variable*

X_4 *is the fourth independent variable*

X_n *is the N-th independent variable*

n and ε *are rezidual variables*

Due to the excessive number of independent variables in relation to the number of cases examined (40), the independent variables have been separated in four groups. Each group was placed in the analysis in an area labeled „iteration". Working procedure involved the initial application of the regression method for all the vriables in that group iteration. After analyzing the quality of the resulted regression models, the independent variables that didn't have a significant influence statistically have been removed (basically were removed from the model those variables that showed statistically insignificant regression coefficients). The significance threshold has been set at 5% and in very few cases variables up to 8% significance have been kept.

2.2 Applying the regression method for the „Total Run Time" dependent variable

Models in this iteration that include cross-country skiing as a method of training:

- Orienteering events (training, or sanctioned events) (Km)
- Stretching and aerobic (hours)
- Essential running drills (Km)
- Combined jumps/obstacle jumping (Km)
- Strength exercises (hours)
- Running in snow, sand/rough terrain, swampy/grassy terrain (Km)
- Cross-country skiing (Km)

Table 1. Correlations between the variables of performance and the means of training.

	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11
X1	1	0,86**	0,61**	0,67**	0,67**	0,68**	0,84**	0,56**	0,62**	-0,6**	-0,69**
X2	0,86**	1	0,61**	0,67**	0,67**	0,68**	0,84**	0,56**	0,62**	-0,6**	-0,69**
X3	0,67**	0,82**	1	0,65**	0,7**	0,87**	0,76**	0,48**	0,6**	-0,69**	-0,61**
X4	0,61**	0,71**	0,7**	1	0,71**	0,61**	0,76**	0,44*	0,63**	-0,81**	-0,77**
X5	0,67**	0,83**	0,7**	0,74**	1	0,72**	0,82**	0,47**	0,8**	-0,69**	-0,72**
X6	0,67**	0,87**	0,71**	0,74**	0,7**	1	0,87**	0,37*	0,85**	-0,77**	-0,79**
X7	0,68**	0,86**	0,61**	0,72**	0,7**	0,61**	1	0,6**	0,71**	-0,77**	-0,73**
X8	0,84**	0,97**	0,76**	0,82**	0,87**	0,8**	0,82**	1	0,86**	-0,83**	-0,87**

X9	0,56**	0,54**	0,44*	0,47**	0,37*	0,6**	0,5**	0,45*	1	-0,46*	-0,42
X10	-0,6**	-0,82**	-0,81**	-0,69**	-0,77**	-0,77**	-0,83**	-0,46*	-0,85**	1	0,91**
X11	-0,69**	-0,84**	-0,77**	-0,72**	-0,79**	-0,73**	-0,87**	-0,42	-0,83**	0,95**	1

- ** Correlation is significant at the 0.01 level (2-tailed).
- * Correlation is significant at the 0.05 level (2-tailed).

A. Applying the regression method for the 'total trial speed' dependent variable
Regression

Tabel 2. Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,824 [a]	,679	,547	41,7954

a. Predictors: (Constant), Cross-country Skiing (Km), Combined jumps/obstacle jumping (Km), Stretching and aerobic (hours), Essential running drills (Km), Orienteering events (training, or sanctioned events) (Km) Strength exercises (hours), Running in snow, sand/rough terrain, swampy/grassy terrain (Km))

Table 3. Model 1: Speed for Test Run 1 function of Orienteering races, stretching and aerobic, Essential running drills, Multijumps, Strength exercises, Multijumps and cross-country skiing. Regression coefficients: values, standard errors, T test, significance thresholds.

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	606,506	53,034		11,437	,000
	Orienteering events, training or Sanctioned events (km)	-6,63E-02	-,116	-,181	-,570	,576
	Stretching and aerobic (km)	-,481	,620	-,184	-,776	-,448
	Essential running drills(km)	-,380	1,185	,083	,321	,752
	Combinet jumps obstacle, jumping(km)	-,791	1,353	-,204	-,584	,567
	Strenght exercices (hours)	1,536E-03	1,607	,000	,001	,999
	Running in snow,sand/rough terrain, swampy/grassy	-,168	,213	-,384	-,790	,441
	Cross –country skiing(km)	1,46E-02	,069	-,036	-,211	,835

a.Dependent Variable:Run 1 speed(sloped terrain)(sec/min)

Table 4. Model 1: Speed for Test Run 2 function of Orienteering races, stretching and aerobic, Essential running drills, Multijumps, Strength exercises, Multijumps and cross-country skiing. Regression coefficients: values, standard errors, T test, significance thresholds.

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	614,752	38,599		15,919	,000
	Orienteering events, training or Sanctioned events (km)	-5,42E-02	,061	-,156	-,892	,390
	Stretching and aerobic (km)	-,499	,393	-,174	-1,268	,225
	Essential running drills(km)	-,221	,602	,048	-,367	,720
	Combinet jumps obstacle, jumping(km)	-,633	,723	-,167	-,875	,395
	Strenght exercices (hours)	-,196	,973	-,057	,-202	,844
	Running in snow,sand/rough terrain, swampy/grassy	-,252	,130	-,532	-1,936	,077
	Cross –country skiing(km)	3,992E-02	,034	,114	1,171	,264

a.Dependent Variable:Run 2 speed(sloped terrain)(sec/min)

Table 5. Volume of training methods employed in 2005-2006

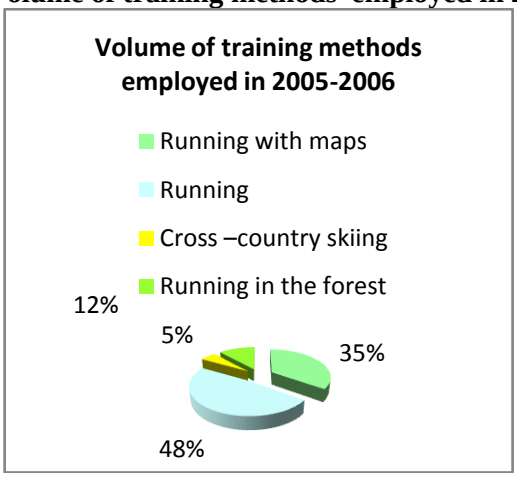
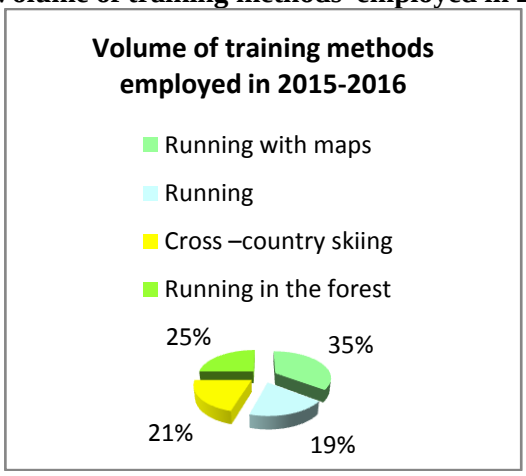


Table 6. Volume of training methods employed in 2015-2016



Testing of Statistical Hypothesis

In this section we will analyze how the average performance of the athletes with good results in summer orienteering compares with average performance of the athletes that increased the volume of training by employing methods specific to ski orienteering. The data was collected during the Trial events organized by the Romanian Orienteering Federation. On the next iteration, in case the answer to the first iteration is affirmative, we will be testing if the athletes with better results employed different training methods than others, which may have caused them to have better results.

For this, we have formulated two working assumptions ((Details on how to build, use and interpret tests of hypotheses can be found in Andrei: 2002):

H_0: $\beta = m$

H_1: $\beta \neq m$

Where

β is the average performance of the athletes with the best results

m is the average value of the performance in the comparison group (This is the group of National Team members, which participated in International Ski-Orienteering)

Conclusion. This paper shows that athletes who used in moderation training methods specific to ski orienteering achieved significantly better performance in running events when compared with athletes who have increased drastically the volume of training specific to cross-country skiing. In other words, increasing the training distance on cross-country skis decreases the performance during the nest season's summer orienteering events. It would be interesting to include in the data set the results of the ski orienteering athletes who decrease the amount of running during the summer months and replace it with roller ski training. We consider this analysis very useful for the athletes who are tempted to increase the amount of time spent on skis during the winter with the desire to get better classifications in the National ski-orienteering events, but they have to be aware there is a definite risk that the performance in the upcoming summer orienteering season will decrease.

References

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[3] Minoiu, V., *Optimizarea pregătirii fizice în disciplina orientare sportivă prin raționalizarea şi standardizarea mijloacelor*, PhD Thesis, pp 150-183, 2011