

## Factors Determining the Sports Result of Sprint Skiers I Category in the View of Their Organism Bioenergetic Types

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**Abstract:** In this paper we present the results of factor analysis when setting the leading indices that determine the sports result of sprint skiers I category in view of their organism bio-energetic types. The starting material for this analysis was the results of general and special physical fitness, reserve and functional possibilities of the organism, as well as the results of a psycho diagnosis.

**Key words:** Factorial weight • Anaerobic type • Mixed type • Aerobic type • Racing skiers

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### INTRODUCTION

One of the main prerequisites for the effective sports training management is the establishment of leading factors [1], pointing the greatest influence on the athlete's result. The issue of determining the leading factors especially acute stands in ski racing. Thus, the performance result of racing skier depends on many reasons related to the development of physical characteristics, functional indices, as well as the neuromuscular system state [2]. However, with occurrence in the cross-country ski racings of sprint distances an even greater interest among specialists cause a genetic predisposition of athletes [3]. Hence, the cumulative study at racing skiers the general and special physical fitness, functional and psycho physiological indices by the bio-energetic types will show the leading factors that have the greatest influence on the sports result depending on their genetic predisposition, which will contribute to a more efficient training process building [4].

### MATERIALS AND METHODS

For the study we used the indices of OPC (overall physical condition), SPC (special physical condition), the psycho physiological indices, as well the functional and reserve capabilities of the organism, to determine it we used the computer software of instant diagnosis "D&K – TEST". The study involved 18 young racing skiers I category.

At the OPC the following tests were used: 100m running, 1000m running, standing long jump; standing 10 times jump; arms flexion/extension on the crossbar in suspension; arms flexion/extension in emphasis lying.

At the SPC the following tests were used: 100m cross country skiing by alternate step; 100m by skate skiing without poling; 100m by double poling with kick; 100m by «V2» one-step skate skiing; 100m by alternate two-step classic step; 500m cross country skiing by skate skiing.

At the psycho-diagnostic study of racing skiers a portable device for the athletes' psycho-diagnostic was used. Using this device the following tests were determined:

- "Tapping test" – the number of beats was fixed in a square 2.5 x 2.5 cm by the probe in the form of a needle valve knob at a maximum tempo in 30 seconds. By "Tapping test" we determined the lability or the excitement state and the neuromuscular system response.
- "Snake" test – the test subject traced the probe on the 3mm width and about 60cm long snake, without touching the boards. We have recorded the time and number of touches, to reveal the touches accuracy and speed. According to the "Snake" test we determined the dynamic tremor that connected with the properties of attention, visual acuity, etc.
- "Tremor" test – the test subject held the probe in the hole width of 3mm for 30sec, at that moment we fixed a number of touches. According to the "Tremor" test we determined the static tremor. It is characterized by

the rapid, rhythmic, motions of limbs or body arising from the alternating contraction of muscles- agonists and antagonist muscles and associated with a time delay of correction afferent impulses.

- "Step-laps" test consisted of 4 laps: two large circumferences of diameter 11cm at a distance of 20mm from each other and slightly below two circumferences of diameter 10mm at a distance of 8 cm from each other. Initially, the rapid touches on two large laps by the probe were made alternately, then the same thing were made on two small laps and finally on all four laps crossly and we have fixed a number of touches-and-errors for 30 seconds. According to the "Step-laps" we determined a complex neuromuscular coordination, as well as the level of the nervous system mobility, that is, the speed of the hand movements' execution [5].
- "Traffic light" test – this test consisted of two buttons, left and right and three flashing red lights. To the stop of left light bulbs the test subject reacted on the button with his left hand, the right light bulb - with his right hand and the average light bulb - simultaneously with both hands. In this test we have measured the complex visual-motor reaction in msec.

To determine the functional and reserve possibilities of the organism we used the computer software of instant diagnosis (by the method of S.A. Dushanin and V.P. Karlenko). The complex program "D & K - TEST" works on the principle of the electrocardiogram registration in standard (I, II, III, aVR, aVL, aVF) leads and the chest (V3R, dV3R, V1, V2, dV2, V4, V5, V6, dV6) leads by Wilson [6]. Using this apparatus we determined such indices:

- ANAMC – the anaerobic power supply resource capacity for the muscle activity. It determines the ability to perform the amount of physical exertion in 3-5 intensity zones [7].
- AMC – an aerobic source of energy supply capacity of muscle activity. It determines the ability to perform the amount of physical exertion within 1-2 and partially in 3 in intensity zones.

GMC – general metabolic capacity. It characterizes the level of the organism efficiency and ability to perform the planned volume [8].

- CCP – creatine phosphate power supply resource capacity of muscle activity. It determines the alactic component of speed capabilities, the strength endurance level and the explosive strength.

- CGPS – the capacity of glycolytic power supply resource of muscle activity. It determines the lactate component of speed capabilities, i.e. the speed endurance [9].
- CAPSR – aerobic power supply resource capacity of muscle activity (maximal oxygen consumption). It determines the quality of their physical load up to the threshold level of anaerobic metabolism.
- WTANM – threshold of anaerobic metabolism. It determines the efficiency of use the aerobic muscle activity providing source.
- PANO HEART RATE – a criterion of efficient use the aerobic energy supply source of muscle activity (pulse of PANO) [10].

The test results of ANAMC and AMC allowed us to determine in the percentage the presence at the athletes of 5 bioenergetic groups. The skiers from the 1st and 2nd bioenergetic groups were ranged in the aerobic type, since the data of athletes for ANAMC was from 1 to 18.9% and for AMC from 81.1 to 100%, which points to their genetic predisposition to the long-distance races. The skiers from the 4<sup>th</sup> and 5<sup>th</sup> bioenergetic groups were ranged in the anaerobic type, since such athletes have the ANAMC from 29% and above and their AMC indices are from 1 to 71%, which characterizes their predisposition to the sprint distances. The skiers of 3rd group, whose indices for ANAMC is from 19 to 28.9% and for AMC is from 71.1 to 81%, were ranged into the mixed type, which determines their predisposition to the mixed distances. After the study, using the instant diagnosis for all studied in the amount of 18 people, we divided them into their respective bioenergetic types. The group of racing skiers of anaerobic type includes 7 persons, mixed type - 6 persons, aerobic type - 5 persons.

By the received results, we carried out the factor analysis, using the closed model of principal components method. The rotation of reference axes was performed using the Varimax-criterion.

## DISCUSSION

According to the factor analysis, in the group of anaerobic racing skiers the following results were obtained.

1<sup>st</sup> factor (45,3% of the total sampling variance) has the high factor weights with the following indices: the standing 10 times jump test; 100m cross country skiing by classic alternate two-step skiing; standing long jump; CGPS; 100m cross country skiing with double poling; 100m running; 100m cross country skiing by alternate step; CCP; number of touches in the "Snake" test; arms

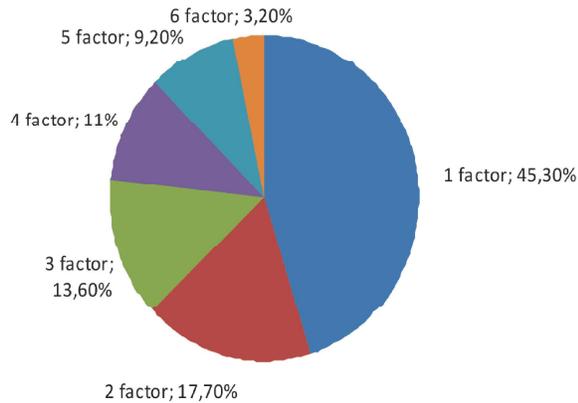


Fig. 1: Indices of factor analysis of the total sampling variance at the anaerobic racing skiers

flexion/extension on the crossbar in suspension; WPano; 100m cross country skiing by «V2» one-step skate skiing. Based on the results, this factor points to the special speed-strength endurance.

2<sup>nd</sup> factor (17,7% of the total sampling variance) has the greatest factor weight with the indices of ANAMC; GMC; 500m cross country skiing; 1000m running; "traffic light" test showed the difficult visual-motor reaction to the right hand. This factor reflects the special high-speed capacity.

3<sup>rd</sup> factor (13,6% of the total sampling variance) the high weights are shown with the PANO HR; CAPSR; arms flexion/extension in the emphasis lying; AMC; "tremor" test. This factor determines the rotator cuff capacity in the aerobic mode.

4<sup>th</sup> factor (11% of the total sampling) has the high weights with the cross "Step-laps" test by number of touches; the cross "Step-laps" test by number of made mistakes; small "Step-laps" test by number of touches; big "Step-laps" test by number of touches and the "Tapping test". This factor points to the rapidity of motor coordination of the neuromuscular apparatus.

5<sup>th</sup> factor (9,2% of the total sampling) is highly correlated with indices of the "traffic light" test, the complex visual-motor response of both hands at the same time; "traffic light" test - difficult visual-motor response of the left hand; "Snake" test – the time of passage; 100m cross country skiing by skate skiing without poling; small "Step-laps" test by number of made mistakes. This factor determines the visual-motor response rapidity.

6<sup>th</sup> factor has a low correlation.

Schematically, the results of the factor analysis in the group of the anaerobic racing skiers are shown in Fig. 1

In the group of mixed racing skiers the results were.

1<sup>st</sup> factor (43,5% of the total sampling variance) has the high factor weights with the indices of 100m cross-country skiing by skate skiing without poling; 100m cross country skiing by alternate step; "tapping-test"; 100m cross country skiing by classic alternate two-step skiing; 1000 m running; "tremor" test; small "Step-laps" test by number of touches; the "traffic light" test - difficult visual-motor response to the left hand; big "Step-laps" test by number of touches. This factor reflects the special speed endurance on the basis of a high level of the nervous system mobility.

2<sup>nd</sup> factor (22,9% of the total sampling variance) has the high factor weights with the indices of AMC; PANO HB; CAPSR; GMC; cross country skiing 100i by "V2" skate skiing; with double poling; the cross "Step-laps" test by number of touches; WPano. This factor is characterized as a special aerobic working capacity in conjunction with the motor coordination.

3<sup>rd</sup> factor (14,5% of the total sampling variance) is highly correlated with indices of the cross "step-laps" test by the number of mistakes; small "Step-laps" test by number of mistakes; big "Step-laps" test by number of mistakes; CCP; standing long jump; arms flexion/extension on the crossbar in suspension; ANAMC; CGPS; the standing 10 times jump; "Snake" test by the time of passage. This factor points to the coordination, speed-power working capacity.

4<sup>th</sup> factor (10,4% of the total sampling variance) the high connection is viewed with the "Traffic light" test, difficult visual-motor response to the right hand; 100m running; "Snake" test – number of touches. This factor characterizes the rapid switching of motor coordination.

5<sup>th</sup> factor (8,7% of the total sampling variance) the high connection is viewed with the Test of arms flexion/extension in the emphasis lying; 500m cross country skiing; the "traffic light" test - difficult visual-motor response to both hands at the same time; 100m cross country skiing by "V2" one-step skate skiing. This factor points to the special speed-strength abilities.

Schematically, the results of the factor analysis in the group of mixed racing skiers are shown in Fig. 2.

The aerobic racing skiers had the following results: 1st factor (37,8% of the total sampling variance) is highly correlated with the "Tremor" test; CAPSR; the standing long jump; PANO HB; WPano; the standing 10 times jump; 1000 m running; arms flexion/extension in the emphasis lying; "traffic light" test by the difficult visual-motor response to the left hand; the "traffic light" test by the difficult visual-motor response to both hands at the same time. This factor reflects the general endurance, together with the speed-strength capabilities.

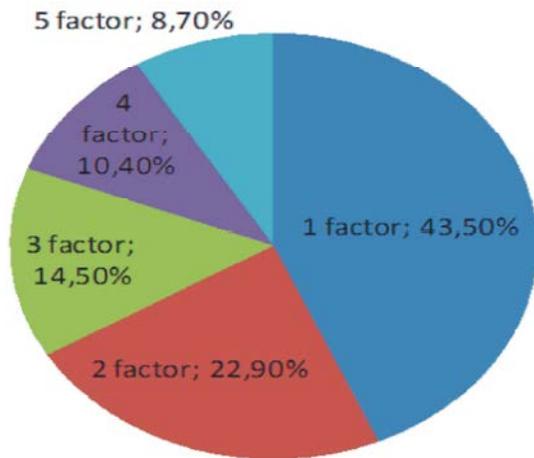


Fig. 2: Indices of factor analysis of the total sampling variance at the mixed type racing skiers

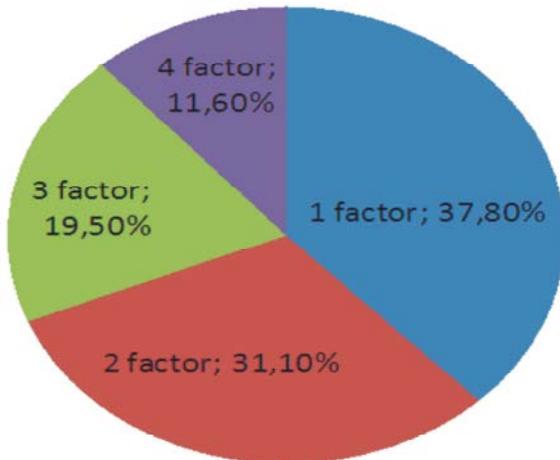


Fig. 3: Factor analysis indices of the total sample variance for the aerobic racing skiers

2<sup>nd</sup> factor (31,1% of the total sampling variance) is highly correlated with the 100m cross-country skiing by skate skiing without poling; the test of arms flexion/extension on the crossbar in suspension; the "Snake" test by the time of passage; the "Snake" test by the number of touches; CGPS; 100 m running; CCP; the cross "Step-laps" test by number of mistakes; 500 m cross country skiing; "traffic light" test by the difficult visual-motor response to the right hand. This factor points to the special speed-strength endurance, together with the rapidity of coordination movements.

3<sup>rd</sup> factor (19,5% of the total sampling variance) is highly correlated with 100m cross country skiing by alternate two-step classic step; the "Tapping-test"; 100m cross country skiing by alternate step; 100m cross country skiing by «V2» one-step skate skiing; GMC;

ANAMC ; AMC; 100m cross country skiing with double poling. This factor reflects the special speed working capacity.

4<sup>th</sup> factor (11,6% of the total sampling variance) is highly correlated with the small "Step-laps" test by number of touches; the small "Step-laps" test by number of mistakes; the big "Step-laps" test by number of touches; the cross "Step-laps" test by number of touches; the big "Step-laps" test by number of mistakes. This factor points to the coordination ability of the neuromuscular system.

The results of factor analysis in the group of aerobic racing skiers are schematically shown in Fig. 3

## CONCLUSIONS

Determination of leading factors, influencing the sport result for the racing skiers with regard to their bioenergetic type will contribute to more successful training process management at various stages of preparation and will also allow to choose the most effective means for the training process.

**Findings:** The general research analysis of bioenergetic sprint skiers showed that the highest factorial weight in the group of anaerobic athletes was identified as a special speed-strength endurance; in the group of sprint skiers of mixed type it was identified as a special speed endurance on the basis of a high level mobility of the nervous system; in the group of aerobic skiers it was named as the overall endurance, together with the speed-strength abilities.

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