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EFFECTS INDUCED BY USING THE SPECIFIC CROSS-COUNTRY SKIING MATERIALS TOWARDS IMPROVING TECHNICAL COMPONENTS IN SKI JUMPING

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Abstract: *The aim of the study is to identify and implement new methods in approaching sports training in ski jumping towards improving technical actions of the athletes in phase I. Practising phase I - the inrun and the takeoff with cross-country has contributed substantially to improving the technical performance of the subjects, which was reflected in the increased length of the jumps. The subjects were four athletes, members of the CSU Brasov jumping ski section, aged 18-20 years. Specific training methods on cross-country skis: adopting the inrun position, alternating the height of the start bar; adopting the inrun position, CM's controlled lifting and lowering during sliding; maintaining a steady inrun position while adopting different upper limbs actions; maintaining a stable position when passing through the transition curves R1 at different angles; adopting and maintaining the inrun position with eyes closed. The study results highlight the positive impact of using this means of sports training on the balance and skill education, on the formation of the sense of proprioception, with a positive motor transfer to the technical performance of the ski jumping execution itself.*

Key words: *cross-country skis, ski jumping, technical components, proprioceptive sense, balance, positive motor transfer.*

1. Introduction

The object of this research results from the fact that, following sports training and competitions, there have been quite large changes in the athletes' technical performance. Although the researchers in the field consider the second phase, respectively the take-off, as the most important phase in ski jumping [1, p. 45], it has been demonstrated that all four phases of the jump are closely interconnected, with positive or negative influences, finding their origins in the first phase of ski jumping.

Specialists should constantly give special attention to the anthropometric changes caused by physical development because of the negative influences induced on the proprioceptive sense of the athletes. The identification and orderly timing of the actions for a good distribution of the

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athlete's CM (centre of mass) during the first phase in ski jumping will create the premise of obtaining a perfect timing at the edge of the hill and, subsequently, an optimal ratio between ballistics and aerodynamics [6, p. 15], creating the conditions for a steady flight and a well-balanced landing. On the subject of the quality of the skier's actions for the correct distribution of the CM, Kagawa also states that this leads to higher sliding speeds [2, p. 129]. Referring to Virmavirta's 2000 study, Muller highlights the existence of significant differences of the pressure on the sole of the foot on the in-run sliding, identifying several causal factors [3, pp. 687-688].

Raschner states that performance improves considerably as skiers have both an advanced sense of balance and a sense of snow, aiming to reduce friction between skis and snow [5, p. 215].

Proprioception provides information through the sensors about joint angle, muscles (length and tension), which is transmitted to the brain on the positioning of body segments in space at any given time [7].

In the matter of proprioceptive sense education, specialists in the field assert that subjects who have experienced executions requiring proprioceptive senses have demonstrated a greater improvement in the actions regarding technical components of a technical process. The benefits of proprioceptive training are highlighted at movement times. The same researchers conclude that additional exercises targeting proprioceptive sense can influence motor learning, noting that brain intelligence uses sensory information to accurately produce motor commands [7].

The same authors recommend the following methods to enhance proprioception: balancing exercises, exercising with eyes closed, plyometric movements and drills [7].

Using cross-country skiing materials, the specific training methods implemented during the research were targeted on the above-mentioned methods, aiming at a positive transfer.

The ability to achieve the motor transfer gives us the possibility to transfer information from an already-learned activity to learning and performing a new one. There are three basic forms of motor transfer:

– "Vertical motor transfer: transfer of experience - information inside the same motor task from a lower to a higher level
– Lateral motor transfer: transfer of experience from one task onto another similar task (example: cross-country skiing – skiing)
– Bilateral motor transfer: transfer of experience from one hand to another or from legs to arms or vice versa" [4, p. 24].

2. The Hypothesis

We consider that by using cross-country skiing materials in the sports training of ski jumpers, with the aim of automating the specific actions of phase I of the ski jumping, the proprioceptive sense of the distribution and maintenance of the CM will be improved, as evidenced in the jumpers' technical performance on the hill.

3. Objectives

The proposed objectives were:

- improvement of phase I movements;
- the technical performance automatism as a result of the correct distribution of the CM for phase I.

4. Materials and Methods

4.1. Subjects

The study was conducted between January 2017 and November 2017 on four athletes, members of the CSU Brasov ski jumping section, aged between 18 and 20 years. The research was carried out at the base of ski jumping hills.

4.2. Used materials

Cross-country skiing equipment, cross-country rollerskis, ski jumping equipment.

4.3. Methods

We used the bibliographic method, the case study method and test method..

4.4. The test method

Test I - Ski jumping on snow - initial test HS 71m - 16.02.2017

Test II - Ski jumping on snow - final test HS 71m - 14.03.2017

Test III - Ski jumping on synthetic grass - initial test HS 71m - 12.09.2017

Test IV - Ski Jumping on synthetic grass - final test HS 71m - 07.11.2017

Full executions were performed on HS71 hills, three jumps for initial testing and three for final testing. The lengths of the jumps have been converted into points according to the FIS regulation, the value of one meter on the HS71 hill being 2.4 points.

4.5. Statistical processing

The data collected during this research was processed and interpreted using Word and Excel.

Examples of exercises used during the research through cross-country skis and rollerskis

1. Adopt and maintain the inrun position on the starting bars with various heights (45, 55, 65 and 75 cm) and in the absence of the starting bar from different positions (low, high);
2. Adopt the inrun position on various surfaces inclined at 10 ° and 25 ° angles from different starting positions;
3. Adopt and maintain the inrun position by lifting or lowering the CM from different starting positions;
4. Adopt and maintain the inrun position with various arm movement in lateral, frontal and dorsal planes;
5. Complete exercises 1, 2 and 3 with eyes closed;
6. Adopt and maintain the inrun position on successive snow piles (20-30 cm).

It was intended to achieve a positive transfer of the technical actions into the individualized technical components of the subjects by implementing these exercises.

5. Results

HS 71m hill, start gate in position 12 – Râșnov (2.4 points/meter)

The subjects 'results - Initial and final tests on HS 71m on snow Table 1

Test/Date	**Test I - 16.02.2017**						**Test II - 14.03.2017**					
Subjects/ Jumps	I		II		III		I		II		III	
	[m]	[p]	[m]	[p]	[m]	[p]	[m]	[p]	[m]	[p]	[m]	[p]
Subject 1	57	43,2	55	38,4	58	45,6	63	57,6	60	50,4	62	55,2
Subject 2	55	38,4	58	45,6	58	45,6	62	55,2	61	52,8	62	55,2
Subject 3	58	45,6	60	50,4	56	40,8	65	62,4	66	64,8	65	62,4
Subject 4	59	48	59	48	57	43,2	64	60	64	60	64	60

Table 2

The subjects 'results - Initial and final tests on HS 71m on synthetic grass

Test/Date	**Test III – 12.09.2017**						**Test IV – 07.11.2017**					
Subjects/ Jumps	I		II		III		I		II		III	
	[m]	[p]	[m]	[p]	[m]	[p]	[m]	[p]	[m]	[p]	[m]	[p]
Subject 1	60	50,4	59	48	61	52,8	64	60	63	57,6	62	55,2
Subject 2	60	50,4	58	45,6	60	50,4	62	55,2	60	50,4	63	57,6
Subject 3	62	55,2	62	55,2	61	52,8	66	64,8	66	64,8	66	64,8
Subject 4	61	52,8	63	57,6	62	55,2	64	60	67	67,2	67	67,2

6. Interpretation of Research Data

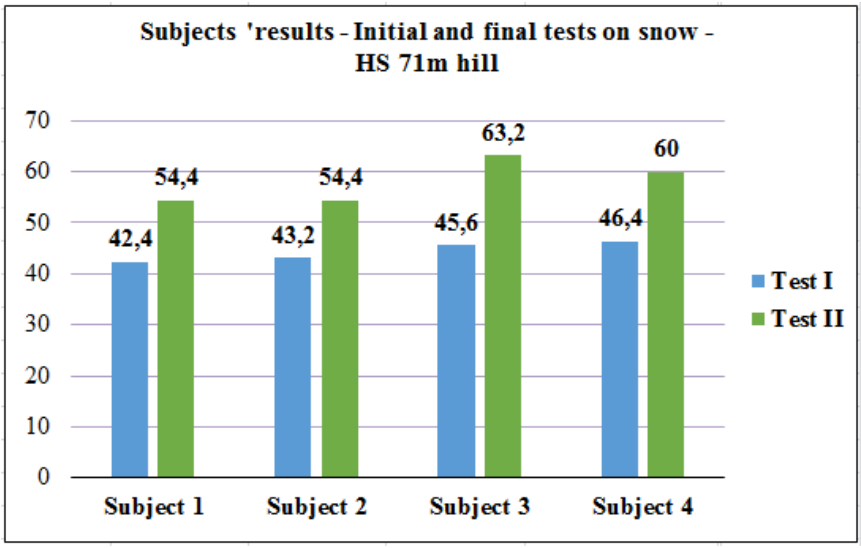

Fig.1. *The average of the points obtained by subjects after initial and final tests on snow*

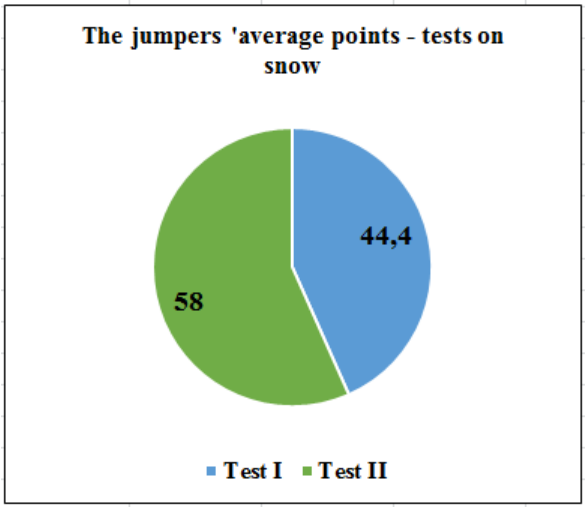

Fig.2. *The total of the four subjects 'averages - tests on snow*

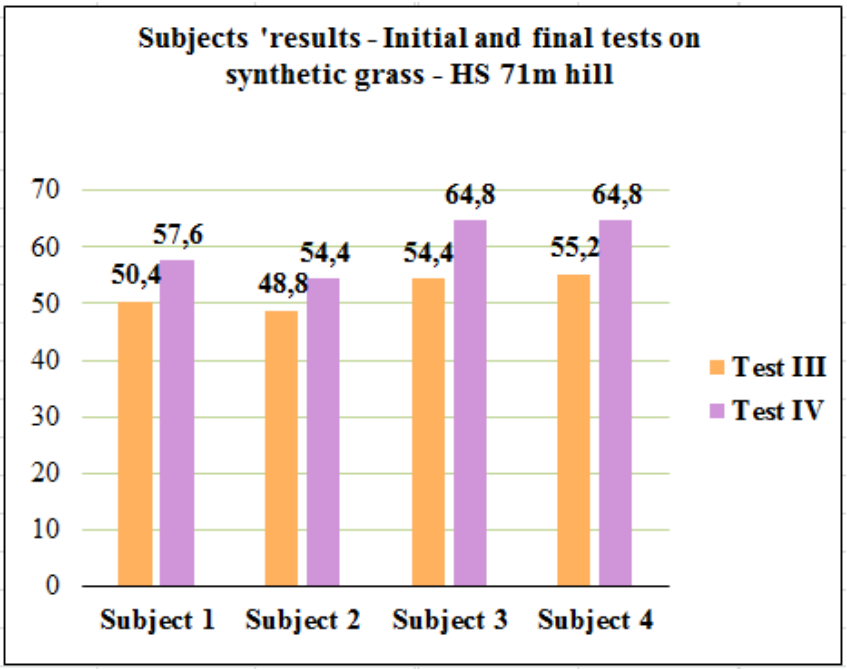

Fig. 3. *The average of the points obtained by subjects after initial and final tests on synthetic grass*

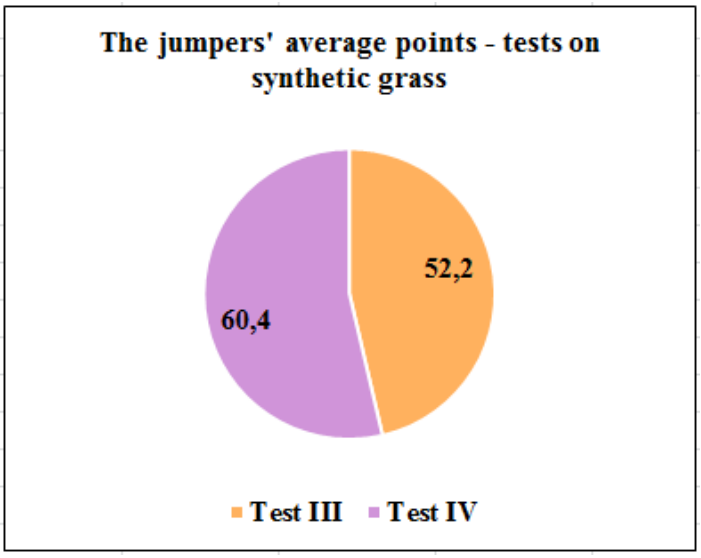

Fig. 4. *The total of the four subjects 'averages - tests on synthetic grass*

7. Discussions

Subject 1 – as a result of the winter tests, the average score increased by 12 points, and in the summer an increase of 7.2 points was recorded.

Subject 2 – following winter tests, an increase of 11.2 points was recorded.

In summer, the average score increased by 5.6 points.

Subject 3 - as a result of the winter tests, an increase of 17.6 points was recorded and the average of the points that were obtained during the summer tests increased by 10.4 points.

Subject 4 - following winter tests, an increase of 13.6 points was recorded. In summer, the average score increased by 9.6 points.

8. Conclusions

1. The quality of the athlete's actions to adopt an effective inrun position with a correct distribution of the CM directly influences the quality of the other phases of the jump, i.e. takeoff, flight, landing and also the quality and length of the ski jumps.
2. This study highlights the positive influence induced by the specific training methods on the direction of improving phase I in ski jumping using cross-country skis and rollerskis.
3. The range of the exercises positively influenced the orderly staging of phase I actions, the individualized adjustment of internal tensions, ensuring proprioceptive sense formation and motion stereotype.
4. The results of the technical training interventions on the jumpers studied in the present research project highlight the substantial increase in the performances of all subjects in terms of the length of the jumps both in summer, on synthetic grass and in winter on snow.
5. The final summer and winter tests show a much improved technical performance of the subjects compared to the initial test, resulting in a great increase in the length of the jumps.

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