Assessment of proprioceptive sensitivity of young ski jumpers

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Abstract

Objective of the study was to evaluate the proprioceptive sensitivity of young ski jumpers.

Methods and structure of the study. The study involved young ski jumpers aged 9 to 11 from Belarus, Slovakia and Russia. The sample consisted of 50 subjects, of which 19 were girls and 31 were boys. The main research methods were the method of pedagogical observation and the method of strain measurement.

Results and conclusions. In the course of pedagogical observation, it was found that the most common mistakes in taking the acceleration stance are caused by uneven distribution of body weight, leading to critical changes in the general center of mass of athletes. Minimization of the asymmetry index when performing a vertical jump on a tensometric platform is one of the indicators of the quality of the functioning of the "posture-voluntary movements" system, as well as proprioceptive sensitivity in young ski jumpers.

Keywords: *ski jumping, tensometry, proprioceptive sensitivity*

Introduction. In ski jumping, the ability to adequately assess the position of the body and its links in space and differentiate efforts becomes decisive for achieving a high sports and technical result. First of all, this is due to the fact that the athlete who is able to measure his actions and control them in constantly changing environmental conditions while maintaining his own balance and correct posture will be able to perform the jump most effectively [1, 3].

The leading contribution to ensuring balance is made by the proprioceptive sensory system, which provides information about the positions and movement of parts and the whole body in space [2, 4].

Proprioception in Russian scientific literature is commonly understood as "... the ability to control and evaluate the relative position and movement of various parts of the body in space, as well as the differentiation of muscle efforts during the performance of motor acts" [2].

In foreign sources, it is interpreted somewhat more broadly: as "... a concept that includes balance and postural control with visual and vestibular input, joint kinesthesia, position sense and muscle reaction time" [5, 6].

Any exercises and special technical means that increase proprioceptive sensitivity will be very useful for ski jumpers, as they contribute to the formation of optimal body control programs during the performance of a competitive action - ski jumping [1, 3].

However, our analysis of the scientific and methodological literature did not reveal special studies on the assessment and development of the proprioceptive sensitivity of young ski jumpers.

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At the first stage of the study, an expert assessment was carried out of the acceptance and retention of the acceleration stance by young ski jumpers.

Each subject was asked to take an acceleration stance and try to maintain it for 10 s. Each subject had

3 attempts, the interval between which was 5 minutes, which was due to the need for his recovery. In the process of pedagogical observation, the experts recorded the errors that occur in young ski jumpers and the frequency of their occurrence.

Results of the study and their discussion. In table 1 presents the results of pedagogical observation. As a result of pedagogical observation, it was found that in the overwhelming majority of cases in young ski jumpers, errors occur due to uneven distribution of body weight, which subsequently leads to changes in the projection of the general center of mass of athletes, causing most other errors according to the "domino" principle.

In order to confirm the data of pedagogical observation, a study was conducted of the subjects on a stationary double strain gauge platform COBS (Germany), equipped with a computer with appropriate software. Each subject was asked, while on the tension platform, to jump up from a place from the main stance and, after resting, jump up from the acceleration stance. Each subject had 3 attempts, the interval between which was 5 minutes, which was due to the need for his recovery.

The use of the strain platform was aimed at obtaining the following data: the height of the jump and its relative power, the strength index and the asymmetry index. The latter was calculated as the ratio of the impulses of the pressure forces exerted by the lower limbs on the plane of the tension platform according to the formula proposed by the specialists of the Tchaikovsky State Physical Education and Sport Academy, and was a quantitative characteristic of motor asymmetry during repulsion [1].

With an absolutely symmetrical repulsion, the asymmetry index is equal to zero; when performing a jump on one limb, the index is 100% [1].

The results of the study on the strain platform are presented in Table 2.

The statistical analysis made it possible to state that the jump height indicators of young ski jumpers from the main stand of all three countries statistically exceed the jump height indicators from the acceleration stand ($p<0.05$), while there are statistically sig-

Table 1. *The results of pedagogical observation of the technique of performance by young ski jumpers of holding the acceleration stance*

Subject of observation	Technical requirements	Error rate, %
Body weight distribution	Evenly on both legs	80
Projection of the total center of mass of the body	Passes through the middle of the foot	70
Torso	Almost parallel to the floor, the shoulders are free, the stomach is slightly pressed against the hip	70
Knees, thighs and shins	Parallel to each other, shoulder width apart	60
Hands	Symmetrically stretched back along the trunk, slightly pressed at the height of the hip joint and freely located parallel to the upper body	50
Back, head	Straight, parallel to the floor, the head «continues» the back («long» back), neck and shoulders are free	40
Shoulder axis	Parallel to the floor	40

Table 2. *Tensometry results of young ski jumpers*

Indicators	Gender	Values of tensometric indicators,					
		Russian Federation		Belarus		Slovakia	
		From the acceleration rack	From the main rack	From the acceleration rack	From the main rack	From the acceleration rack	From the main rack
Vertical jump height, m	b	0,24±0,05	0,34±0,07	0,28±0,02	0,37±0,06	0,27±0,01	0,33±0,01
	g	0,24±0,06	0,32±0,08	0,28±0,03	0,4±0,08	0,25±0,00	0,26±0,05
Strength index	b	1,91±0,13	2,5±0,52	2,15±0,17	2,84±0,11	2,22±0,24	2,62±0,011
	g	1,91±0,14	2,5±0,34	2,1±0,16	2,65±0,13	2,05±0,11	2,6±0,07
Relative jump power, W/kg	b	6,44±2,1	10,47±3,17	8,7±1,7	14,0±3,01	7,6±0,6	11,0±0,034
	g	6,22±1,55	9,84±2,46	8,5±1,42	13,3±3,08	7,1±0,5	9,0±1,21
Asymmetry index, %	b	13,45±6,95	14,93±6,4	10,2±3,13	8,34±6,09	8,56±4,77	13,04±1,39
	g	15,31±7,96	16,9±6,43	9,36±3,16	7,83±3,05	9,77±2,75	12,81±2,03

nificant differences in the jump height indicators from the main stand. there were no stand-ups between athletes from different countries both among boys and girls (p>0.05). As for the jump from the acceleration stance, among boys, the best results were among young athletes from Belarus and Slovakia, and among girls, only girls from Belarus (p<0.05).

When studying the differences in jump values in three attempts (as an expected indicator of the proprioceptive sensitivity of young ski jumpers), the coefficients of variation in the samples of both boys and girls from all three countries fell within the range from 0.23 to 0.25, which indicates a sufficient homogeneity of the results. demonstrated by the subjects.

As for the "Power Index" indicator, the statistical analysis made it possible to state that in young ski jumpers of all three countries from the main stance it statistically exceeds that when jumping from the acceleration stance (p<0.05), while statistically significant there were no differences in the strength index from the main stance between athletes from different countries, both among boys and girls (p>0.05). Among the boys, the higher values of the "Index of Strength" indicator, recorded in the jump from the acceleration stand, turned out to be among young athletes from Belarus and Slovakia (p<0.05), and among girls there were no statistically significant differences in its values (p>0, 05). When studying the differences in the "Power Index" indicator in three attempts (as an estimated indicator of the proprioceptive sensitivity of young ski jumpers), the coefficients of variation in the samples of both boys and girls from all three countries fell within the range from 0.07 (when jumping from the main stance) to 0.13 (when jumping from the acceleration rack), which indicates the absolute homogeneity of the results demonstrated by the subjects in this indicator.

An approximately similar picture was obtained when analyzing such an indicator as "Relative jump power". Similarly, the indicators of the relative jump power of young ski jumpers from the main stance of all three countries statistically exceed the relative power of the jump from the acceleration stance (p<0.05), however, according to this indicator, statistically significant differences were recorded between athletes from different countries with performing a jump from the main stance: higher values were recorded in boys and girls from Belarus (p<0.05).

As for the jump from the acceleration stand, there were no statistically significant differences in the "Relative power of the jump" among the boys (p>0.05), and among the girls, the representatives of Belarus again turned out to be better (p<0.05). When studying the differences in the indicator "Relative jump power" in three attempts (as an estimated indicator of the proprioceptive sensitivity of young ski jumpers), the coefficients of variation in the samples of both boys and girls from all three countries fell within the range from 0.23 to 0.25, which indicates sufficient homogeneity of the results demonstrated by the subjects in this indicator.

The conducted statistical analysis made it possible to state that the indicators of the "Asymmetry Index" in young ski jumpers of all three countries when performing two jumps do not statistically differ (p> 0.05), however, statistically significant differences were recorded in this indicator between athletes from different countries when performing a jump from the main stance: higher values were recorded in boys and girls from Belarus (p<0.05). As for the jump from the acceleration stand, among boys, the best results were among young athletes from Slovakia, and among girls, among representatives of Slovakia and Belarus (p<0.05). It should be noted that when studying the differences in the "Asymmetry Index" in three attempts (as an expected indicator of the proprioceptive sensitivity of young ski jumpers), the highest values of the coefficients of variation in the samples were obtained: the range was from 0.38 (when jumping from the main stance) to 0.52 (when jumping from an acceleration rack), which indicates a high heterogeneity of the results demonstrated by the subjects in this indicator, and therefore it (when striving for a minimum) becomes the most informative when studying proprioceptive sensitivity in young ski jumpers.

Conclusions. The most common mistakes in taking the acceleration stance are caused by uneven distribution of body weight, leading to critical changes in the general center of mass of athletes. Minimization of the asymmetry index when performing a vertical jump on a tensometric platform is one of the indicators of the quality of the functioning of the "posture - voluntary movements" system, as well as proprioceptive sensitivity in young ski jumpers.

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