Current trends in scientific research of sports training in freestyle

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Abstract

Objective of the study was to analysis of current trends in the field of scientific research on freestyle training.

Methods and structure of the study. The research employed a combination of theoretical analysis of literary sources and data categorization. The PubMed and Research Gate databases were utilized to gather and examine scientific material.

Results and conclusions. It has been confirmed that the current research in freestyle acrobatics is centered around the development of innovative systems for monitoring the physical fitness of elite athletes. These systems take into account specific fitness indicators, their relative importance, and a scale of reference values. The use of this model has allowed us to create a model for elite athletes.

Another significant area of research is the use of computer modeling, which has revealed that the main limitation in the twisting technique of acrobats is the increased frontal moment of inertia of the body due to the use of sports equipment.

Sports biomechanics focuses on the analysis of the phase structure of competitive exercise techniques in acrobatics.

The importance of incorporating exercises that target the core stabilizer muscles, which enhance the landing kinetics of freestyle skiers, is emphasized.

The moguls emphasize the significance of developing explosive power among elite moguls.. In certain freestyle disciplines, it is crucial to consider the impact of landing on the muscles of athletes. The findings presented here can be valuable for coaches and professionals in enhancing the training of freestyle skiers.

Keywords: *review, modern trends, sports training, freestyle, acrobatics, mogul, freeski.*

Introduction. Freestyle is one of the youngest Olympic skiing sports, which has been actively developing in the last few decades. However, unfortunately, there has been relatively little fundamental research in most freestyle sports disciplines. Nevertheless, the existing knowledge about the sports training of freestyle skiers requires periodic generalization, systematization and comprehension in order to establish key trends in scientific research in this area, taking into account which allows increasing the effectiveness of the training process [6, 7].

Objective of the study was to identification of modern trends in scientific research into sports training in freestyle based on the analysis of scientific and methodological literature and systematization of the obtained data.

Methods and structure of the study. The work used the method of theoretical analysis of scientific and methodological literature. To study and collect scientific material, the generally accepted Pub Med and Research Gate databases were used. We studied scientific publications on the research topic for the period from 1999 to 2024. The obtained information was systematized. In total, more than 30 publications on freestyle and alpine skiing were studied, 8 of which were used in this article.

Results of the study and discussion. The specialists of Shanghai Sport University Y. Yao, H. Niu [6] developed a system of indicators for monitoring the physical fitness of elite freestyle acrobats. The developed control system is based on the principles of standardization of results and takes into account three key aspects: specific indicators of fitness, their factor weight and the scale of standard values. The use of cluster analysis made it possible to select the most important indicators of physical fitness for elite acrobats, divided into three factor groups: physique, physiological function and physical qualities. It was found that the greatest influence on the sports results of elite athletes in acrobatics is exerted by the factor of physical qualities (the factor weight for men was 0,42, for women – 0,41), in second place in terms of influence was the factor of physiological function (the factor weight for men – 0,33, for women – 0,32), in third place was the factor of physique, the weight of which for men was 0,25, for women – 0,27. The indicators of acrobats' fitness control in the body type factor group were the length of the Achilles tendon, the width of the pelvis, the circumference of the pelvis and the Quetelet index. The hemoglobin level, the relative maximum anaerobic power and the oxygen concentration were assigned to the physiological function factor group. The indicators of the physical qualities factor group were pure strength, the number of squats on a balance beam with a raised barbell, a 30-meter sprint and a 12-minute run. The use of the developed control system made it possible to determine the general and ideal model of physical fitness of Chinese elite acrobats.

The use of this control system allowed these same specialists [7] to determine the champion model of physical fitness for freestyle acrobats in preparation for the Olympic Games in Beijing. It was found that elite acrobats have the following model characteristics in such indicators as: lean body mass (59,2 kg for men, 47,1 kg for women), waist/height 100 (45,26 for men, 44,49 for women), leg length/height 100 (58,64 for men, 58,76 for women), relative MAM (16,48 W/kg for men, 14,45 W/kg for women), relative VO2max (49 ml/min for men, 46 ml/min for women), blood urea (6,03 mmol/l for men, 3,60 mmol/l for women), one-time squat with a barbell (170 kg for men, 135 kg for women), overhead squats on balance beams (9,06 s for men, 9,43 sec women), lateral sword throw (6,39 m men, 6,05 m women), 30-meter sprint (3,98 sec men, 4,70 sec women), 12-minute run (2800 m men, 2740 m women).

M. Eadon from the University of Calgary [8] studied the limits of aerial twisting technique of acrobats in competition conditions using computer modeling during the performance of a triple somersault with five rotations. Various asymmetrical movements of the arms and hips creating rotations during the flight were studied in order to maximize the twisting and to ensure the tuck before landing. It was found that when performing a triple somersault, acrobats can perform four to six rotations (twists). The main limiting factor is the increased frontal moment of inertia of the whole body due to the equipment (outfit and skis), which limits the amount of tilt. Reducing the weight of the equipment may make acrobatic movements easier to perform, but is unlikely to allow one to advance beyond the established limits.

D. Howe, J. Renaud, M. Durand [1] studied the technique of competitive exercise of athletes in acrobatics. It was established that the structure of the competitive exercise in acrobatics consists of six successively performed phases: increasing speed on the descent (acceleration), body control while sliding along the transition section of the ski jump, takeoff, body control while «exiting» the ski jump, performing acrobatic tricks and organizing the landing.

During the acceleration, acrobats pay attention to «skis sliding on the snow», «weather conditions», «the speed with which they arrive in the area before the jump», «how they use the sliding area», «how they climb the ski jump in comparison with the previous jump».

During the transition, acrobats assessed their readiness for the future takeoff by analyzing their stability during sliding. Based on the analysis of the listed conditions, acrobats can change the way they perform an acrobatic trick. In the take-off phase, acrobats focus on achieving the ideal position for take-off from the ramp. At this point, athletes pay great attention to the feeling of transition from a supported glide to an unsupported position in the air.

The next phase includes three key components: body positioning for the initial rotation (the initial part of the acrobatic jump), continuation of the rotation (the central part), and checking the jump (the final part). In the initial and central parts of the jump, athletes focused on «reaching a certain expected moment». These moments were «the end of the rotation» or «the ability to determine your location in flight and during the rotation».

In the final part of the jump, athletes analyzed the deceleration of the rotation speed, controlled the spread of the arms, and examined the landing zone. In the landing phase, acrobats estimated the time until contact with the slope, the probable landing point.

Chinese scientists [5] have found that eight weeks of core stabilizing muscle training improves landing kinetics in freestyle acrobats. During the study, 18 acrobats were divided into two groups: experimental and control, nine people in each. During the experiment, the EG acrobats performed a specially designed training program aimed at developing the core stabilizing muscles. This program was performed by the EG athletes twice a week for eight weeks as a supplement to skills training. The training program consisted of the following exercises: abdominal bridge with opposite support, glute bridge with one leg, side bridge, abdominal and back bridge with Swiss ball, V-pull up, back hyperextension, seated diagonal rows with Swiss ball, seated incline pull-ups with Swiss ball, bent-knee dips with side crunches, torso twists, standing shoulder press, single-leg Swiss ball press with one-armed dumbbell, shoulder press, single-leg squat with Swiss ball, supine hip curl with one leg on foam roller, single-leg handstand with eyes closed, single-leg handstand with side lunge, single-leg box jump. After the end of the experiment, the EG athletes significantly and statistically significantly outperformed the CG acrobats in landing kinetics ($p<0,05$). Scientists from the University of Auckland [2] studied the prospects of complex biomechanical analysis in moguls. The specialists developed a special device to measure the effect of force on moguls skiing technique. This device was installed between the ski boot and the binding. During the study, the following indicators were used to assess the perception of moguls of their performances: safety, stability, speed, edging, cushioning, tilt, and overall performance. For the kinematic analysis of the moguls' movement technique, it was proposed to use the knee tilt angle, the torso and hip tilt to the sides and forward, as well as the trajectory of the body's center of mass. All the assessed parameters showed a tendency to improve from the first to the last performance.

The specialists of the Pacific Sports Institute of Canada conducted an analysis of the jumping results of world-class mogul skiers over the four-year Olympic cycle from 2006 to 2010 [4]. The control tests for explosive power were the squat jump, standing jump, depth jump and jumping off a block. The analysis of the results showed that men and women generally improved their results in explosive power from the first to the fourth year of training. The greatest increase in explosive power was noted between the first and second years of training. The minimal increases in results between the third and fourth years are explained by the use of a block of corrective exercises for the purpose of injury prevention. Explosive power is the most important component in moguls, clearly distinguishing athletes by their level of preparation at the World Cup stages. I. L fqvist and G. Bj rklund conducted a study to measure the force experienced by slopestyle skiers when landing after a long-distance jump [3]. Tensometric insoles were used to assess the force. The results showed that athletes who performed a 180° jump experienced a force of 1446±367 N upon landing, while when performing a 180° switch jump, the landing force was 1409±257 N. Thus, a force twice the body weight can be considered the minimum value for slopestyle skiers.

Conclusions. Thus, the conducted review presents modern trends in scientific research of sports training in freestyle, the results of which can be used by coaches and specialists in the implementation of the training process in such freestyle disciplines as: acrobatics, mogul and slopestyle.

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