Factor structure of the readiness of highly skilled freestyle skiers (mogul)

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Abstract

Objective of the study is to determine the factor structure of elite freestyle skiers' preparedness using the example of the mogul discipline.

Methods and structure of the study. To achieve this goal, the method of factor analysis was used, which was implemented using the IBM SPSS Statistics computer program. The study involved highly qualified freestyle skiers (men), members of the Russian national mogul team (n=36) aged 20-25 years. 9 factors were identified in the structure of the mogulists: special morphology, general morphology, strength, anaerobic abilities, coordination, effectiveness of the cardiovascular system, speed and strength abilities, athletic and technical fitness and technique of downhill skiing.

Results and conclusions. The results of the study revealed that the factorial structure of the training of highly qualified mogulists has a pronounced morphological orientation. The greatest impact on athletic performance is exerted by special and general morphology, including indicators of muscle and fat components, height and body weight. These parameters determine the effectiveness of an athlete's movements on the track and the level of his functional fitness to the extreme conditions of competitive activity. Factors of strength, anaerobic capacity, and coordination also make a significant but less pronounced contribution to performance. The data obtained confirm the need to take into account morphological characteristics when planning a training process aimed at developing optimal ratios of mass, strength and technique in moguls. Thus, the presented factor structure makes it possible to specify the key areas of training for elite freestyle skiers and serves as the basis for improving scientific and methodological support in this sport.

Keywords: *factor structure, athletes of the highest sports skills, freestyle, mogul.*

Introduction. Modern freestyle skiing, and especially its mogul discipline, is one of the most complex and multi-component sports, combining elements of high coordination, strength, endurance, speed, flexibility, and technical skill [2, 3]. The training of mogul skiers is complex in nature, with results determined by the integration of morphological, functional, coordination, speed-strength and technical qualities [5, 7]. In this regard, one of the pressing scientific tasks is to determine the structure of the relationships between the various components of high-level athletes' training and to identify the leading factors that determine the effectiveness of competitive activity.

In the context of ever-increasing competition in the international arena, as well as the increasing technical requirements for performing jumps and completing the course, knowledge about the factors of athletic training and their impact on athletic performance is becoming particularly important [8].

Despite the existence of a number of studies [5, 8] devoted to the physiological and biomechanical aspects of freestyle training, the structure of the relationships between the components of elite athletes' preparedness in mogul skiing remains insufficiently studied. This limits the possibilities for optimising the training process and developing indi-

vidual programmes for the development of key abilities in athletes.

Objective of the study is to determine the factor structure of elite freestyle skiers' preparedness using the example of the mogul discipline.

Methods and structure of the study. Highly skilled freestyle skiers (men), members of the Russian national mogul skiing team (n=36) aged 20-25, participated in the study.

To determine the factor structure of mogul skiers' preparedness, factor analysis was used, implemented using the IBM SPSS Statistics computer program (version 27) (Analysis → Dimension Reduction → Factor Analysis (principal component method, varimax rotation method)). Each preparedness factor consisted of two indicators, the contributions to the variance of which were summed. The final score for the performance was used as the resulting factor (with which the main preparedness factors were compared) in mogul skiing.

To form the factor structure of elite mogul skiers' preparedness, we used the results of stage and ongoing surveys of athletes as part of the Scientific and Methodological Support activities conducted by specialists from a comprehensive scientific group in Tchaikovsky from October 2024 to February 2025.

The results were determined based on morphological indicators using the method developed by T.F. Abramova with the use of special anthropometric equipment. Strength indicators were measured using the leg dynamometry method implemented in the Biodex isokinetic dynamometer. Anaerobic indicators and cardiovascular system characteristics were assessed on a Monark 894E cycle ergometer using the Wingate test and a Cortex MetaLyzer 3BR2 gas analyser according to the maximum test method with a stepwise increasing load. To assess coordination, the Stabilan 01-02 APK and the jump difficulty coefficient taken from competition protocols were used. Speed and strength indicators were determined using jump tests performed on a Muscle Lab speed endocore. All of the above instrumental methods were applied in accordance with the methodological recommendations of the Analytical Department of the Russian National Teams Sports Training Centre.

The results of sports and technical training and downhill skiing technique were recorded based on the data from the Russian Cup stage protocols.

Results of the study and discussion. A study of the structure of mogul skiers' athletic training identified nine key factors.

The first factor identified in the training structure

Table. Factor structure of freestyle skiers' preparedness in the mogul discipline

Factors	Indicators	Contribution of indicator to variance, %	Total contribution of factor to variance, %
Special morphology	Muscle component	13,9	31,6
	Fat component	17,7	
General morphology	Weight	7,4	27,5
	Height	20,1	
Strength	Maximum leg strength	10,7	13,1
	Flexor-to-extensor ratio	2,4	
Anaerobic capacity	Maximum leg muscle power	7,2	8,8
	Anaerobic threshold leg muscle power	1,6	
Coordination	Coordination readiness index	6,5	6,7
	Jump difficulty coefficient	0,2	
Cardiovascular efficiency	Heart stroke volume index	3,9	5,3
	Heart rate at anaerobic threshold	1,4	
Speed and strength	Maximum push-off power in squat jumps	2,1	4,8
	Maximum push-off power in jumps with no hands	2,7	
Sports and technical skills	Total points for speed	0,5	1,7
	Total points for jumps	1,2	
Downhill skiing technique	Rolling time	0	0,4
	Total points for turns	0,4	

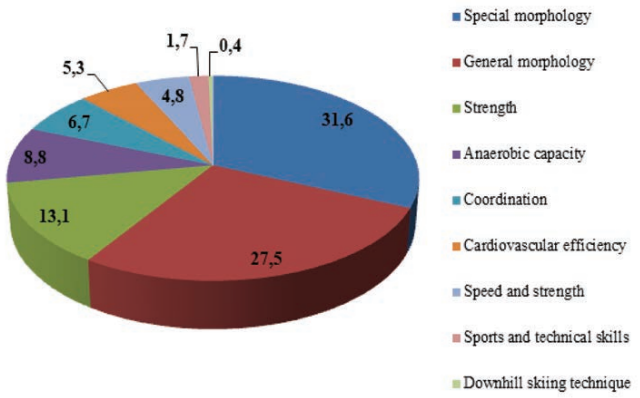

Fig. Factor structure of preparedness of highly qualified mogulists, %

was general morphology, which included athletes' weight and height. The second factor was special morphology, which included indicators of muscle and fat components. The third factor, which assessed strength, included indicators of maximum leg strength and the ratio of flexors to extensors. The fourth factor was speed-strength abilities, with indicators of maximum push-off power in squat jumps and handstand jumps. The fifth factor assessed the athletes' anaerobic capabilities with indicators: maximum leg muscle power and anaerobic threshold power when working with the leg muscles. The sixth factor included indicators characterising the efficiency of the cardiovascular system (stroke volume index, heart rate at the anaerobic threshold). The seventh factor was coordination with indicators: coordination readiness index and jump difficulty coefficient. The eighth factor is downhill skiing technique, with indicators of skiing time and total points for turns. The last, ninth factor is athletic and technical preparedness, characterised by the total points for speed and jumps.

The table and figure show the results of a study of the factor structure of elite mogul skiers' preparedness. It was found that the factor with the greatest influence on athletic performance was special morphology (31.6%). General morphology had a slightly smaller impact – 27.5%. It should be noted that among the indicators of general morphology, height had the most pronounced effect (20.1%). Next in the hierarchy of fitness were the factors of strength and anaerobic capacity, with contributions to the variance of 13.1% and 8.8%, respectively. The influence of the coordination factor was even smaller, at only 6.7%. The cardiovascular system efficiency factor had an impact of 5.3%, and the speed-strength factor had an impact of 4.8%. The factors with the least influence on sporting results in mogul skiing were sporting and technical preparedness (1.7%) and downhill skiing technique (0.4%).

When analysing the results, it should be noted that the factors with the least influence on athletic performance were athletic and technical training and downhill skiing technique, which scientists [1, 4] in previous studies on other sports identified as key factors. This contradiction can possibly be explained by the fact that the factor analysis method allows us to identify hidden causes affecting the observed variables, which may include the range of variation in each of the variables in a specific sample of athletes [6].

In our case, the difference in the results of athletic and technical training and downhill skiing technique was significantly less than in the results of morphology. At the same time, the final score for a competitive performance in mogul skiing is calculated as follows: 60% of the final score is for turning technique, 20% is for the quality and amplitude of jumps from the jumps, and 20% is for speed of movement down the slope. This multicomponent nature of the final assessment in determining the final score could also have influenced our results.

It should also be noted that the contribution of factors to the variance may change if a smaller (or larger) number of factors are used, which may also have a different composition of indicators. Thus, our results should only be studied taking into account the composition of factors we have identified. However, we note that the data obtained indicate that athletes with higher muscle component indicators, height and lower fat component and weight values have an advantage on the mogul course compared to other competitors. In addition, this established fact requires further research, for example, conducting a similar experiment with highly skilled female mogul skiers.

Conclusions. Thus, the results of this study allow us to conclude that the key factors in the preparedness of highly skilled mogul skiers are specialised and general morphology. The results obtained should be taken into account when planning and implementing pedagogical interventions in mogul skiing.

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