Prospects for use of strength exercises under unstable work posture as a method of increasing strength abilities in highly qualified biathlonists

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Abstract

Objective of the study was to reveal, on the basis of a theoretical analysis, training effects when using strength exercises in an unstable working posture and to evaluate the prospects for their use as a method of increasing the specific strength of highly qualified biathletes.

Methods and structure of the study. To solve the problems of the study, a systematic review and analysis of foreign scientific and methodological literature on the problems of strength training was carried out.

Results and conclusions. The obtained results of scientific work made it possible to single out as the most significant effects of neuromuscular adaptation when performing strength exercises in an unstable working posture, first of all, improvement of the reciprocal innervation of agonist-antagonists and synchronization of the activity of agonists, synergists and stabilizer muscles. In this regard, strength exercises performed under conditions of an unstable support or with weights that create a multidirectional instability of the movement trajectory can be considered as a promising methodological solution to the problem of increasing the strength abilities of highly qualified biathletes.

Keywords: *strength exercises, unstable support, electromyography, biathlon.*

Introduction. The technique of skating skiing used in modern biathlon makes high demands on the ability to maintain a stable position of the common center of body mass in the repulsion and sliding phases [2, 3, 6, 8]. Increased requirements for maintaining balance in skating are due to the fact that the athlete is forced to exert considerable effort with a small area of support and in conditions of constantly acting disturbing external forces. In addition, the simultaneous one-step move, which is dominant among biathletes, places high demands on the speed-strength abilities of the lower, and especially the upper limbs [1].

Thus, the effective performance of the skating movement involves the ability of a biathlete to demonstrate high power of working efforts with a small area of support, in conditions of continuous opposition to reactive and inertial forces that cause the body to deviate from a biomechanically expedient position [16].

Strength training of highly qualified athletes in modern biathlon provides for the implementation of various exercises in the mode of maximum and explosive strength, which contributes to increasing the power of motor efforts in competitive movement. At the same time, most strength exercises are performed in the position of relative stability of the working posture [5]. However, as mentioned above, skating is performed by biathletes under conditions of an unstable support, under the action of various disturbing forces. In this case, the efficiency of transformation of the speed-strength capabilities of the skeletal muscles can be limited by the nervous system, for which the stability of the working posture is more important than the movement itself [4].

The above determines the relevance of studying the problem of improving the strength and speed-strength abilities of athletes in an unstable work-

ing posture provided by an unstable support (BOSU destabilizing devices, fitball, hanging loops, T-Bow platform, etc.) or resistance that creates an unpredictable trajectory of movement (destabilizing bar Earthbreak, aquabag, bar with weights suspended on elastic bands, etc.), and the possibility of "transferring" the achieved power effects to more biomechanically specific movements.

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Methods and structure of the study. To solve the problems of the study, a systematic review and analysis of foreign scientific and methodological literature on the problems of strength training was carried out.

A computerized systematic search for relevant articles published from January 2002 to March 2022 was carried out using the PubMed, Scopus, ResearchGate and Web of Science electronic databases using the keywords: resistance training, instability training, unstable surface, unstable load, core stability, core strength, electromyography, muscle activity.

In addition, relevant articles were extracted from the references. The criteria for inclusion of articles in the number of analyzed were: the presence of EMG data on the level of muscle activation during strength exercises; use as destabilizing devices and surfaces of BOSU, fitball, hanging loops, T-Bow and WobbleBoard platforms, Dyna Disc balancing disk; conducting strength exercises and training in an unstable working posture in the form of controlled trials for healthy, adult, physically active people (including athletes).

Previous systematic reviews using similar inclusion criteria were also analyzed. The included articles had to be published in English in peer-reviewed journals. As a result, out of 327 articles initially selected, 89 studies met the inclusion criteria and were used for analysis.

Results of the study and their discussion. ***Improving the functional reliability of the joints under the influence of exercises in conditions of instability.*** Based on EMG studies, an increase in sensorimotor control over the dynamic stability of joints and an increase in the efficiency of reflex reactions of muscles performing postural or stabilizing functions were found [9, 13].

Influence of the instability factor on the mechanisms of neuronal control of muscle efforts. It is assumed that the performance of strength exercises in an unstable working posture strengthens neuronal synaptic connections in the cerebral cortex, thereby increasing the cortical representation of the muscles involved in the work. As a result, there is an increase in the influence of the supraspinal centers of the CNS on – motor neurons and an increase in the ability of muscles to produce force [15].

The influence of the degree of instability and motor experience of an athlete on the manifestation of the power of efforts in an unstable position. The results of experimental studies indicate that, depending on the amount of resistance and the degree of instability, the manifestation of maximum power can be reduced by up to 30% compared with exercises performed on stable surfaces [16]. In addition, the lower the level of strength training of an athlete and the less motor experience of working on unstable supports, the higher the deficit of strength in an unstable position [10, 14].

Urgent and delayed adaptive effects of training programs using the instability factor. It has been established that within the framework of urgent adaptation, a change in neuromuscular coordination is observed in the direction of strengthening the coactivation of antagonist muscles and reducing the activity of agonists. At the same time, in terms of a delayed effect, training in an unstable environment improves the reciprocal innervation of antagonistic muscles, creating favorable conditions for increasing angular velocity.

In addition, targeted training on unstable surfaces increases "core stability", i.e. the ability of the complex of the lumbo-hip muscles to control the position and movement of the lower body and maintain, within physiological limits, the stability and structural integrity of the spinal column under external influences, which in turn improves the production of force and its transmission between the links of the upper and lower extremities [10, 11] .

Features of the "transfer" of training effects from strength exercises performed in conditions of an unstable working posture to other types of movements. The results of a number of studies [17, 18] indicate the absence of a "direct" transfer of the effect of resistance training under unstable conditions to power output under stable conditions. At the same time, the main factors limiting the manifestation of the achieved strength effects are the biomechanical similarity of exercises and the similarity of the muscle work mode.

Features of the periodization of strength ex-

ercises performed in stable and unstable conditions within the preparatory period. The results of a number of studies indicate the possibility of using two options for periodization of strength exercises. The first option provides for the consistent use of strength exercises in unstable, and then, in stable performance conditions [7]. The second option involves the parallel use of strength exercises during the preparatory period [12]. At the same time, it is indicated that the second variant of periodization is more suitable for sports with a variable structure of motor actions.

Conclusions. It can be assumed that for highly qualified biathletes it is advisable to use strength exercises in an unstable working position from the standpoint of preventing injuries of the musculoskeletal system by increasing sensorimotor control over the position of the joints and stability of the core muscles.

Strength exercises in an unstable working posture provided by an unstable support or resistance that creates an unpredictable trajectory of movement can be considered as a means of enhancing the effect of traditional biathletes' strength exercises in relation to explosive strength by enhancing the role of the cerebral cortex in MU activation, reducing the coactivation of antagonists and synchronization of the activity of synergist and stabilizer muscles.

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