

# Innovative system of exercises for development of cadets' coordination abilities

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## ABSTRACT

The development of coordination abilities of cadets is the most complex and important task of the entire system of mass sports activities in the theory and practice of physical culture. Currently, mass sports and recreational activities are becoming not only one of the key areas of formation and development of coordination abilities in the independent work of each cadet, public cadet self-government, but also an effective power of persuasion in the need to improve the physical training of both cadets and teachers for professional activities. The new millennium raises innovative challenges to all generations. This includes improving the quality of life, strengthening health, leading an active lifestyle, and preserving peace on earth. One of the pressing tasks of the future development of the social state is to improve the quality of life, improve the health of the nation and the demographic situation. Currently, there are acute issues of public health, especially among young people. Demographic problems are no less urgent, than migrants from abroad seeking to settle on the territory of the most developed countries. Thus, demographic issues are still to be solved, while physical training and sports should work towards improving the health of young people. The authors of this article have tried to investigate the features of dynamic increase of physical motor activity of cadets in recent decades. This study helped to receive such results of motor behaviour of cadets, which for many years predetermined a genuine interest in active physical training and sports. Cadets showed a particular interest after their independent model of self-development during training at the military institute. A crucial role in changing this situation is played by the activation of cadet independence and creative approach to the development of coordination abilities and physical qualities during study at the institute, to increase the motor activity of cadets, the desire for a healthy lifestyle, systematic physical culture and sports. This is due to the greater independence in matters of self-development and training for future professional activities.

**Keywords:** Health; Coordination; Balance; Cadets; Physical training; Sports.

### Cite this article as:

Annenkova, S.V., Panachev, V.D., Opletin, A.A., Zelenin, L.A., Smirnov, A.A., Legotkin, A.N., Kusykova, R.F., & Ponomarev, N.L. (2021). Innovative system of exercises for development of cadets' coordination abilities. *Journal of Human Sport and Exercise*, 16(4proc), S1842-S1856. <https://doi.org/10.14198/jhse.2021.16.Proc4.31>

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Abstract submitted to: Spring Conferences of Sports Science. [Costa Blanca Sports Science Events](#), 21-22 June 2021. Alicante, Spain.

JOURNAL OF HUMAN SPORT & EXERCISE ISSN 1988-5202.

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doi:10.14198/jhse.2021.16.Proc4.31

## INTRODUCTION

The important fact that was taken into consideration for this study is that in the new millennium, student life itself has changed significantly compared to that of previous generations of students. Now modern students have more time to improve the effectiveness and quality of their self-studies in science and sports, since there is no urgent need to take care of food and accommodation. These problems are taken over by the institute itself and cadet self-government, which is common practice in all the best higher military institutions in the world. Cadet life is very diverse and rich. After the end of lectures, practical classes and seminars, each cadet has free time, which must be effectively used to improve intellectual and physical abilities (Vilensky & Pots, 2014).

The department of physical training and sports, together with the Sports Committee, performs a large amount of mass sports and recreational activities in fourteen sports in the educational institution. Moreover, the department conducts extensive research work together with cadets of all faculties. Thus, during 2018-2019, the attitude of cadets to a healthy lifestyle, physical training and sports was monitored using a special questionnaire. The questionnaire was developed for both cadets and teachers. This sociological study included two parts – interviews and responses to questionnaire questions – and interviewed 1,680 cadets from various military institutes.

The results of the study showed that the majority (98 %) of cadets were engaged or are currently engaged in sports in their leisure time (98 % of male cadets and 92 % of female cadets). A positive attitude to active physical training and sports reported 96 % of respondents (98 % of male cadets and 95 % of female cadets). More than a third (35 %) would like to do swimming (27 % of male cadets and 48 % of female cadets). The popularity of swimming is explained by the increased interest of the majority of cadets in this sport, since the region has many rivers, lakes and ponds, and in the Perm region – the region of thousands of rivers and lakes – there are very few pools, especially in educational institutions. The popularity of sports such as shooting, sports games, and hand-to-hand combat is very high. After finishing secondary school, young people usually stop doing active sports due to the lack of spare time in order to successfully study in the higher educational institution. Only 26 % of respondents (28 % of male cadets and 25 % of female cadets) continue to practice their favourite sports in order to achieve maximum results in international, local and city-level competitions. Now, improve their health, cadets are engaged in physical training and additionally attend classes in health-promoting groups, especially those cadets who need to restore their health status after injuries.

According to the study, negative attitude to drugs reported 99 % of respondents, and to smoking – 93 %. Occasionally, 18 % of cadets drink alcohol. Probably, it is necessary at this age to strengthen a positive attitude to physical training and sports and healthy lifestyle in higher education institutions. During this comprehensive study, based on the results of respondents' responses and their analysis, it was found that the majority of cadets 56 % (59 % of male and 51 % of female) positively assess the quality of classes of physical education. They are generally satisfied with the form of conducting classes, content and methodology based on the modern requirements for them at the institute. The financial situation of cadets depends almost entirely on parents and relatives – 97 %.

The majority of cadets associate their future professional activity after graduation with a very high-paid job – 65 %. Only 6 % (7 % and 4 %, respectively) of respondents would like to be trainers and continue playing sports professionally. In the future, after graduation, most cadets consider for their profession other indicators: high earnings, pleasure from work, the ability to travel, high prestige and status, the ability to visit

other regions – 45 %. Sociological analysis has shown that students lead mainly a healthy lifestyle, are fond of various sports, try to improve their health through these activities in order to live without medication, have enough time for rest and use their leisure time rationally.

The department of physical training and sports performed a comprehensive sociological study during 2018-2019. Analysis of the results of this study shows that more than 90 % of cadets of all faculties are engaged in the main group of physical training and sports. The rest of the cadets have temporary health restrictions and are engaged in a special medical group. According to a sociological study, cadets were actively engaged in various sports before entering the institute; 85 % now also would like to do sports in modern sports facilities; 35 % - hand-to-hand combat, shooting, sports games. To increase the motivation of cadets to regular physical training and sports, the department of physical training and sports has developed a pedagogical methodological complex for the discipline 'Physical culture'. There was developed a modern educational program for all medical groups, which provides an individual program for each group of diseases, taking into account the health of students. Special tests on special physical fitness for each group of diseases have been developed. They allow developing the right recommendations for cadets in correcting their functional state, developing professionally important qualities during the educational process and independent sports activities to form a healthy lifestyle.

These measures allowed to increase the motivation of cadets to regular physical training, mass sports, which is objectively confirmed by the data of sociological research. Based on the data of annual medical examinations, research and analysis of the personal development factor of the cadet's personality associated with psychological stability, we put into the foundation for their professional competencies and motor skills modern methods of improving their physical fitness and motor activity for future professional life, which leads to the process of modern competence-based education and health improvement throughout the life. Exercises are focused on balance development; the obstacle course affect the vestibular apparatus. Coordination exercises were used to improve the neuromuscular system, develop mobility in the joints, endurance and dexterity, accuracy of movements, which is manifested in their rhythmicity. An important factor in the development of the balance system is the psychological and emotional state, which have a great impact on the state of the nervous system.

## MATERIALS AND METHODS

The designed system of stimulated balance development and a complex of original exerciser are used in the classes. Initial training provides for systematic classes for the formation of balance, as well as the participation of a trainer who forms the volitional, moral foundations of the individual, without which the process of achieving high results is impossible. A systematic approach with the use of exercisers and balance-related exercises provide the necessary orientation of processes (mental, physiological, biological, biomechanical, biochemical, etc.), while significantly strengthening the structural and functional components of balance. Exercises performed with a more rational amplitude to maintain balance on exercisers cause a boost of precision processes in the body, representing an integral pedagogical process.

The system-forming factor plays an important role in a systematic approach. Therefore, the system of development with the use of exercisers is of high value. Scientific-methodical and research literature, rich practical experience of teaching at our institute, as well as scientific research, have allowed us to create an improved model of the stage development of balance using exercisers. In accordance with this scheme, the trainer and the cadet are socially interconnected and influence each other during the training. The teacher, thanks to the accumulated knowledge, plans technical training. Before teaching the basic elements of the

technique, the trainer performs a perspective-predictive activity that transmits knowledge to the student. The rules of competitions, trends and prospects of development of the studied sport and patterns of growth in the movement complexity are studied. The cadet learns the necessary reference points of the technique relying on the trainers' knowledge. As a result, a novice athlete gains priority of motor and coordination knowledge (Bondin, 2014; Zhitnickaya, Berkowitz et al., 2014; Aghajanian, 2014; Iseman, 2014; Kazin & Kasatkin, 2014; Aleshina, 2014; Bezryhih, 2014; Vasilyeva, 2014; Malyarenko, 2014; Apanasenko, 2014; Valiulina, 2014; Ovchinnikov, 2014; Salov, 2014; Aronson, 2013).

In the system of balance development and training on technique, the formation of an imaginative representation of movement is determined by the sensory-perceptual reflection of objective reality and is not only a link in the chain of cognitive processes, but also a regulator of substantive actions that ensure the adequacy of the subject, means and conditions of implementation. The sensory-perceptual organization that unites the sense organs into a single integral system, in which the visual analyser is the leading one and provides orientation in space, participates in the development of personality (Zelenin, 2014a). The studied technique activates the formation of an imaginative representation of a movement and includes the understanding of the material, improves the following thought processes: comparison – contrasting, analysis and synthesis, abstraction, generalization and concretization, transition from the particular to the general and vice versa. The main method of forming subjective components is the ideomotor training, i.e. the mental representation of a movement by a person who did not perform it previously. Objective components form a motor image, which is mastered by the simplest technical elements of movements that carry information about the target technique. Such simple actions are 'leading up' exercises, which are a set of necessary and sufficient manifestations that guarantee getting an idea of the movement technique being learned. The designed balance development system trains the working positions of the body and is a means of forming a variety of balances. The system of balance development and training on technique is adapted to the capabilities of novice cadets. Trained working postures develop a variety of balances, allow cadets to make a real transition from the idea to the implementation and lay a reliable motor foundation for the subsequent development of movements with coordination novelty (Zelenin, 2014a).

Having mastered the simplest elements of movement techniques, the novice athlete performs semantic scheming, moving from the 'object model' (i.e., the technique itself) to the 'project model' (as s/he imagines the technique). The formation of visual and sensory representation of the image of the simplest elements of the studied movement technique involving the balance is significantly improved if students carry out the main control movements. The athlete, who regulates the working position and the correctness of the movement technique, better understands how s/he has mastered the technique program for its subsequent implementation. Having previously received clear sensory image of the technique and the features of maintaining the balance, and being guided by them, a novice athlete in the process of initial testing of balance exercises learns the studied motor actions at the stage of skill formation much faster and more efficiently. Learning new motor-coordination exercises for balance contributes to the effective formation of new motor images. The system of balance development and training on technique consists of the following components: planning of technical training; priority of knowledge; formation of a figurative representation of a movement; subjective components, objective components, modal composition; testing of balance exercises. These components are interrelated and mutually dependent, complement and interpenetrate each other, and the studied aspects are sometimes impossible to separate in practice, which indicates their natural consistency (Zelenin, 2014a).

According to the law of compatibility, the components listed above are coordinated and complemented by the functioning of heterogeneous and dissimilar movement structures. Various technical elements strictly

perform the corresponding operations and functions. Testing of balance exercises is carried out at the stage of initial study, at which the exercises are learned to the level of motor skill. The use of directed exercises of the balance development system makes it possible to isolate new separate phases of mastered or improved movements, as well as their combinations. Repeated reproduction of balance retention and controlled variability of certain elements of motor movements provides fast and firm acquisition of motor experience and trained techniques by novice athletes. The use of our system contributes to increased stability in everyday life. Below are considered the features of using the system of balance development and mastering the technique of movements by beginners at different stages of development.

Stability is largely associated with holding certain postures in different types of balance. Correct postures are an important basis for effective performance of subsequent movements, in particular, their external effectiveness. They characterize the readiness to solve the upcoming motor task. Postures can be attributed to those body states that are called operational rest, despite the fact that they do not contain external movements, but they comprise the purposeful readiness for action. The stage of initial study includes the largest first block, consisting of general preparatory and intermediate exercises performed on field training exercises in statics and dynamics. These physical exercises are represented by components of balance and two main types of balance: static (isometric mode of operation of the muscles, which causes specific static manifestations to maintain balance) and dynamic, in which the balance is kept in motion:

- Retaining balance for a long time in different starting positions (feet together, feet apart, separately on the left, then on the right foot, in a stand) when performing various physical exercises without objects;
- Long-term balance retention after rotating movements from 1 to 20 times around the vertical axis, stopping first in the position of the legs together, then separately on the left, then on the right foot, and finally in a stand;
- Long-term balance retention after rotating movements in the horizontal plane (rolling forward and back from 1 to 20 times), first in the position of the legs together, then separately on the left, then on the right foot, and finally in the posture;
- Long-term balance retention on the left, then on the right foot, in the posture after performing jumps over the line, triangle, square with a turn to the right, then to the left;
- Retaining balance in the stand when performing movement techniques on a block-type training device;
- Retaining balance in the stand while performing the technique with the simultaneous active formation of a small side balance on the simplest obstacle course simulator – a training device in the form of one-fourth of the round log with small swings to the sides;
- Retaining balance in a simple stand to develop balance.

At the stage of initial learning, we purposefully used static exercises for the formation and development of static balance (on the feet), lengthy in time, associated with the first training sessions with numerous and diverse tasks for the development of static balance endurance. Our long-term pedagogical experience has shown that in order to master the technique and maintain balance, it is necessary to form a long-term static balance on the feet in different starting positions, as well as in a stand, i.e. to cultivate static balance endurance from the first lessons. Our system detects and determines which support leg is comfortable to stand on and on which side, which is facilitated by the exercisers used in it. Tasks of the balance development system are based on its components and involve a lot of muscle tension. All this requires the development of a specific static endurance balance on the feet with different starting positions to maintain it. In terms of keeping balance on the foot, and then on the right foot and in the posture, these starting positions are unusual conditions for performing motor coordination tasks by young athletes, causing a significant tremor of all

muscle groups of the legs, which makes it much more difficult to control movements. When using the system, young athletes gain richer and more diverse motor experience, they can more easily extrapolate movements in complicated conditions, and have higher mobility of the nervous system in risky coordination actions and when overcoming themselves. Our review of the literature has shown that in the theory and methodology of sports, static balance endurance, as a physical ability, was not characterized and neither was a method for its development. This physical ability requires a deep study, since it affects the balance in any sport (Zelenin, 2014c,d; Spigel, 2012).

At the stage of initial training, we purposefully used specific manifestations of dynamic balance, dynamic physical exercises of the group, which include:

- Retaining balance in motion with the performance of various motor actions in conditions of increased support (on a log lying on the ground with a diameter of 300-400 mm; on an inclined gymnastic bench turned upside down);
- Retaining balance when sliding on two skis with the feet tied together on a smooth snow pedestrian road with the inclusion of pushing movements with two hands using ski poles;
- Retaining balance while performing elements of the technique of overcoming obstacles, movements on a sliding support on snow (ice);
- Retaining balance while performing the technique in full coordination.

The balance development system designed by us has a wide variety of balance manifestations caused by different types of motor actions that contribute to the improvement of the functional state of the cerebellum and vestibular apparatus during the training process. Knowledge of the components, main varieties and specific manifestations of balance significantly improves the content of the training process and contributes to the better effectiveness of the process of holding the body in space, as well as the development of techniques for beginners.

This stage, which due to directed physical exercises is the most important for improving the overall level of balance, stimulates the accelerated development of technical skills of novice athletes. It is especially important for learning balance exercises, which actively stimulate the impact on the body stability while mastering the technique with the help of exercises to the level of motor skills. This requires a lot of work and more time from beginners, as well as the use of more subtle and precisely selected directed motor actions. The balance development system contributes to the improvement of balance while regulating the working posture with accelerated mastering of the correct work of the trunk when performing movements in the starting position, strongly acting through the brain and muscles.

In the course of training, the trainer often faces the task of constructing techniques for special preparatory exercises from the positions of a system-logical approach. The use of the balance development system determines rational artificial conditions that allow accelerated filling the memory with motor-coordination material and build their training taking into account the internal ordering and regularities of the formation of conditioned-reflex connections (Zelenin, 2014b). Physical exercises aimed at balance quickly form an individual motor style and provide the cadet with significant assistance in mastering the technique of overcoming difficult obstacles, in increasing the stability of its performance. The use of a balance development system that stimulates the stability of the body is one of the promising areas for more effective improvement of technical skills. They create time reserves, reducing the duration of learning exercises in the training process. Our research shows that, firstly, this can be achieved by temporarily omitting the repetition of previously mastered balance exercises and, secondly, the balance development system (directed physical exercises, special physical exercises for balance) allows the significant reduction of the time needed for

mastering the technique in unity with the formation of balance. Learning the technique elements on the floor allows cadets to quickly master the main supporting actions that are the semantic core of the technique. These actions are very stable and are improved throughout the entire period of training. Third, an important advantage of our directed physical exercises for balance is that they create a technical (artificial) environment that allows avoiding motor errors in technique and balance retention, as well as constant retraining, which cannot be avoided in the traditional process of training (Zelenin, 2014a). In teaching a significant number of exercises for balance to the level of motor skills, we applied a certain sequence of training, which provides the order of tasks, the use of a certain order of tools, methods, techniques and approaches of training within one and a series of classes, as well as the transition from one type of tasks, tools, methods, techniques and approaches of training to others. At the same time, the optimal sequence reduces the training time for balance movements and techniques to 15 weeks. During the training on balance exercises and mastering techniques, the following negative aspects were observed: overcoming the gravity force, certain inertial forces; insufficient coordination of movements; low mobility of the upper shoulder girdle; low amplitude of the rotation of trunk, hip joint; poor spatial orientation.

Training devices included in the balance development system are the main components of balance and were performed in dynamic and static modes of muscle operation and had a more complex structure of movements. They provided an additional reserve for improving the effectiveness of coordination movements. They rapidly develop the ability to maintain a stable body position in changing poses. Balance is significantly improved with the use of special physical exercises on different supports for stability (on high, narrow, round, sliding moving supports, in supported and unsupported positions), as well as exercises in the form of rotations around the vertical axis of the trunk and in the horizontal plane, which train the vestibular apparatus. The balance development system allows a significant increase in the stability of a novice athlete. Specific exercises stimulate rational balancing (retaining balance in a stand on the floor by slightly inclining body parts), while increasing the level of stability. When performing a variety of poses on the feet for retaining balance, the cadet constantly deviates to a short distance from the main body position, while trying to retain the stability of the body. To retain a specific balance, the athlete balances by slightly shifting aside the pelvis, trunk, arms, and tilting the trunk forward at different angles. This rationalizes retaining balance in different starting positions on the feet, helps to save energy. Psychological competitive spirit and positive emotional state activate the state of the nervous system and improve psychological preparation. In this case, the balance of nervous processes is achieved, the tremor decreases, which is an important condition for maintaining a stable body position to retain balance.

Of great importance are the factors that determine the success of the formation of the ability to powerfully master complex strength exercises. One of these factors is the balance state of the nervous processes that create a high level of psychological preparation (positive emotions increase performance, muscle activity), allowing more rational distribution of muscle efforts, concentrating them in a given direction, in the ability to retain balance.

The next factor is the degree of development of differentiated braking. It causes excitation in one muscle group and braking in another group (antagonistic) during each coordinated exercise, which is characteristic of accompanying (reciprocal) braking. The processes of excitation and braking in the muscular system are approximately equal, but due to the braking of antagonists, the mechanical energy of muscle contraction is significantly saved. Repeated performance of balance retention in different starting positions on the feet leads to a rational change in the mode of operation of the agonist muscles and their antagonists, which leads to an additional reduction in energy consumption.

The most important factor that ensures the ability to retain balance in the starting positions on the feet is the state of the neuromuscular apparatus. The ability to keep a steady state of the body (to retain balance after small inclinations) is provided by the tonic (retaining the balance in the posture of statics and dynamics) and tetanic tension (retaining the balance in the unsupported phase: a jump turned to the right, to the left from 90° to 360°; a roll forward, backward with a jump to right, left from 90° to 360°). Jumping and rolling with turns affect the vestibular apparatus, which sends powerful flows of impulses from the central nervous system to the working muscles.

An important factor is the level of development of physical and coordination qualities and abilities that increase the ability to maintain a stable body position in different postures on the feet, which actively stimulate the overall increase in balance, as well as the development of a specific balance for training in motion (Zelenin, 2014a).

Endurance is an essential factor that improves balance: the higher the level of general and particular endurance is, the faster the novice cadet learns different types of balance. Endurance in sports is the leading quality for the development of all other physical qualities.

The next factor that affects the ability to retain balance depends on the level of mobility in the joints. Certain mobility in the hip joint, thoracic and lumbar sections, and upper shoulder girdle better provides a rational location of the body and its individual links, which makes it easier to manage stability in movement.

Dexterity is the next most important factor that plays a huge role in the ability to retain balance, especially after rotational and jumping exercises. When performing the latter, the requirements for motor, visual, and vestibular analysers that actively affect intermuscular and intramuscular coordination are increased. The latter allows solving complex motor problems.

An important factor is the accuracy of movements, which provides a rational arrangement of the body's individual parts, as well as on the floor and on some elevation in various types of balance (static and dynamic postures), in the ability to retain the balance.

An important factor is the rhythmicity of retaining balance with a uniform distribution and redistribution of muscle forces when performing various physical exercises to retain balance. It is maintained continuously for a certain time, characterized by consistency and amplitude of movements. Any motor action has a certain amplitude of movement with the corresponding duration in time (pace) and the effort applied when performing balance exercises.

One of the main factors for retaining the balance is the psychological mood and emotional state, which influences the increase in the ability to retain balance. The trainer always pays great attention to the state of the athletes' nervous system, which strongly affects the amount of tremor. Reducing the latter is achieved by a special method (breathing and relaxation exercises, massage, bath). The better the trainer and the athlete control themselves, the better they maintain their balance.

A low level of endurance directly affects the development of specific balance retention and causes quick fatigue (ache or cramps in the muscles). In connection with the need to develop this important physical ability, we introduced a new term 'Static balance endurance' into the theory and methodology, which means the coordination ability to maintain a stable vertical position of the body for a long time under static muscle tension and balance with barely noticeable movements of the pelvis and front leg when performing complex motor



movements (Zelenin, 2014b). The method of developing static balance endurance in theory and methodology has not been developed. Retaining the balance in movement has its own characteristics. At the same time, there are high requirements for sensor systems. Unusual conditions for performing coordination tasks cause a significant tremor of all muscle groups of the legs, which makes it difficult to control movements. It is necessary to stimulate the formation of static balance endurance from the very first training sessions, since adolescents have a rich and diverse motor experience and it is easier for them to learn movements in complicated conditions. Purposeful training of static balance endurance is a controlled process, during which it is necessary to take into account the specifics of this trained quality. This requires a new scientific approach, designing the methods for developing and improving this important physical ability for cadets. In this regard, our system of balance development is aimed at actively forming static balance endurance while simultaneously performing the main elements of the upper body movement technique and maintaining isometric tension with the lower body – legs, which are active constantly and for a long time to retain balance.

Stability requires the development of a specific static balance endurance for constant regulation of the working posture, since the upper part of the body – the upper shoulder girdle, arms, trunk (chest), back (lower part of the vertebral column) perform dynamic motor actions. Retaining balance in different starting positions (postures) has its own characteristics, which are manifested when moving. Retaining balance on the left and then the right leg stimulates the revealing of rational balance techniques (Zelenin, 2014a).

It follows that the designed system of balance development is interconnected, mutually conditioned and represent a single whole. These are two constantly interacting functional parts that use all-natural movements and artificial influences on them in such a way that, with gradually decreasing artificiality and increasing volume of training, they constantly ensure the maximum realization of natural potential. The balance development system developed by us solves an important task of accelerated non-forced training of novice athletes in increasing the stability of the body in space, as well as significantly reducing motor errors and retraining.

The designed system of balance development training greatly increases the level of technical readiness and enhances the possibility of achieving the maximum result planned. It is much easier to conduct training using coordination exercises for balance, since they create optimal conditions for the athlete to assimilate the information presented and perform actions, facilitate the process of their performance, reduce the protective reactions of athletes, thereby optimizing the functioning of the direct communication channel. From the very beginning of training, special balance exercises create artificial conditions that allow mastering a simplified analogy of the master version of the exercise. They create the ideal of the exercise that the trainer should strive for when teaching the students.

The system of special physical exercises allows beginners to quickly understand the essence of the training exercise, the biomechanical parameters of movement and work on its individual parts with the help of a trainer. It effectively improves both static and dynamic balance, significantly increases the image of motor representations, forms a program of stability of the body position in different postures. The balance postures presented in training allow making a real transition from the idea to the implementation and lay a reliable motor experience for the subsequent accelerated development of the technique, which is a model.

## RESULTS AND DISCUSSION

In various situations at work, in everyday life, there are increased requirements for physical fitness and coordination of movements (Zhou, Tang, Newlands & King, 2014; Karnath & Dieterich, 2014; Blume, 2013;

Rosenbaum, 2014; Dubrovskiy, 2014; Vaynbaum, 2014; Waskiewicz, Juras & Raczek, 2014; Starosta & Fostiak, 2014; Hirtz, 2014; Young, 2014; Pozzo, Levik & Berthoz, 2015; Weinert, 2013; Luca, 2013; Loosch, 2010; Malinna, Beunen, Claessens, Lefevre, Vanden Eunde, Renson, Vanreusel & Simon, 2011; Martin & Carl, 2013). Using preparatory tools for passing control standards helped to identify, determine and justify the most effective and accessible way to create effective physical fitness and coordination of movements in physical training and sports classes. The process of forming physical fitness for improving the health of cadets in physical training and sports classes in the institute was carried out providing that: the essence of the physical fitness development in cadets through physical training and sports classes was determined as a harmonious combination of physical qualities, retaining balance in static postures, controlling movement in three-dimensional space (spatial coordination), rapid and timely motor reaction in the process of performing a motor act (reflexometry); there are used special tools for the development of cadets' physical fitness and coordination of movements in physical training and sports classes; it involves the effective development of physical qualities and coordination abilities to control the body in space in the five active points of the anthropological structure of the body; the combination of theoretical knowledge and physical culture in training sessions of cadets to solve various motor tasks.

In accordance with the above, the following tasks were solved:

1. Definition of the essence, structure and content of preparatory exercises for passing the standards for physical training and the development of coordination abilities of cadets in physical training and sports classes.
2. Study of pedagogical capabilities of preparatory exercises for passing the standards for physical training on the formation of coordination abilities of cadets in physical training and sports classes, comparing the motor preparedness and functional state of cadets in the control and experimental groups.
3. Substantiation of experimental methods for implementing pedagogical capabilities of preparatory exercises for passing standards for physical training on the formation of coordination abilities of cadets in physical training and sports classes.
4. Assessment of the effectiveness of preparatory exercises to pass the physical training standards for the coordination abilities of cadets.

Theoretical studies of researchers and practitioners (Martin, 2010; Kruger & Zimmerman, 2013) of physical culture in education and sports were used; among them are empirical: observations, questionnaires, interviews, testing, individual and group conversations on the technique of movement control in the future profession and life, individual interests of students in sports, performing research training tasks and exercises during the educational and experimental process with an assessment of their quality achievements in the formation of motor functions and in individual work on the principle of feedback (teacher-student).

As a result of the research, a system of means of preparatory exercises for passing standards in physical culture was developed; it has a coordinating and developing orientation, as well as a method of training sessions that provides effective formation of physical fitness and coordination abilities in the process of physical education of cadets. The introduction in physical education of cadets of preparatory exercises performed with open and closed eyes, provides a high level of formation of coordination and physical abilities in physical training and sports. The pedagogical capabilities of preparatory exercises for passing the standards for physical training on the formation of coordination abilities of the cadet are determined. A distinct connection was revealed in the training process: the effective positive impact of preparatory exercises to pass the physical training standards for the formation of coordination abilities of cadets in a pedagogical experiment that is the basis for the introduction of these exercises in the process of physical education for

the implementation of tasks on formation of coordination abilities of cadets in the classes of physical training and sports.

The practical significance of the research is as follows: 1. There were developed tools and methods for the formation of coordination abilities of cadets. 2. Analysis of the research results allows recommending the developed tools and methods as effective in physical education of cadets in physical training and sports classes, including them in the content of the curriculum and sports and recreation classes. 3. The obtained results can also be used in secondary vocational institutions for the development of professional skills, special physical qualities aimed at improving applied physical fitness.

To determine the identity of coordination abilities and physical fitness of the observed groups of cadets, as well as the adequacy of methodological techniques, a summative experiment was conducted, the results of which are presented in Table 1.

Table 1. Parameters of the motor functions that reflect the coordination abilities and physical qualities of cadets.

Parameters	Control group (CG) (n = 50)	Experimental group (EG) (n = 50)	p
Coordination abilities (integrated parameter), mm	24.83 ± 0.73	26.20 ± 0.97	>.05
Coordination abilities with open eyes, mm	14.76 ± 0.98	17.90 ± 1.18	<.05
Coordination abilities with closed eyes, mm	33.56 ± 1.66	30.69 ± 1.85	>.05
Coordination abilities after the standard load with open eyes, mm	19.74 ± 1.28	19.60 ± 1.17	>.05
Coordination abilities after the standard load with closed eyes, mm	29.98 ± 1.49	33.11 ± 1.86	>.05
Static coordination, s (Romberg test)	84.36 ± 0.30	83.74 ± 0.35	>.05
Sensitivity of vestibular analyser, s (Yarotskiy test)	82.08 ± 2.32	76.60 ± 3.11	>.05
Reflexometry, cm	18.40 ± 0.42	19.30 ± 0.49	>.05
Height of a standing jump, cm (according to Abalakov)	52.38 ± 0.87	52.7 ± 1.19	>.05
Length of a standing jump (long jump), cm	197.98 ± 3.25	211.14 ± 2.21	<.05

From the Table 1 it can be seen that the parameters of spatial and static coordination, sensitivity of the vestibular analyser, reflexometry, and height of a jump between students from KG and EG did not differ ( $p > .05$ ).

The difference was distinct only in the parameters of the length of a standing jump and coordination abilities with open eyes with  $p < .05$  (Table 2). Taking into account the summative experiment, two equivalent groups were formed – control (KG) and experimental one (EG) –, the functional model and the main pedagogical conditions for designing experimental methods for the formation of physical fitness and coordination abilities of cadets were identified.

The results of the main experiment (Table 2) confirmed the effectiveness of the used preparatory exercises for passing the standards in the development of coordination abilities and physical qualities in the classes of physical training of cadets.

Table 2. Parameters of coordination abilities and physical qualities of cadets at the final stage of the formative experiment.

Parameters	Experimental group (50 person)				Control group (50 person)				Difference between the final results of the EG and CG	
	Before the experiment X1 ± x	After the experiment X2 ± x	X1-X2 / %	p	Before the experiment X1 ± x	After the experiment X2 ± x	X1-X2 / %	p	X2EG and X2CG t	p
Coordination abilities (integrated parameter), mm	26.20 ± 0.97	18.84 ± 0.7	28.09	<.001	24.83 ± 0.73	24.91 ± 0.66	00.32	>.05	6.16	<.001
Coordination abilities with open eyes, mm	17.90 ± 1.18	14.68 ± 0.85	17.98	<.001	14.76 ± 0.98	13.86 ± 1.08	77.45	<.05	0.84	>.05
Coordination abilities with closed eyes, mm	30.69 ± 1.85	22.75 ± 1.38	25.87	<.001	33.56 ± 1.66	33.02 ± 1.72	11.60	>.05	4.43	<.001
Coordination abilities after the standard load with open eyes, mm	19.60 ± 1.17	15.46 ± 0.75	21.12	<.001	19.74 ± 1.28	19.88 ± 0.85	00.20	>.05	33.82	<.001
Coordination abilities after the standard load with closed eyes, mm	33.11 ± 1.86	23.73 ± 1.26	28.32	<.001	29.98 ± 1.49	30.75 ± 1.71	22.56	>.05	3.27	<.01
Static coordination, s	83.74 ± 2.46	89.14 ± 0.85	66.44	<.05	84.36 ± 2.09	83.08 ± 2.46	11.51	>.05	2.3	<.05
Sensitivity of vestibular analyser, s	76.6 ± 3.11	86.78 ± 1.4	13.28	<.001	82.08 ± 2.32	86.60 ± 1.53	55.50	<.05	0.09	>.05
Reflexometry, cm	19.30 ± 0.49	16.24 ± 0.43	15.85	<.001	18.40 ± 0.42	18.54 ± 0.43	0.76	>.05	3.45	<.01
Height of a standing jump, cm	52.7 ± 1.19	57.78 ± 1.03	9.63	<.001	52.38 ± 0.87	52.02 ± 0.84	0.68	>.05	4.29	<.001
Length of a standing jump (long jump), cm	211.14 ± 2.21	219.10 ± 2.06	33.77	<.001	197.98 ± 3.25	197.6 ± 2.53	0.19	>.05	6.49	<.001

Notes: (X1-X2 in %, EG = 50 person; X3-X4 in %, CG = 50 person).

First of all, in the EG was found a significant ( $p < .001$ ) improvement in the integral indicator, that reflects the precision of interaction of all sensory systems and the level of inter- and intramuscular coordination of the motor apparatus. This increases the closeness of the relationship calculated by correlation analysis. If before the beginning of the experiment the dependence values were in the range  $r = 0.157 - 0.238$  ( $p > .05$ ), then at the end they were  $0.264 - 0.562$  ( $p > .05 - p < .05$ ). Overall, the quality improvement was 28.0 % ( $p < .001$ ).

In the same group (EG), similar indicators increased significantly after the standard load (up to 21.1 %;  $p < .001$ ), in contrast to the control group. After performing the standard load, the improvement of this indicator compared to the initial level was 28.3 % ( $p < .001$ ). The sensitivity of the vestibular analyser before and after the experiment differed by 13.28 % ( $p < .001$ ); in the control group by 5.5 % ( $p < .05$ ), with the least effective development of this quality. The rapidity of motor reaction in EG was improved by 15.85 % ( $p < .001$ ). There were no significant changes in the control group ( $p > .05$ ).

The final analysis of the end results between the experimental and control groups of cadets on the coordination abilities (integrated parameter) revealed a high degree of development in the EG at  $t 6.16$  ( $p < .001$ ). The most difficult conditions for the coordination of movements with closed eyes – coordination abilities with closed eyes and after the standard load with closed eyes – at  $t 4.43$  ( $p < .001$ ),  $t 3.82$  ( $p < .001$ ) and  $3.27$  ( $p < .01$ ) confirmed a high level of improvement in the development of sensory (sensitive) and precision motor functions in the cadets of the experimental group.

## CONCLUSIONS

1. Analysis of scientific and methodological literature and materials prior to the study showed that in the practice of physical education of students there is a lack of science-based approaches to the use of preparatory exercises to pass the standards for physical fitness and support exercise as an effective means of development of coordination abilities for a number of motor skills, physical fitness in general, and especially during the learning process.
2. The data of the summative experiment indicate the identity of the level of physical fitness and coordination abilities of cadets in the control and experimental groups. The exception is the parameters with open eyes and the sensitivity of the vestibular analyser. The obtained results formed the basis for the development of an experimental methodology that determines the structure and content of means of preparatory exercises for passing the standards for physical training in the physical education of cadets, the development of specific coordination features.
3. The study helped to develop a system of means of preparatory exercises for passing the standards for physical training and auxiliary exercises, the method of their application, which provides a high positive effect in the development of physical fitness, coordination abilities and physical qualities of cadets in the process of training in the higher educational institution during the physical training and sports classes.
4. There was formed a functional model for the development and evaluation of coordination abilities of cadets, which provides targeted formation of motor and functional potential of cadets.
5. The study revealed high effectiveness of the used tools and methods of experimental methodology in physical education of students.

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