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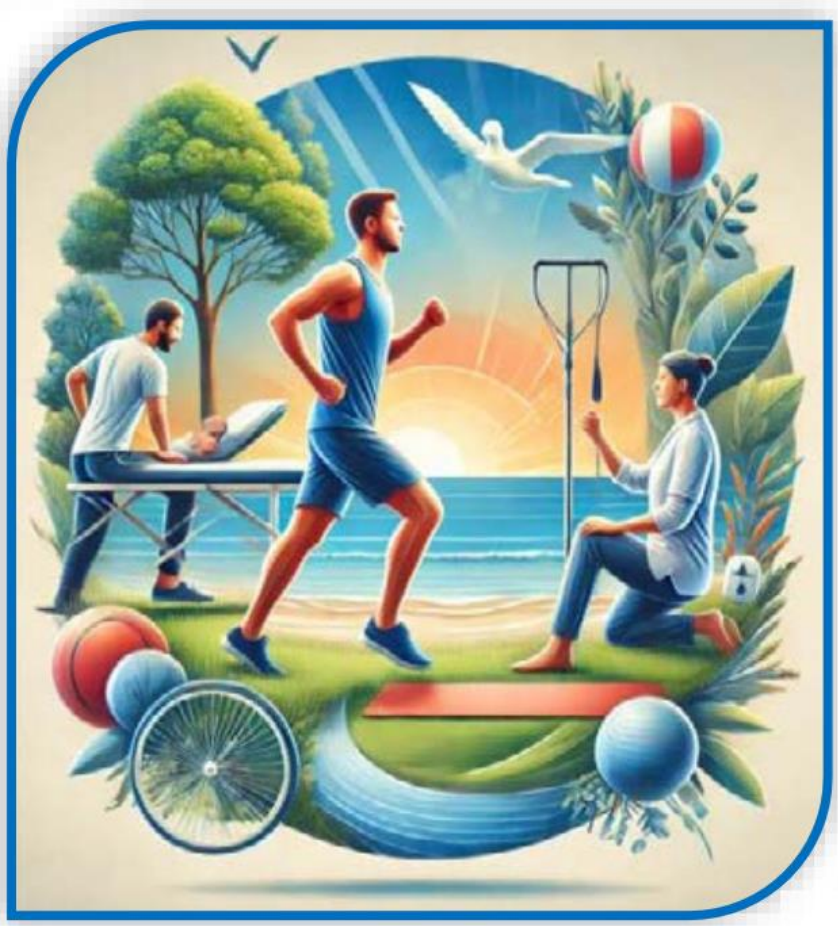

Scientific journal

on problems of health improvement and promotion, physical education, sports, physical therapy

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HEALTH-SAVING TECHNOLOGIES, REHABILITATION AND PHYSICAL THERAPY

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Field and Problems

The journal presents articles on the problems of constructing sports training, theoretical, methodological, medical, biological, psychological, and pedagogical problems of physical education and sports, rehabilitation and physical therapy, theoretical and methodological bases for the development and improvement of technologies for maintaining health by means of physical culture and sports and physical therapy.

For postgraduate students, doctoral students, masters, coaches, athletes, physical therapists, rehabilitologists, teachers of secondary schools, teachers of secondary schools.

Mission

The main mission of the journal is scientific substantiation and delivery of information to readers about the possibilities of overcoming health problems, mental stress, and improving and preserving one's sports assets. The way to self-improvement of a person consists in the application of health preservation technologies, the central link of which is motor activity. The journal's mission is also to create and scientifically substantiate health preservation technologies in difficult living conditions and educational activities in the field of physical education, sports training and physical therapy.

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ТЕХНОЛОГІЇ ЗБЕРЕЖЕННЯ ЗДОРОВ'Я, РЕАБІЛІТАЦІЯ І ФІЗИЧНА ТЕРАПІЯ

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Історія: 2018 на базі міжнародної конференції «Технології збереження здоров'я, фізична реабілітація та рекреація у вищих навчальних закладах», заснованій у 2008 році. Ця конференція також частково поєдналась з конференцією «Фізичне виховання і спорт у вищих навчальних закладах», яка була заснована у 2005 році.

Сфера і проблематика: У журналі представлені статті з проблем побудови спортивної підготовки, теоретичних, методичних, медико-біологічних, психолого-педагогічних проблем фізичного виховання і спорту, реабілітації та фізичної терапії, теоретико-методичних основ розробки та вдосконалення технологій збереження здоров'я шляхом засоби фізичної культури і спорту та фізичної терапії.

Для аспірантів, докторантів, магістрів, тренерів, спортсменів, фізичних терапевтів, реабілітологів, вчителів загальноосвітніх навчальних закладів, вчителів загальноосвітніх навчальних закладів.

Місія

Основною місією урналу є наукове обгрунтування про можливості вирішення проблем, пов'язаних з порушенням здоров'я, психологічним стресом, а також підвищення рівм рівня підготовленості спортсменів. Шлях самовдосконалення людини полягає в застосуванні технологій збереження здоров'я, центральною з яких є рухова активність. Місія журналу полягає також в створенні і науковому обгрунтуванні технологій збереження здоров'я в спорті, фізичному вихованні і фізичній терапії.

Випуск рекомендовано до друку рішенням вченої ради Харківського національного педагогічного університету імені Г.С. Сковороди, протокол № 7 від 6 грудня 2025 року.

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ORIGINAL ARTICLE. HEALTH-SAVING TECHNOLOGIES IN SPORT

Comprehensive use of fitness technologies to develop the physical abilities of young basketball players

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Authors' Contribution: A – Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection

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Abstract

Background and purpose	Physical training of basketball players aged 13–14 is an extremely important stage, since this period coincides with the active phase of pubertal development and a sensitive window for the formation of many motor qualities. The purpose of the study: to develop and experimentally verify the effectiveness of a comprehensive methodology for using fitness technologies to ensure the comprehensive development of physical abilities of young basketball players.
Material and methods	Participants of the study: 20 young basketball players from the sports reserve of the Comprehensive Children's and Youth Sports School No. 2 of the Kharkiv City Council, who were divided into a control and experimental group of 10 people each. The age of the subjects was 13–14 years. All children and parents gave their consent to participate in the experiment. Methods: analysis of scientific sources, methods of testing physical abilities, methods of mathematical statistics. The experiment lasted 12 weeks.
Results	The control group program included traditional exercises for the development of general, traditional for basketball, special and general physical training exercises. The complex training approach applied in the experimental group involved a combination of functional exercises, plyometrics, high-intensity interval training and corrective techniques, which allows simultaneously developing strength, explosiveness, coordination, and endurance. It was found that the test results of the athletes of the experimental group were higher compared to the results of the control group. Significant differences were recorded in the explosive strength of the lower extremities ($p<0.01$), which confirms the effectiveness of the applied plyometric and speed-strength exercises, as well as in the "vertical jump" test ($p<0.05$), which indicates the positive effect of the proposed method on the development of explosive strength and power.
Conclusions	It is shown that the application of the developed methodology allows optimizing the training process, making it more functional, intensive and safe for young athletes, which is the basis for preparing a high-quality sports reserve.
Keywords	basketball, physical abilities, fitness technologies, intensive interval training, plyometric training, functional training, corrective technologies.

Анотація

Ірина Собко, Олександр Єфіменко, Ірина Подмарьова. Комплексне застосування засобів фітнесу для розвитку фізичних здібностей юних баскетболістів

Обґрунтування і мета	Фізична підготовка баскетболістів у віці 13–14 років є надзвичайно важливим етапом, оскільки цей період збігається з активною фазою пубертатного розвитку та сенситивним вікном для формування багатьох рухових якостей. Мета дослідження: розробити та експериментально перевірити ефективність комплексної методики застосування засобів фітнесу для забезпечення комплексного розвитку фізичних здібностей юних баскетболістів.
Матеріал і методи	Учасники дослідження: 20 юних баскетболістів зі спортивного резерву Комплексної дитячо-юнацької спортивної школи № 2 Харківської міської ради, які були розділені на контрольну та експериментальну групу по 10 чоловік. Вік досліджуваних 13-14 років. Усі діти та батьки дали згоду на участь в експерименті. Методи: аналіз наукових джерел, методи тестування фізичних здібностей, методи математичної статистики. Експеримент тривав 12 тижнів.
Результати	В програму контрольної групи були включені традиційні вправи для розвитку загальної традиційні для баскетболу вправи спеціальної та загальної фізичної підготовки. Комплексний тренувальний підхід, застосований в експериментальний групі, передбачав поєднання функціональних вправ, пліометрики, інтервальних тренувань високої інтенсивності та корекційних методик, що дозволяє одночасно розвивати силу, вибуховість, координацію, витривалість. Встановлено, що результати тестів спортсменів експериментальної групи виявилися вищими порівняно з результатами контрольної групи. Достовірні відмінності зафіксовано у вибуховій силі нижніх кінцівок ($p<0.01$), що підтверджує ефективність застосованих пліометричних та швидкісно-силових вправ, також у тесті «вертикальний стрибок» ($p<0.05$), що свідчить про позитивний вплив запропонованої методики на розвиток вибухової сили та потужності.
Висновки	Показано, що застосування розробленої методики дозволяє оптимізувати тренувальний процес, зробивши його більш функціональним, інтенсивним та безпечним для юних спортсменів, що є основою для підготовки якісного спортивного резерву
Ключові слова	баскетбол, фізичні здібності, фітнес технології, інтенсивне інтервальне тренування, поліметричні тренування, функціональні тренування, корекційні засоби.

Introduction

The modern game demands from young athletes a comprehensive and athletic development that is constantly increasing. The game has become much faster and more explosive, requiring not only technical skills, but also explosive strength (for jumping, jerking and acceleration), speed endurance (to maintain a high pace during each individual quarter of the game), special agility (for maneuvering and defensive movements). At the same time, increasing the intensity and number of loads increases the risk of injury [1,2]. Traditional methods of physical training, focused mainly on general developmental and running loads, often do not provide the functional readiness necessary for modern basketball. They may not sufficiently develop intermuscular coordination and special endurance. The relevance of the work is confirmed by the search for new, functionally oriented approaches, since fitness technologies (TRX, TRX Rip Trainer, functional loops, medicine balls, plyometrics, High-Intensity Interval Training) allow you to train muscle groups in complex interaction, maximally imitating game movements; individualize the training process to correct imbalances; achieve a higher coefficient of transfer of the training effect to game performance [3-5].

Physical training of basketball players at the age of 13-14 is a critically important stage, since it falls on the active phase of pubertal development and a sensitive period for the development of many motor qualities. As emphasized by the authors of Kozyna et al. (2023) [6], the goal of physical training at this stage is to create a strong athletic foundat ion and form specific functional qualities necessary for further specialization. This age is characterized by hormonal changes and rapid growth (pubertal leap), which dictates special requirements for the training process. Experts emphasize that adolescence is one of the most favorable (sensitive) periods for the formation of coordination abilities and reaction speed. It is at this time that neuromuscular connections are most plastic, so it is advisable to actively use exercises for proprioception, balance, and rapid change of direction, which will allow laying a solid foundation for motor skills and increasing the athletic readiness of young athletes. [7-9].

According to leading experts, a feature of sports training in basketball is the integration of functional training with technical and tactical work. Physical qualities should not be developed in isolation [10]. Functional training should be performed in conditions that simulate game pressure and fatigue. For example, plyometric jumps or coordination exercises are performed immediately before or between technical elements: (throws, passes). Due to growth disproportions at this age (sharp lengthening of the limbs), the risk of muscle imbalances increases. Therefore, functional training should include a special corrective block aimed at restoring optimal movement patterns and strengthening weak links, which is the basis of health-preserving techniques (which emphasizes the relevance of fitness) [11,12].

Recent studies have actively studied the effectiveness of using fitness equipment (medballs, fitballs, coordination ladders) for the development of special agility and coordination in various sports [13-15]. Literature analysis shows that the need to transition from general physical training to functional-specific is justified, and the effectiveness of individual fitness technologies for the development of basic physical abilities in basketball [10,12].

Nevertheless, to date, there is a certain methodological gap, which consists in insufficient systematization and experimental confirmation of the effectiveness of the integrated methodology for using these tools specifically for the Ukrainian sports reserve at the age of 13-14. That is why there is a need to conduct an experimental study aimed at creating and testing a holistic, integrated fitness methodology.

The purpose of the study: to develop and experimentally verify the effectiveness of a comprehensive methodology for using fitness equipment to ensure the comprehensive development of the physical abilities of young basketball players.

Material and Methods

Participants

Participants of the study: 20 young basketball players from the sports reserve of the Comprehensive Children's and Youth Sports School No. 2 of the Kharkiv City Council, who were divided into a control and experimental

group of 10 people each. The age of the subjects was 13-14 years. All children and parents gave their consent to participate in the experiment.

Ethical statement

The Ethics Committee of H.S. Skovoroda Kharkiv National Pedagogical University was given permission to conduct this research, as it complies with the Declaration of Helsinki of the World Medical Association - ethical principles of medical research involving human subjects (No. KhNPU/PhES/EC/2/4/2024).

Methods of determining the level of physical readiness

To objectively assess the level of physical fitness of young basketball players (13-14 years old) and verify the effectiveness of the experimental methodology, a set of standardized control tests was selected. The selection of tests was based on the principles of reliability, informativeness, specificity (maximum correspondence to game movements in basketball) and accessibility (possibility of conducting in a youth sports school).

LIst of tests

1. Shuttle run 4 x 9 m (s). The athlete runs 4 segments of 4 by 9 meters, touching the line with his hand or overcoming the chip. The best time is recorded

2. Long jump from a standing position (cm). The athlete performs a jump from two feet without a preliminary run-up. The distance from the starting line to the heels is measured. It assesses the ability to start power and acceleration, which is the foundation for all dynamic actions

3. Vertical jump up (cm). The athlete stands sideways to a vertical wall or a special measuring scale, touching it with one hand. First, he records the height of the maximum reach while standing, after which he performs a jump up from the previous half-squat, touching the wall with the same hand at the highest point of the jump. The difference between the reach height and the mark after the jump determines the result. 2–3 attempts are made, the best one is counted

4. Plank test (s). The athlete takes a standing position lying on his forearms: the elbows are located under the shoulder joints, the body is held in a straight line from head to heels, without bending in the lower back or raising the pelvis. At the command "Start", the time during which the participant is able to maintain the correct technique is recorded. The test is stopped if the body position is disturbed or there is no desire to continue, and the result is recorded in seconds as the maximum time of static retention.

5. Throwing a 2 kg medicine ball (m). The athlete stands behind the throwing line, feet shoulder-width apart, the medicine ball is held with both hands at chest level. At the command, he performs a powerful push throw forward or up-and-down (depending on the technique) without lifting his feet off the floor. The distance from the throwing line to the place where the medicine ball first touches the ground is measured with a tape measure. 2–3 attempts are made, the best result in meters is recorded in the protocol.

Procedure

The experimental method was developed for young basketball players aged 13-14 and lasted 12 weeks. The goal of the program was a comprehensive optimization of physical training by integrating functional-specific fitness technologies into the standard training process.

The control group program included traditional exercises for the development of general, traditional for basketball, special and general physical training exercises.

The complex training approach used in the experimental group involved a combination of functional exercises, plyometrics, high-intensity interval training and corrective techniques, which allows you to simultaneously develop strength, explosiveness, coordination, endurance and stabilization capabilities of the musculoskeletal system. Such a system ensures the transfer of training effects into specific technical and tactical basketball actions, improves the quality of performing high-speed maneuvers, jumps and throws, and also contributes to the prevention of injuries typical of adolescence. The following table 1 lists the main groups of tools and examples of exercises that were used in the training process.

Table 1

Characteristics of fitness technologies implemented in the training of basketball players in the experimental group

Functional training	
Exercises on unstable supports are used, which allow the athlete to include stabilizer muscles, exercises to develop strength, coordination, and balance in dynamics	Standing ball throws on a BOSU, crossover-balance-throw, jump-stop-throw, jump-to-balance shot, lateral shift with throw, one-legged squat on unstable support with transfer.
Plyometrics	
Exercises aimed at developing explosive strength through rapid execution of the muscle's "stretch-contraction" cycle	Squat Jump, Box Jumps), Depth Jumps, Lateral Bounds, Broad Jumps, plyometric sprints, jumps with a touch of the shield, Hurdle Jumps).
High-Intensity Interval Training	
Alternating short periods of maximally intense work with short periods of rest or low activity	Sprints of 15–30 m with short rest, interval runs, jerks with a change of direction (5–10–5), jump intervals, combined series of "sprint + protective movements", shuttle-run with different intensities, interval jerks "baseline-to-baseline", work on a timer: 20 s of maximum activity + 10 s of rest.
Corrective measures (Pilates, yoga, stretching)	
Working on deep muscles, joint and fascia mobility, increasing the elasticity of soft tissues, improving intermuscular coordination;	"Plank with leg lift", "Side plank", "Massage roller rolling for calves and quadriceps", "Seated hamstring stretch", "Pigeon pose" (yoga) for hip mobility, "Shoulder-supported bridge" for gluteal muscle activation, "Pectoral muscle stretch in the doorway", "Thoracic opener" on the roller, "Hip flexor stretch" in a lunge.

The functional-explosive training block is aimed at developing speed-strength qualities and special endurance. The block included plyometric exercises (jumping from a height, jumping onto low platforms, jumping with countermovement) and High-Intensity Interval Training (using cyclic high-intensity exercises with short rest intervals, for example, burpees, speed push-ups, acceleration with a medicine ball). The intensity of functional-explosive training is high (85-95% of HRmax, anaerobic zone), the volume is 30-40 minutes of pure work (3-4 cycles of 8-10 minutes). The frequency of training is 1 time per week.

The corrective and stabilizing fitness block is aimed at strengthening the muscles of the middle part of the body, increasing joint mobility and preventing injuries. Includes TRX (functional loops), TRX Rip Trainer – exercises on unstable support to strengthen stabilizer muscles (especially oblique abdominal muscles and shoulder girdle muscles), corrective exercises (Pilates-oriented exercises aimed at eliminating muscle imbalances, for example, strengthening the back of the thigh and buttocks), stretching (using a foam roller for massage and dynamic stretching to improve fascia elasticity and ankle and hip joint mobility). The intensity of corrective and stabilization fitness is medium (70-80% of HRmax), the volume is 25-30 minutes of work. Fitness classes were integrated into two main blocks during the week (table 2)

Statistical analysis

For each test, the arithmetic mean ($\bar{x}$) and standard deviation (S) were calculated separately for the control and experimental groups. Student's t-test for independent samples was applied, using the program Microsoft Excel та SPSS Statistic 26.

Table 2
Fitness classes blocks of the experimental program

Training day	Main emphasis	Content of the fitness block
Monday	Technical and tactical work	Corrective and stabilization fitness (30 min)
Wednesday/Thursday	Main physical activity	Functional explosive training
Other days	Technique, game, recovery	(40-50 min)

Results

At the beginning of the experiment, the statistical data obtained prove the homogeneity of the control and experimental groups in terms of physical fitness indicators, which is a fundamental condition for the validity of the pedagogical experiment. (table 3). Homogeneity of groups is a prerequisite for the validity of a pedagogical experiment. If the groups were equal at the beginning of the study, then any statistically significant improvements in the experimental group after the experiment can be unambiguously attributed to the positive impact of the developed fitness methodology.

Table 3
Physical fitness indicators of young basketball players before the start of the experiment (n=10)

Test (unit of measurement)	Control group	Experimental group	Difference between groups (Δ)	Student's t-test	Certainty (p)
Shuttle run 4 x 9 m (s)	10.55±0.35	10.60±0.38	0.05	0.48	p > 0.05
Long jump from a standing position (cm)	198.2±6.1	197.5±6.9	0.7	0.29	p > 0.05
Vertical jump (cm)	45.1±3.2	44.8±3.5	0.3	0.24	p > 0.05
Plank test (s)	65.8±0.9	66.5±8.5	0.7	0.23	p > 0.05
2 kg medicine ball throw (m)	7.15±0.40	7.20±0.35	0.05	0.39	p > 0.05

After the experiment, the analysis of the results shows that the implemented experimental methodology using fitness technologies had a positive effect on the physical fitness indicators of the participants of the experimental group (table 4). The most significant changes were recorded in the explosive strength of the lower extremities: in the standing long jump test, the increase was statistically significant ($p<0.01$), which indicates the effectiveness of the applied plyometric and speed-strength exercises. Similarly, in the vertical jump test, a significant improvement was also noted ($p<0.05$), which confirms the positive effect of training on the development of explosive strength and power. The indicator of general muscular endurance, assessed by the Plank test, significantly improved ($p<0.05$), which indicates the effectiveness of the use of functional fitness exercises in strengthening the muscles of the middle part of the trunk. In exercises that characterize coordination and speed capabilities, in particular the 4x9 m shuttle run, although positive dynamics were recorded, they were statistically insignificant ($p>0.05$), which may indicate an insufficient volume or specificity of the impact of this technique on speed and coordination abilities.

Table 4

Physical fitness indicators of young basketball players after the experiment (n=10)

Test (unit of measurement)	Control group	Experimental group	Difference between groups (Δ)	Student's t-test	Certainty (p)
Shuttle run 4 x 9 m (s)	10.01±0.28	9.95±0.30	0.06	0.46	p > 0.05
Long jump from a standing position (cm)	198.2±10.2	210.8±6.5	0.7	2.69	p < 0.01
Vertical jump (cm)	46.1±3.5	49.5±3.5	3.4	2.17	p < 0.05
Plank test (s)	83.8±13.9	91.0±10.1	7.2	2.10	p < 0.05
2 kg medicine ball throw (m)	7.25±1.40	7.75±0.30	0.5	1.10	p > 0.05

Overall, the results show that the use of fitness technologies in the training process contributed to a significant improvement in explosive and general muscular endurance, while the impact on speed and strength qualities requires further improvement and adaptation of the methodology.

Discussion

The results confirmed the hypothesis of the study and demonstrated a statistically significant advantage of the developed fitness method over the traditional physical training program for young basketball players aged 13–14. According to modern sports science, traditional approaches, based mainly on isolated strength exercises, provide limited transfer of the training effect to competitive activity [16,17]. In contrast, the inclusion of plyometrics and High-Intensity Interval Training, which simulate the explosive, interval nature of movements in basketball, contributes to the development of specific speed-strength endurance and improves the physical and functional characteristics of athletes. This explains the more significant increase in test indicators in the experimental group, in particular, the improvement of results in vertical jump and shuttle run. According to the literature, the combination of plyometric exercises, High-Intensity Interval Training and strength-functional training gives a strong training effect due to the combination of different development mechanisms. Plyometrics improves explosive power and reaction speed, High-Intensity Interval Training - the ability to repeatedly perform intense actions, and stabilization exercises strengthen the muscles of the middle part of the body and reduce imbalances. Together, this not only increases test results (jumps, shuttle run, "plank"), but also has a positive effect on game efficiency: jump height in the game, jerk speed, stability during throws and tackles [18,19]. At the same time, such programs have important conditions for application. As described by scientific sources, a pronounced effect of plyometrics usually requires 6–12 weeks of training, and the load should be increased gradually so as not to overload the growth zones in adolescents. A clear execution technique is also a prerequisite for safety. In addition, regular testing before and after the training cycle allows you to determine which combinations of exercises have the greatest impact on game performance at a given age [20,21].

An important element of the methodology was the inclusion of corrective fitness (TRX, Pilates), which has proven effective in increasing core stability and reducing muscle imbalances typical of adolescence. Scientific studies confirm that the development of central stabilization has a positive effect on throwing accuracy and reduces the risk of musculoskeletal injuries. Systematic reviews and meta-analyses indicate that training the muscles of the middle part of the body increases balance indicators, core strength and the ability to transfer energy from the trunk to the extremities, which directly affects the accuracy of throwing and striking in various sports. Experimental work demonstrates that targeted programs for stabilizing the muscles of the middle part of the body (including TRX and Pilates components) improve static and dynamic stability indicators, reduce asymmetries and optimize landing mechanics and force transmission. These adaptations reduce the load on the joints and lower extremities and, as a result, contribute to the prevention of musculoskeletal injuries [4,10]

There is also empirical evidence of the relationship between training the muscles of the middle part of the body and improving technical accuracy: studies in team sports have shown an improvement in the accuracy of kicks and throws after a course of such training, which indicates the role of the muscles of the middle part of the body as an intermediate link in the transfer of energy from the legs and body to the upper limb [21].The dynamics of improving special agility, confirmed by the results of shuttle running, are consistent with the conclusions of scientists about the effectiveness of high-intensity interval training for developing the ability to quickly recover between jerks, which is a key requirement in basketball. At the same time, the results of the control group showed the limitations of the traditional method, which does not provide sufficient functional impact and does not meet modern requirements for the speed and strength activity of athletes in game sports.Thus, the introduction of fitness technologies allowed transforming general physical training into a more specific, functionally oriented training, which ensured the targeted development of basic game qualities, increased technical stability and reduced risk of injury. The obtained data are consistent with modern scientific concepts regarding the importance of interval, plyometric and stabilization training in the training of young athletes.

Conclusions

The application of the developed methodology allows not only to significantly improve the basic physical abilities for basketball, but also to optimize the training process, making it more functional, intensive and safe for young athletes, which is the basis for preparing a high-quality sports reserve.

Conflict of interest

The author declares no conflict of interest.

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