PEDAGOGICAL ACADEMY:
SCIENTIFIC NOTES

PHYSICAL EDUCATION AND SPORTS

UDC 796.015.132:796.89

DOI https://doi.org/10.5281/zenodo.17190744

Periodization of the training process in the preparation of highly qualified powerlifters for international competitions

Oksana Kashychkina,

Singer, Ararat, 18090 Collins Ave T22, Sunny Isles Beach, FL 33160, USA,

https://orcid.org/0009-0005-9889-0703

Accepted: 11.09.2025 | Published: 24.09.2025

Abstract. *The relevance of the study is due to the need to improve approaches to periodization in the training system of high-level powerlifters, since classical models do not fully take into account the individual characteristics of athletes' adaptation, the growing density of the international calendar and the need for prompt adjustment of training loads. It emphasizes the expediency of integrating traditional principles of periodization with modern digital methods of control and monitoring. The* ***purpose of the article*** *is to scientifically substantiate and systematize approaches to organizing the training process of high-level powerlifters, with a focus on increasing the effectiveness of training for international competitions. The* ***research methodology*** *is based on the analysis and synthesis of scientific and methodological literature, content analysis of recent publications, comparison of classical and modern periodization models, and generalization of practical experience in training high-level athletes. A systematic approach was used to establish the relationship between the volume and intensity of loads, the dynamics of recovery processes and the adaptive capabilities of the body.* ***The study's results*** *showed that the multi-level organization of the training process, in the form of*

macro-, meso-, and microcycles, provides control over adaptation and a more accurate prediction of the athlete's peak form. It was found that the use of digital monitoring (HRV, biomechanical analysis, and subjective fatigue indicators) increases the effectiveness of individualizing athletes' loads. The main problems of the training process for powerlifters were identified: overload, significant individual adaptation differences, insufficient standardization of methods, and the complexity of implementing modern control technologies in practice. The scientific novelty of the study lies in the systematization of approaches to combining classical principles of periodization in the training process with innovative methods of digital control, as well as in demonstrating the effectiveness of the modular approach to building macrocycles that account for the specifics of the international competition calendar. ***Conclusions.*** *The need for individualized training loads, the integration of complex recovery strategies, and digital monitoring systems to minimize the risk of overtraining and ensure the stability of sports results is proven. Prospects for further research are related to the development of personalized algorithms for planning the training process in real time, the use of artificial intelligence to predict recovery processes, as well as the study of psychophysiological aspects of powerlifters' adaptation to the stressful conditions of international competitions.*

Keywords: *strength training, athletes' adaptation, training cycles, load individualization, sports recovery, performance monitoring, international competition schedule.*

Періодизація тренувального процесу у підготовці пауерліфтерів високої кваліфікації до міжнародних змагань

Кашичкіна Оксана Іванівна,

співачка, «Арарат», 18090 Коллінз Авеню, Т22, Санні-Айлз-Біч, Флорида 33160, США, https://orcid.org/0009-0005-9889-0703

PEDAGOGICAL ACADEMY:
SCIENTIFIC NOTES

Анотація. *Актуальність дослідження зумовлено необхідністю вдосконалення підходів до періодизації у системі підготовки пауерліфтерів високої кваліфікації, оскільки класичні моделі не враховують у повному обсязі індивідуальні особливості адаптації спортсменів, зростаючу щільність міжнародного календаря та потребу в оперативному коригуванні тренувальних навантажень. Це підкреслює доцільність інтеграції традиційних принципів періодизації з сучасними цифровими методами контролю й моніторингу.* ***Мета статті*** *полягає у науковому обґрунтуванні та систематизації підходів до організації тренувального процесу пауерліфтерів високої кваліфікації з орієнтацією на підвищення ефективності підготовки до міжнародних стартів.* ***Методологія*** *дослідження ґрунтується на аналізі й синтезі науково-методичної літератури, контент-аналізі публікацій останніх років, порівнянні класичних і сучасних моделей періодизації, а також узагальненні практичного досвіду підготовки спортсменів високого рівня. Використано системний підхід для встановлення взаємозв'язку між обсягом та інтенсивністю навантажень, динамікою відновних процесів і адаптаційними можливостями організму.* ***Результати*** *дослідження показали, що багаторівнева організація тренувального процесу у вигляді макро-, мезо- і мікроциклів забезпечує контроль адаптації та більш точне прогнозування виходу спортсмена на пікову форму. Виявлено, що застосування цифрового моніторингу (HRV, біомеханічний аналіз, суб'єктивні показники втоми) підвищує ефективність індивідуальної корекції навантажень спортсменів. Встановлено основні проблеми тренувального процесу пауерліфтерів: перевантаження, значні відмінності індивідуальної адаптації, недостатня стандартизація методик та складність впровадження сучасних технологій контролю у практику. Наукова новизна дослідження полягає у систематизації підходів до поєднання класичних принципів періодизації тренувального процесу з інноваційними*

методами цифрового контролю, а також у доведенні ефективності модульного підходу до побудови макроциклів із урахуванням специфіки міжнародного календаря змагань. ***Висновки.*** *Доведено необхідність індивідуалізації тренувальних навантажень, інтеграції комплексних відновних стратегій і цифрових систем моніторингу для мінімізації ризику перетренованості та забезпечення стабільності спортивних результатів. Перспективи подальших досліджень пов'язані з розробкою персоналізованих алгоритмів планування тренувального процесу у режимі реального часу, застосуванням штучного інтелекту для прогнозування відновних процесів, а також вивченням психофізіологічних аспектів адаптації пауерліфтерів у стресових умовах міжнародних змагань.*

Ключові слова: *силова підготовка, адаптація спортсменів, тренувальні цикли, індивідуалізація навантажень, спортивне відновлення, контроль працездатності, міжнародний календар змагань.*

Problem statement. The key task in the system of training elite-level powerlifters for international tournaments is to find effective balancing schemes between workload, recovery strategies and specialized training components that allow accurately directing the athlete's form to the main competitions of the season. The scientific relevance of the topic stems from the need to clarify the body's mechanisms of adaptation to extreme power loads, identify patterns of recovery processes, and build effective training cycles that take into account the individual characteristics of athletes. The practical significance of the problem is evident in the need to develop universal yet personalized methodological recommendations for coaches and athletes that will enhance the stability of results and minimize the risk of overtraining. The connection with critical scientific tasks involves the formation of interdisciplinary approaches that combine sports physiology, biomechanics, and training theory. On the practical level, this requires the development of technologies

for managing the preparatory process across different stages of the macrocycle, taking into account international standards of sports training. Thus, solving the specified problem is a necessary condition for increasing the competitiveness of national teams and integrating modern scientific achievements into the practice of training powerlifters of the highest level.

Analysis of recent studies and publications. Analysis of modern studies on the problems of periodization of training of highly qualified powerlifters for international competitions allows us to distinguish four interrelated areas. The first area concerns the macrostructure of the annual cycle and load planning. S. Drachuk, T. Didyk, I. Kulchytska and M. Chernysh show that the correct structuring of the macrocycle, taking into account the preparatory, pre-competition and competition periods, forms the basis for the stable progress of athletes [1]. M. S. Roztorhuy et al. emphasize that the balance between volume and intensity in the competitive period allows for maintaining maximum strength without overload [2]. M. Sapuppo et al., in a case study, described individualized preparation for the start, which included the control of morphological and functional indicators [3]. A. Gonchar analyzed the load in young powerlifters and proved that specialized approaches to bench press training provide increased performance [4]. In this direction, research on the formalization of criteria for transitioning between the phases of the macrocycle and justifying the role of individualization for different age groups is promising.

The second direction focuses on studying the influence of competition frequency on athletes' peaking. J. Pearson et al. proved that an excessive number of competitions during the year can inhibit strength progress, while an optimized frequency of starts contributes to increased performance [5]. T. O. Bompa and C. Buzzichelli, in their work, systematized models of strength periodization, emphasizing the importance of a gradual increase in intensity and the role of tapering [6]. C. Latella and co-authors analyzed the long-term dynamics of strength adaptation in powerlifters based on a 15-year observation, proving the importance

of strategic planning of loads and peaking intervals for a stable increase in results [7]. V. A. Islamov and co-authors described a system of integrated strength indicators in cadets, which allows you to track the level of readiness during the competitive season [8]. In this direction, further research into the optimal frequency of participation in competitions for different categories of athletes, as well as testing evidence-based models of readiness assessment, is promising.

The third direction is related to the variability of training protocols and the search for effective microcycle models. F. J. González-Alcázar et al. compared low-load protocols with high volume and a traditional high-load approach, finding similar morphological and functional changes in powerlifters [9]. M. H. Stone et al. pointed out the advantages of block periodization, which allows for more effective control of fatigue and an increase in strength indicators [10]. D. G. Suarez et al. demonstrated phase-specific changes in muscle morphology and speed-strength characteristics of athletes during a block training cycle [11]. V. I. Horoshko and O. V. Hordiienko, in a new study, confirmed the value of using the PICO model to systematize the evaluation of periodization programs in female athletes [12]. It is promising to study the combination of traditional and modern protocols of dosing volume and intensity, taking into account age and gender differences.

The fourth direction integrates the concept of minimally effective training load and tapering. P. Androulakis-Korakakis et al. proved that to maintain a high level of strength, a minimum volume of working sets in the high-intensity range is enough, which allows athletes to allocate recovery resources [13] rationally. S. K. Travis et al., in their review, found that tapering with a gradual decrease in volume while maintaining intensity is the most effective strategy for reaching peak form in powerlifters before major competitions [14]. In this direction, it is promising to combine the concept of a minimally effective stimulus with optimal tapering models and verify their effectiveness using standardized readiness indicators.

Identification of previously unresolved parts of the general problem. Despite significant progress in the study of periodization in strength training, several aspects remain unresolved. The specifics of the application of classical models in high-level powerlifting have not been sufficiently studied, especially in the conditions of a tight international competition calendar. The issues of the optimal combination of macro-, meso- and microcycles, the interaction of the volume and intensity of loads with recovery processes, as well as the problems of overload and individual differences in adaptation, remain open. The limitations of scientifically based methods and the lack of empirical data do not allow for the creation of a unified system suitable for practical application in the training of world-class athletes.

The proposed study aims to fill these gaps by systematizing modern approaches, analyzing the structural elements of training cycles, and developing recommendations that take into account the individualization of loads. The use of modern methods of monitoring the functional state, the integration of digital technologies, and the generalization of practical experience will allow not only to clarify the mechanisms of adaptation, but also to create more flexible and scientifically sound periodization models that can ensure the stability and effectiveness of powerlifters' performances at the international level.

Formulation of the objectives of the article (task statement). The purpose of this article is to scientifically substantiate and systematize approaches to periodization of the training process for highly qualified powerlifters, aiming to increase the effectiveness of preparation for international competitions.

Tasks of the article:

1. To reveal the specifics of periodization of the training process in power sports and to analyze the structure of macro-, meso- and microcycles in the training of highly qualified powerlifters.

2. To establish the relationship between the parameters of the training load and the dynamics of recovery processes, identifying key problems that limit the effectiveness of periodization optimization.

3. To formulate practical recommendations for improving the training process based on the principles of individualization and modern requirements of the international sports calendar.

Presentation of the main research material. Periodization of the training process in power sports is considered a leading methodological tool that ensures a gradual increase in loads, their optimal alternation with recovery phases and the achievement of maximum sports form in a period determined by the calendar. In high-level powerlifting, the features of periodization are determined by the need to combine high volumes of strength exercises with the competitive specificity of three disciplines: barbell squats, bench press, and deadlift. It requires the coordination of work on developing maximum strength, technical and tactical stability, and recovery mechanisms within a single macrocycle. In modern conditions, the training of powerlifters is focused on accurate prediction of peak form for international starts, which necessitates the need for a high level of individualization of training plans (table 1).

Table 1

Structural features of periodization in high-level powerlifting

Preparation stage	Main tasks	Character of loads	Expected results
Preparatory (basic)	Formation of a general strength base, development of strength endurance	High volume, moderate intensity	Increase in working volume, laying the foundation for specialized training
Special preparatory	Development of maximum strength in key exercises, technical stabilization	Average volume, high intensity	Optimization of the technique, an increase in strength indicators
Pre-competition	Achieving peak form, adaptation to the competitive regime	Low volume, very high intensity	Concentration on peak results, modeling of competitive conditions

Preparation stage	Main tasks	Character of loads	Expected results
Recovery	Reduction of loads, restoration of physiological resources	Very low volume and intensity	Restoration of working capacity, prevention of overtraining

Source: formed by the author on the basis [1, p. 165-167; 2, p. 105-106; 6; 10, p. 2354-2358]

The consistency of the periodization stages in the training of highly qualified powerlifters ensures not only the structure of the training process, but also allows you to manage the complex adaptive reactions of the body to extreme power loads. In practice, the preparatory stage is implemented through the widespread use of auxiliary exercises, such as front squats, bench presses in various variations, and pull-ups from elevated positions, which form the general power base and increase resistance to loads [9]. The special preparatory stage focuses on modeling competitive movements with regulated pauses and amplitude control, allowing the athlete to adapt to the specific requirements of international starts. The pre-competition period is characterized by the use of «peak» training with an intensity of more than 90% of the maximum indicators, with a significant reduction in volume, due to which physiological and psychological readiness for record attempts is formed [11]. In the recovery phase, active recreation methods, low-volume technical training, and equally essential recovery procedures, such as cryotherapy, kinesiotherapy, and massage, are employed, allowing for the maintenance of functional status without overload.

Thus, when preparing athletes for the World Powerlifting Championships, carefully designed macrocycles allow athletes to reach peak form within a precisely defined period. The use of digital platforms for monitoring training performance enables the timely detection of symptoms of overtraining and allows for adjustments to the program before negative consequences occur [15]. By combining the classical periodization model with modern sports science tools, a practical training

management tool is created, which enhances the stability of performances and competitiveness in the international arena.

In the training system for highly qualified powerlifters, the structure of the training process is organized in the form of macro-, meso-, and microcycles, which allows for a rational combination of long-term planning with a flexible response to the athlete's condition. A macrocycle usually covers a period of one to twelve months and is aimed at achieving peak form before the main competition. Within the macrocycle, mesocycles last from three to eight weeks, which focus on the development of certain qualities, such as maximum strength, technical stability or speed-power characteristics. The smallest structural unit is a microcycle, which covers from three to seven days and determines the immediate sequence of training sessions, their volume, intensity and load-rest ratio. Such a multi-level organization ensures the controllability of the training process and allows for integrating the individual characteristics of the athlete into the general periodization system (table 2).

Table 2

Structural and content characteristics of macro-, meso- and microcycles in the training of powerlifters

Cycle level	Duration	Main content	Target orientation
Macrocycle	6–12 months	A combination of basic, special preparatory, pre-competition and recovery stages	Achieving peak sports form before the main tournament
Mesocycle	3–8 weeks	In-depth development of individual qualities: strength, technique, recovery	Directed adaptation to specific tasks of the stage
Microcycle	3–7 days	Specific training sessions with a particular volume and intensity	Optimal alternation of loads and rest, monitoring of condition

Source: formed by the author based on [1, p. 167-169; 6; 11; 7, p. 206-207]

The multi-level organization of the powerlifting training process demonstrates its effectiveness due to the precise delimitation of tasks at each level of the cycle and

their mutual coordination. At the macrocycle level, long-term planning is provided, which takes into account the calendar of international competitions, preparation phases and the need to reach peak form at a precisely defined moment. For example, to prepare for the world championship, a macrocycle can be built for 10–12 months, where the first 4–5 months are devoted to volume work to increase the overall strength base, the next 3–4 months to specialized development of maximum strength in key exercises, and the final 2 months to the pre-competition phase with peak loads and a gradual decrease in volume.

The mesocycle in modern practice acts as a tool for targeted adaptation. It can be aimed at correcting weak links, such as a lag in the deadlift or issues with maintaining technique in squats. The duration of 4–6 weeks allows for a concentrated impact on a specific quality, which is verified through test attempts at the end of the cycle. In the practice of leading national teams, mesocycles are used with an emphasis on «peak strength» before continental competitions and on «technical and tactical stability» before world-class starts.

A microcycle is the most flexible unit that determines the direct distribution of loads during the week. In modern conditions, models such as «4 workouts in 7 days» are used, where two days are allocated for heavy basic exercises with high intensity (85–92% of the maximum), one day for auxiliary exercises of medium intensity, and another day for recovery or technical classes [12]. The use of technologies for controlling the speed of the barbell movement allows for real-time adjustment of the weight of the projectile depending on the functional state of the athlete. Practice shows that such an organization of microcycles reduces the risk of overtraining and trauma, while simultaneously increasing the stability of results at international competitions.

In the training of highly qualified powerlifters, the relationship between the volume and intensity of loads and the dynamics of recovery processes is considered a key factor determining the effectiveness of adaptation. A high volume of training

work usually stimulates metabolic processes and structural changes in the muscles, while increased intensity activates neuromuscular mechanisms and allows the development of peak strength indicators. However, exceeding individual capabilities in one direction or another leads to the accumulation of fatigue and disruption of the recovery balance, which can reduce performance in the preparatory period (table 3).

Table 3

Relationship of volume and intensity of loads with recovery processes in powerlifting

Load type	Volume/intensity	Dynamics of recovery processes	Example of practical application
High volume at moderate intensity	Significant tonnage, many sets in the range of 65–75% of 1RM	Predominantly metabolic fatigue, recovery within 24–48 hours	Use in basic training to develop general strength endurance
Moderate volume and high intensity	70–85% of 1RM, medium tonnage	Combination of neuromuscular and metabolic stress, recovery 48–72 hours	Use in a special preparatory period to increase maximum strength
Low volume and peak intensity	90% and more of 1RM, limited number of sets	High stress on the nervous system, recovery may take longer, 72-96 hours	Use in the pre-competition phase to simulate competition conditions

Source: compiled by the author based on [3; 4; 5, c. 1216–1218; 9; 13; 14]

In practical conditions, trainers are increasingly using monitoring systems to monitor recovery processes after various types of loads. For example, after high-volume microcycles, a decrease in heart rate variability is observed, which indicates the need to include active recovery, such as swimming or low-intensity exercises [15]. In contrast, after peak-intensity training, nervous exhaustion predominates, and the primary tools are regenerative measures, including normalization of sleep, the use of electrical stimulation, and control of movement speed [16]. Modern digital technologies open up fundamentally new opportunities for monitoring the training process in powerlifting. The use of portable sensors, mobile applications and cloud platforms allows for the collection and analysis of a wide range of data in real time: from heart rate and heart rate variability (HRV) to indicators of movement

biomechanics and subjective assessments of fatigue [17]. By integrating these parameters, individual digital profiles of athletes are created, reflecting the dynamics of their functional state and adaptive capabilities. Artificial intelligence and machine learning are utilized to predict recovery processes, identify hidden risks associated with overtraining, and generate personalized recommendations for optimizing load. This approach enables the flexible management of the training process, allowing coaches to adjust the structure of micro- and mesocycles quickly. Athletes receive timely feedback, which enhances the effectiveness of training for key competitions. This approach minimizes the risk of overtraining and increases the stability of results during the competition period.

Optimizing the periodization of training for highly qualified powerlifters for international competitions faces a set of problems that largely determine the effectiveness of the training process. One of the key difficulties is overload, which occurs as a result of excessive volume or intensity of work, when the body's adaptive capabilities do not have time to recover, which leads to a decrease in performance, an increase in the risk of injuries and a violation of the stability of results [1, p. 165-167; 10, p. 2354-2358]. An additional factor is individual differences in adaptation, which determine different rates of recovery after the same loads: in some athletes, the neuromuscular system returns to its original state faster, while others require significantly longer recovery phases [2, p. 105-10]. It complicates the application of unified periodization models and requires a high level of individualization.

A significant problem is the lack of scientifically sound methods based on modern data from sports physiology and neurobiology [6]. A significant part of training programs in practice still relies on the empirical experience of individual coaches, which reduces the possibility of standardization and verification of their effectiveness. No less significant is the difficulty of integrating innovative monitoring technologies, such as biomechanical analysis of movements or heart rate

variability tracking systems [15]. Despite the availability of such tools, they often require additional financial resources, specialized personnel training, and time for data interpretation, which is not always compatible with an intensive competitive calendar.

A significant barrier is also the uncertainty of competitive schedules, as changes in the dates of international tournaments necessitate adjustments to the entire structure of the macrocycle [3]. It creates the risk of untimely reaching peak form or, conversely, achieving it too early. The psychological aspect also remains important: high competition and the expectation of a result form additional stress, which can hinder physiological adaptations if there is no systematic work with sports psychologists [8]. Added to this is the problem of recovery from injuries, as even minor injuries in power disciplines can significantly alter the periodization plan and necessitate a complete restructuring of training cycles.

Improving the training process of highly qualified powerlifters should be based on a combination of classical principles of periodization with the latest methods of individualization, which allows you to maximally adapt the program to the characteristics of a particular athlete. A practical step is the use of functional state monitoring systems, particularly the analysis of heart rate variability, speed of lifting, and subjective indicators of fatigue, which allows for the timely detection of signs of overload and the adjustment of both volume and intensity of work. It is advisable to implement a modular approach to building macrocycles, where individual blocks of maximum strength development, technical stability, and recovery can be flexibly adjusted depending on changes in the international calendar or individual athlete needs. Given the increasing density of international tournaments, it is essential to take into account the recovery factor. In practice, this means using «tapering» strategies before major competitions, when the load is reduced, but the intensity is maintained at a high level to maintain neuromuscular adaptations. It is essential to incorporate comprehensive recovery measures,

including cryotherapy, massage, electrical stimulation, sleep correction, and nutritional support, which help accelerate the body's return to an optimal functional state.

A promising direction is the use of digital technologies and artificial intelligence to create personalized load models. Such systems, analyzing the accumulated data, form a forecast of optimal days of high performance and warn about the risks of overtraining. The practical results of implementing this approach in leading national teams indicate an increase in the stability of performances during the season and a more accurate return of athletes to peak form before the decisive starts. Taking into account the modern requirements of the international sports calendar, the key is the development of adaptable training programs that can be quickly adjusted when tournaments are postponed or added. The use of individualization principles, the integration of monitoring technologies, and multi-level recovery strategies allows for creating a flexible, scientifically based training system that ensures the competitiveness of powerlifters on the world stage.

Conclusions. The study found that the effectiveness of training high-level powerlifters for international competitions is ensured by a multi-level periodization system that combines macro-, meso-, and microcycles, allowing for the management of adaptation processes and bringing athletes to peak form in the desired competitive period. It is demonstrated that the key factor is the optimal ratio of volume and intensity of loads, combined with individualized recovery control using biomechanical monitoring, heart rate variability analysis, and digital platforms. The main problems that complicate the optimization of periodization are identified: risks of overload, significant individual differences in adaptation rates, a shortage of scientifically based methods, limited use of modern monitoring technologies, as well as organizational and psychological challenges associated with a tight and changing calendar of international competitions. It is recommended to implement a modular approach to building macrocycles, utilize digital monitoring systems and artificial

intelligence to predict recovery, and integrate comprehensive recovery tools, ranging from physiotherapy procedures to sleep and nutrition optimization. Prospects for further research include the creation of personalized algorithms for planning loads in real-time, modeling peak states using artificial intelligence, and studying the psychophysiological aspects of powerlifters' adaptation to the stressful conditions of international competitions.

References

1. Драчук С., Дідик Т., Кульчицька І., Черниш М. Особливості планування річного макроциклу в пауерліфтингу. *Фізична культура, спорт та здоров'я нації: збірник наукових праць*. 2021. Вип. 11, № 30. С. 162–170. URL: https://dspace.vspu.edu.ua/server/api/core/bitstreams/42224dee-824a-4ab5-92d0-7db7570bf91f/content (access date: 09.07.2025).

2. Розторгуй М. С., Гангур О. В., Оліярник В. І., Гавриленко М. М. Планування навантаження у підготовці пауерліфтерів високої кваліфікації у змагальному періоді макроциклу. *Науковий часопис Українського державного університету імені Михайла Драгоманова. Серія 15*. 2021. Вип. 7, № 138. С. 104–108. DOI: https://doi.org/10.31392/NPU-nc.series15.2021.7(138).22.

3. Sapuppo M., Oberlin D., Burke R., Pinero A., Mohan A., Augustin F., Schoenfeld B. Preparation for powerlifting competition: a case study. *International Journal of Strength and Conditioning*. 2024. Vol. 4, № 1. DOI: https://doi.org/10.47206/ijsc.v4i1.361.

4. Gonchar A. Analysis and optimization of training load to improve bench press performance in young powerlifters. *Академічні візії*. 2025. Вип. 44. DOI: https://doi.org/10.5281/zenodo.15718413.

5. Pearson J., Spathis J. G., Van Den Hoek D. J., Owen P. J., Weakley J., Latella C. Effect of competition frequency on strength performance of powerlifting athletes. *The Journal of Strength & Conditioning Research*. 2020. Vol. 34, № 5. P. 1213–1219. DOI: https://doi.org/10.1519/JSC.0000000000003563.

6. Bompa T. O., Buzzichelli C. Periodization of strength training for sports. Human Kinetics Publishers. 2021. 308 p. URL: https://books.google.com.ua/books?hl=uk&lr=&id=AyIfEAAAQBAJ&oi=fnd&pg=PR1 (access date: 09.07.2025).

7. Latella C., Teo W. P., Spathis J., van den Hoek, D. Long-term strength adaptation: A 15-year analysis of powerlifting athletes. *The Journal of Strength & Conditioning Research*. 2020. Vol. 34, № 9. P. 2412-2418. DOI: 10.1519/JSC.0000000000003657.

8. Islamov V. A., Dalskii D. D., Salnikov V. A. Description of principles and development of an integrated strength indicator system for powerlifting cadets during the competition season. *Humanitarian Military Journal*. 2025. Vol. 1, № 2. P. 131–140. URL: https://manmiljournal.ru/hmj/article/view/679879 (access date: 09.07.2025).

9. González-Alcázar F. J., Jiménez-Martínez P., Alix-Fages C., Ruiz-Ariza A., Casuso R. A., Varela-Goicoechea J., Jerez-Martínez A. Impact of low-load high-volume initial sets vs. traditional high-load low-volume bench press protocols on functional and structural adaptations in powerlifters. *Applied Sciences*. 2025. Vol. 15, № 4. 1974. DOI: https://doi.org/10.3390/app15041974.

10. Stone M. H., Hornsby W. G., Haff G. G., Fry A. C., Suarez D. G., Liu J., Pierce K. C. Periodization and block periodization in sports: emphasis on strength-power training – a provocative and challenging narrative. *The Journal of Strength & Conditioning Research*. 2021. Vol. 35, № 8. P. 2351–2371. DOI: https://doi.org/10.1519/JSC.0000000000004050.

11. Suarez D. G., Mizuguchi S., Hornsby W. G., Cunanan A. J., Marsh D. J., Stone M. H. Phase-specific changes in rate of force development and muscle morphology throughout a block periodized training cycle in weightlifters. *Sports*. 2019. Vol. 7, № 6. 129. DOI: https://doi.org/10.3390/sports7060129.

12. Horoshko V. I., Hordiienko O. V. Using the PICO model to evaluate the effect of training periodization on female powerlifter performance. *Науковий часопис Українського державного університету імені Михайла Драгоманова. Серія 15*. 2025. Вип. 3, № 189. С. 204–209. DOI: https://doi.org/10.31392/udu-nc.series15.2025.03(189).39.

13. Androulakis-Korakakis P., Michalopoulos N., Fisher J. P., Keogh J., Loenneke J. P., Helms E., Steele J. The minimum effective training dose required for 1RM strength in powerlifters. *Frontiers in Sports and Active Living*. 2021. Vol. 3. 713655. DOI: https://doi.org/10.3389/fspor.2021.713655.

14. Travis S. K., Mujika I., Gentles J. A., Stone M. H., Bazyler C. D. Tapering and peaking maximal strength for powerlifting performance: a review. *Sports*. 2020. Vol. 8, № 9. 125. DOI: https://doi.org/10.3390/sports8090125.

15. Williams T. D., Esco M. R., Fedewa M. V., Bishop P. A. Inter-and intra-day comparisons of smartphone-derived heart rate variability across resistance training overload and taper microcycles. *International Journal of Environmental Research and Public Health*. 2021. Vol. 18, № 1. 177. DOI: https://doi.org/10.3390/ijerph18010177.

16. Addleman J. S., Lackey N. S., DeBlauw J. A., Hajduczok A. G. Heart rate variability applications in strength and conditioning: A narrative review. *Journal of Functional Morphology and Kinesiology*. 2024. Vol. 9, № 2. 93. DOI: https://doi.org/10.3390/jfmk9020093.

17. Mateus N., Abade E., Coutinho D., Gómez M. Á., Peñas C. L., Sampaio J. Empowering the sports scientist with artificial intelligence in training, performance, and health management. *Sensors*. 2024. Vol. 25, № 1. 139. DOI: https://doi.org/10.3390/s25010139.