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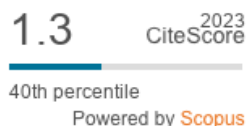
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ORIGINAL ARTICLES. SPORT

The effects of fitness training on physical preparedness of highly qualified football players

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Abstract

Background and purpose

If everything is systematized and well-built in football player's physical training, and not only classical techniques are used, but also innovations, the chances of winning increase many times over. This study aims to develop an experimental training program to increase the physical preparedness of highly skilled football players in the preparatory period of the annual macrocycle by means of fitness training.

Material and Methods

Participants: 34 players of Football Club "Zorya" (Luhansk city) aged 25.5±1.6 years. Methods: pedagogical experiment; tests of general and special physical fitness, mathematical statistics.

Results

Experimental program was developed to increase the efficiency of the training process of highly skilled football players. The main feature of this program was the use of innovative methods of modern fitness training: TRX/TRX-Rip, MAX®, Tabata, High-Intensity Interval Training (HIIT), Strenflex, 6D Sliding, myo-fascial release, in addition to the classic methods of exercises. Functional classes that based on the use of step platforms were offered instead of classical aerobics classes. The physical preparedness testing of FC "Zorya" football players at the end of the preparatory period of the 2019/2020 season indicated a significantly better level of athlete's readiness for the next competitive period comparing to the corresponding periods of the previous season.

Conclusions

The implementation of experimental program in the training process of highly qualified football players of FC "Zorya" (Luhansk) contributed to the improvement of their general and special physical preparedness. Program effectiveness was confirmed by the FC "Zorya" winning bronze medals in the championship of the Ukrainian Premier League 2019/2020 season.

Key words: fitness test, football player, special physical preparedness, preparatory period, competitive period



Анотація

Лісенчук Г., Хмельницька І., Богатирьов К., Кокарев Б., Кокарева С., Деркач В., Марцінковський І., Крупеня С., Цеслицька М. Вплив фітнес-тренування на фізичну підготовленість футболістів високої кваліфікації

Обґрунтування і мета

Якщо у фізичній підготовці футболіста все систематизовано і грамотно побудовано, і використовуються не тільки класичні прийоми, а й інновації, то шанси на перемогу збільшуються в рази. Метою дослідження є розробка експериментальної програми підготовки для підвищення фізичної підготовленості висококваліфікованих футболістів у підготовчий період річного макроциклу засобами фітнес-тренування.

Матеріал і методи

Учасники: 34 гравці ФК «Зоря» (м. Луганськ) віком $25,5 \pm 1,6$ років. Методи: педагогічний експеримент; тести загальної та спеціальної фізичної підготовленості, математична статистика.

Результати

Для підвищення ефективності тренувального процесу висококваліфікованих футболістів розроблено експериментальну програму. Головною особливістю цієї програми стало використання, окрім класичних вправ, інноваційних методів сучасного фітнес-тренування: MAX®, Tabata, високоінтенсивного інтервального тренінгу (HIIT). Замість занять класичною аеробікою запропоновано функціональні заняття, які базуються на використанні степ-платформ. Тестування фізичної підготовленості футболістів ФК «Зоря» наприкінці підготовчого періоду сезону 2019/2020 засвідчило значно кращий рівень підготовленості спортсмена до наступного змагального періоду у порівнянні з відповідними періодами попереднього сезону.

Висновки

Впровадження експериментальної програми у тренувальний процес висококваліфікованих футболістів ФК «Зоря» (м. Луганськ) сприяло покращенню їх загальної та спеціальної фізичної підготовленості. Ефективність програми підтверджено здобуттям ФК «Зоря» бронзових медалей у чемпіонаті Української Прем'єр-ліги сезону 2019/2020.

Ключові слова: фітнес-тест, футболіст, спеціальна фізична підготовленість, підготовчий період, змагальний період

Аннотация

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Обоснование и цель

Если в физической подготовке футболиста все систематизировано и грамотно построено, и используются не только классические приемы, но и инновации, то шансы на победу увеличиваются в разы. Целью исследования является разработка экспериментальной программы подготовки для повышения физической подготовленности высококвалифицированных футболистов в подготовительный период годичного макроцикла средствами фитнес-тренировки.

Материал и методы

Участники: 34 игрока ФК «Заря» (г. Луганск) в возрасте $25,5 \pm 1,6$ года. Методы: педагогический эксперимент; тесты общей и специальной физической подготовленности, математическая статистика.

Результаты

Для повышения эффективности тренировочного процесса высококвалифицированных футболистов разработана экспериментальная программа. Главной особенностью этой программы стало использование, кроме классических упражнений, инновационных методов современной фитнес-тренировки: MAX®, Tabata, высокоинтенсивного интервального тренинга (HIIT). Вместо занятий классической аэробикой предложены функциональные занятия, основанные на использовании степ-платформ. Тестирование физической подготовленности футболистов ФК «Заря» в конце подготовительного периода сезона 2019/2020 показало значительно лучший уровень подготовленности спортсмена к следующему соревновательному периоду по сравнению с соответствующими периодами предыдущего сезона.

Выводы

Внедрение экспериментальной программы в тренировочный процесс высококвалифицированных футболистов ФК «Заря» (г. Луганск) способствовало улучшению их общей и специальной физической подготовленности. Эффективность программы подтверждена получением ФК «Заря» бронзовых медалей в чемпионате Украинской Премьер-лиги сезона 2019/2020.

Ключевые слова: фитнес-тест, футболист, специальная физическая подготовленность, подготовительный период, соревновательный период



Introduction

Today, in connection with the decline in the sports results of Ukrainian football players on the international arena, the problem of improving the training process of their preparation at the different stage of the realization of individual capabilities is acute [1, 2, 3]. One of the key issues in solving this problem is the development and implementation of innovative training programs for professional football players based on original fitness technologies [4, 5]. In the training process of elite professional football teams, the methods of high-intensity functional fitness training such as TRX-Rip and Muscle Activity Excellence M.A.X. are widely used [6, 7, 8]. At the same time, these methods are unfamiliar to football coaches of the Ukrainian Premier League (UPL). The analysis of scientific and methodological literature and the experience of practical activities with professional Ukrainian football clubs show that today to improve the physical fitness of football players, it is necessary to introduce the latest technologies using innovative techniques of fitness training and fitness multi-sport [9, 10]. Therefore, the scientific justification, approval, and practical introduction of an experimental program on physical training using fitness training tools into the training process of highly qualified football players is relevant. At the same time, there are very few studies in the available scientific and methodological literature that contain methodological recommendations for the variable use of various methods of high-intensity interval training in the training process of qualified football players during the annual training cycle as well as a means of express recovery of players after high muscle loads [11, 12].

The research objective was to develop an experimental program of physical training of highly qualified football players using fitness training tools in the preparatory period of the annual macrocycle. The crux of the athlete's approach to fitness and health was rooted in the latest research and being able to measure as many variables as possible with actionable data.

Material and methods

Participants

34 highly qualified football players aged

25.5±1.6 years took part in the study. The researchers followed all protocols and procedures required by the Biomedical research Ethics Committee and conform to the directive of the Helsinki 2008 Declaration to ensure adherence to all standards for adequate protection and well-being of participants. The study was approved by the Zaporizhzhia Polytechnic National University (Code: 0116U004848).

Procedure

The research was conducted based on the team of the Premier League of the Ukrainian football championship FC "Zorya" (Luhansk) and at the Zaporizhzhia National University in the period from 2014 to 2020. The framework of the ascertaining experiment was the sports season of 2018/19, formative – the 2019/20 season. In the annual training cycle of football players of FC "Zorya" (Luhansk) in the 2018/2019 sports season, the training process was carried out in accordance with the program for building the training process in force at that time, and in the 2019/2020 sports season, an experimental program was used in the first and second preparatory periods of the annual training cycle.

The ascertaining experiment was conducted within the framework of the annual macro cycle of the 2018/19 season. The formative experiment was conducted in the 2019–2020 sports season because of the application of an experimental program using innovative means in the first and second preparatory periods of the annual training cycle of FC Zorya (Luhansk) players.

Data collection

The following tests: Running 30 m, Standing long jump, Stand & Rich, Multi-stage fitness test 7×50 m, Yo-Yo intermittent test, Five-time leap, Long-range ball shot, 2 kg medicine ball throw-in, Bridge push-up, Side split, Front split have been used to determine the physical preparedness of football player.

Statistical analysis

Since the samples of indicators of the physical fitness of football players corresponded to the law of normal distribution (which was confirmed by Shapiro-Wilk test), parametric descriptive statistics were used in the study. The arithmetic mean $\bar{x}$



, standard deviation SD were determined. The statistical significance of the difference between the test indicators at different stages of the experiment was determined by t-test.

The dynamics of test results was determined as the difference between test result at the end of the certain training period in 2019/2020 vs 2018/2019 (by subtraction operation). To be able to compare visually the dynamics of test results, the values of which differ by 2 orders of magnitude, the data were standardized so that they belong to a small specific interval [0,1]. In statistics, the term "standardization" has a very specific meaning and refers to the transformation of data by subtracting each value from some reference value (usually the sample mean $\bar{X}$) and dividing it by the standard deviation (usually the sample SD). When applied to input data, standardization makes the results of various statistical methods completely independent of value ranges or measurement units. This important transformation brings all values (regardless of their distribution and original units) to compatible units from a distribution with a mean of 0 and a standard deviation of 1. This operation is often used when processing certain benchmarks and scores to remove certain data ranges and transform them into a dimensionless pure value, so that it is possible to compare and weigh indicators of different units or quantities.

Statistica Version 14.0.1.25 (TIBCO Software) was used for statistical processing.

Results

The analysis of special physical preparedness of the FC "Zorya" players in the ascertaining experiment (Table 1) showed the insufficient effectiveness of the traditional program for the physical training of highly qualified football players in the preparatory and competitive periods of the annual training cycle and the need to correct this program, due to the inclusion of innovative means of fitness training [5].

The obtained data showed the level of athlete's training was marked by optimal fitness indicators only in the tests that characterized the explosive power and joint flexibility. The results of the "Standing long jump" and "Front split" corresponded to the "above average" level. The rest of the highly qualified football players' indicators, which characterized the speed, special and speed endurance, strength abilities and flexibility of corresponded to the "average" level of development. The most interesting of the strength

tests, in our opinion, was the test "2 kg medicine ball throw-in". For football players, it is somewhat specific, even though a high degree of probability it imitates a real technical and tactical action specifically the introducing the ball from the outfield.

The research data indicated that before the end of the 2nd preparatory period of the annual macrocycle, it was almost impossible to achieve optimal indicators in most parameters characterizing the athlete's physical condition on the eve of the second round of the UPL championship 2018/19. Only test indicators "Standing long jump", "Five-time leap" and "Long-range ball shot" corresponded to the "above average" value. The indicators of the remaining tests of football player's general and special physical preparedness corresponded to the "average" level. Negative changes in the indicators of special physical preparedness were recorded after the 1st competitive period – from 3.6% to 29.4% and after the 2nd – from 2.9% to 9.3%. The dynamics of special physical preparedness of the FC "Zorya" players at the end of the first and second preparatory periods 2018/2019 vs 2019/2020 is presented in Figure 1.

The most significant was the letdown in tests for special endurance and flexibility. The 4th place in the UPL championship in the 2018/19 season was the consequence of this situation, which became the basis for the development of an author's program for the physical training of highly qualified football players of FC "Zorya".

The main difference between the experimental program and the traditional one was the using of innovative methods of modern fitness training, namely: MAX®, Tabata, High-Intensity Interval Training (HIIT), TRX/TRX-Rip, Strenflex, 6D Sliding, in addition to the classic methods of exercises. The peculiarity of the construction of the first preparatory mesocycle in the 2019/20 sports season was that the one consisted of 5 micro-cycles and contained two shock micro-cycles following one another, unlike the second preparatory mesocycle. This sequence, in our opinion, was due to the shortening of the training period in connection with the regulations of the UPL championship of the previous season and the schedule of International official games of the European League in the 2019/20 season. The team's complex scientific group followed the classic ideas about cycling and the ratio of means during the preparatory period from the point of view of the percentage distribution of the training load



types during the given training period.

The functional classes based on the step platform using were offered instead of classic aerobics classes:

- the original method of conducting the class according to the non-traditional scheme of using step-platforms in the form of a solid continuous line "clones-attack"; classes in the "double-step" or "triple-step" mode with increased coordination complexity and load; using step platforms as an obstacle to be avoided or jumped over [13];

- strenflex instead of crossfit and Bosu in combination with mini-tramp instead of fitball [14];

- exercises using the 6D Sliding technique were offered instead of typical running exercises and exercises with rubber shock absorbers (expanders of various configurations);

- complexes of exercises with the use of TRX® functional loops were further developed, which were supplemented with exercises with a new training device using the TRX-RipTrainer™ technique [15];

- specially developed complexes consisting of five "mini-circles" – blocks of five exercises aimed at different muscle groups, performed with an interval of 1.5-2 minutes of active rest between them – were added to the usual technique of interval circuit training, which had a classic scheme and consisted of 20 exercises-"stations", conditionally located "in a circle" with the observance of alternating training

influences;

- in the preparatory and final parts of training classes, complexes of myo-fascial relaxation (MFR) exercises with roles of different configurations: pointed, with a pronounced protector (to stimulate activity) in the warm-up; smooth or with an indistinct protector (for stretching and relaxation) in a hitch – were added to traditional stretching.

Summarizing the results of physical preparedness of FC "Zorya" football players at the end of the preparatory and competitive periods of the 2019/20 sports season, it can be stated that there was a significantly better level of football players' preparedness for the next periods compared to the corresponding periods of the previous season (Table 2).

Therefore, at the end of both preparatory periods, the results of football players in flexibility tests (by 16.8% and 26.8% respectively), "Yo-Yo intermittent test" (by 15.6 % and 15.9%), "2 kg medicine ball throw-in" (by 21.9% and 16.3%), and in the exercise "Bridge push-up" (by 6.7% and 5.8%). In addition, at the end of the 2nd preparatory period, the football players had significantly better results in the tests "Long-range ball shot" (by 6.7%), "Side split" (by 7, 2%) and "Front split" (by 8.7%). The dynamics of special physical preparedness of the FC "Zorya" players at the end of the first and second competitive periods 2018/2019 vs 2019/2020 is presented in Figure 2.

Table 1

Indicators of Physical Preparedness of FC Zorya Players at the End of Various Periods of Preparation for the 2018/2019 and 2019/2020 Sports Season ($\bar{X} \pm SD$), (n=34)

Test	At the end of the first preparatory period		At the end of the second preparatory period	
	2018/2019	2019/2020	2018/2019	2019/2020
Running 30 m, s	4.07±0.03	3.85±0.05*	4.14±0.12	4.15±0.05
Standing long jump, cm	2.61±0.05	2.70±0.50	2.65±0.05	2.70±0.33
Stand & Rich, cm	-4.93±0.05	-4.10±0.05***	-4.55±0.15	-3.25±0.15***
Multi-stage fitness test 7×50 m, s	60.96±0.29	57.52±1.20*	59.89±0.45	58.55±0.15
Yo-Yo intermittent test, min	11.43±0.15	13.21±0.19***	11.40±0.20	13.21±0.19***



Five-time leap, m	13.80±1.45	13.85±0.25	13.75±1.05	14.19±2.11
Long-range ball shot, m	58.50±1.33	58.45±1.13	59.50±1.23	63.50±1.75*
2 kg medicine ball throw-in, cm	824.1±4.28	1004.6±0.27***	824.1±5.28	958.6±6.15***
Bridge push-up, cm	64.9±2.05	60.5±1.05*	68.5±1.05	64.5±1.05*
Side split, cm	49.5±1.50	49.0±0.14	50.0±1.01	45.5±1.50**
Front split, cm	34.5±1.55	32.4±1.20*	36.5±1.50	33.3 ±1.30**

Note. * – the difference between test results compared to previous sports season is statistically significant at the level $p<0.05$; ** – $p<0.01$; *** – $p<0.001$.

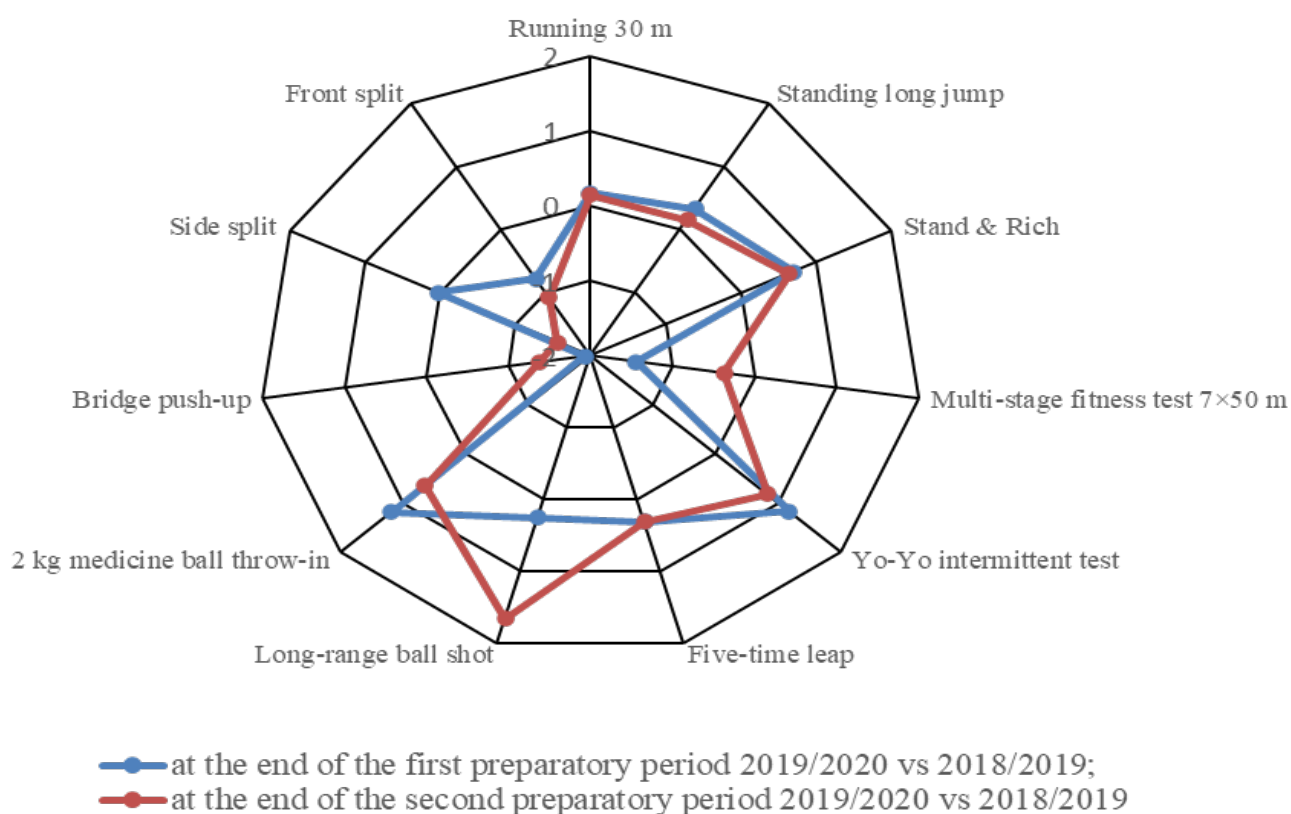


Figure 1. The dynamics of special physical preparedness (standartized values of the test results) of the FC "Zorya" players



Table 2

Indicators of Physical Preparedness of Highly Qualified Football Players at the End of Preparatory Periods of Different Competitive Seasons ($\bar{X} \pm SD$), (n=34)

Test	At the end of the first competitive period		At the end of the second competitive period	
	2018/2019	2019/2020	2018/2019	2019/2020
Running 30 m, s	4.30±0.03	4.15±0.03	4.33±0.13	4.35±0.05
Standing long jump, cm	2.45±0.35	2.56±0.23*	2.57±0.13	2.61±0.33
Stand & Rich, cm	-6.12±0.03	-5.00±0.02***	-5.93±0.03	-4.05±0.10***
Multi-stage fitness test 7×50 m, s	62.78±0.30	59.79±1.13*	61.97±0.35	59.79±0.33
Yo-Yo intermittent test, min	8.07±0.17	11.60±1.05***	10.34±0.29	11.05±1.05*
Five-time leap, m	13.30±1.12	13.42±1.11	13.30±1.22	13.77±1.33
Long-range ball shot, m	55.15±1.05	56.75±1.05	57.55±1.23	61.90±1.33*
2 kg medicine ball throw-in, cm	786.4±5.22	900.6±0.21***	800.6±5.25	864.3±5.25*
Bridge push-up, cm	69.4±2.22	61.3±1.05**	69.4±1.41	69.1±2.02
Side split, cm	57.3±1.40	54.5±1.50*	59.4±3.11	55.7±1.23*
Front split, cm	39.5±1.50	37.2±1.25*	39.8±1.25	39.5 ±1.55

Note. * – the difference between test results compared to previous sports season is statistically significant at the level $p < 0.05$; ** – $p < 0.01$; *** – $p < 0.001$.

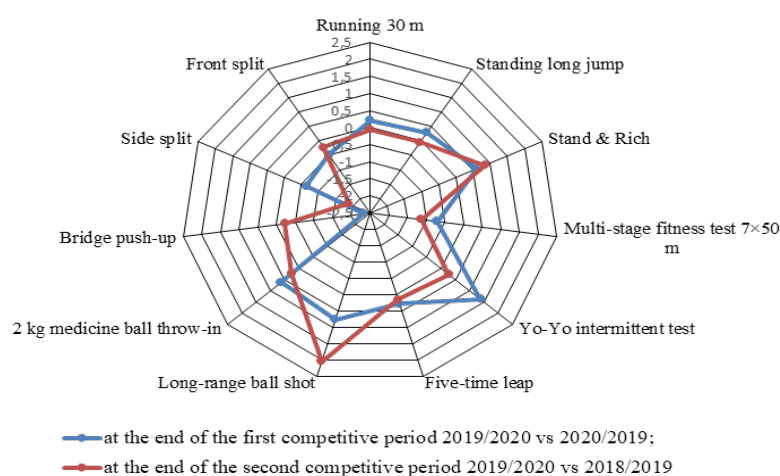


Figure 2. The dynamics of special physical preparedness (standartized values of the test results) of the FC "Zorya" players



According to the coaching staff and top management of the club, the results of the team's performances in the UPL championship confirmed the effectiveness of the experimental program for building the educational and training process of FC "Zorya" team in the first and second preparatory periods of the annual cycle of preparation for the 2019/20 season. The implementation of program in the training process of highly qualified football players of FC "Zorya" (Luhansk) contributed to the improvement of the level of general and special physical preparedness and the achievement of high sports results – bronze medals of the championship of the Ukrainian Premier football league and entry to the UEFA European League.

Discussion

The problem of improving the athlete's physical preparedness in sport games is of interest to many researchers. Some scientists propose to use the mathematical basis for the integral development of strength, speed and endurance [16, 17], to study the relationship between athlete's fundamental motor skills and game specific skills [18] and also to utilize machine learning algorithms to predict the performance probabilities of players [19].

The systematic analysis of the data presented in the special scientific and methodological literature indicates the presence of various approaches to improving the content and structure of football players' physical training programs [20, 21] thanks to the use of aerobics and step aerobics [22, 23], CrossFit®, stretching, bodybuilding [24]. The problem of football player's fitness improving is related to the search for effective approaches that relate to the provision of the educational and training process with modern training tools and techniques of their practical implementation [10, 25, 26].

The research results of Madarsa & Mohamad (2022) indicated that the six-week pre-season training program, which included aerobic, anaerobic, and resistance training, as well as technical-tactical training drills, significantly improved cardiovascular fitness and sprinting ability [27]. The findings imply that proper pre-season training programs based on intermittent anaerobic and aerobic training can enhance professional football players' performance and an appropriate performance-monitoring program can determine the effectiveness of a pre-season program. All exercises involved and combined major

muscle groups in soccer and due to the load (as a combination of body weight or little resistance and time spend in each exercise) the purpose seemed to be to improve the strength (endurance) of the muscles trained. Furthermore, the exercises were placed in an order that ensured a changed between muscle groups with the practical effect to maximize efficacy of training and limit total duration of session. Regarding the importance of speed endurance training during a season, it is necessary to improve performance in yo-yo intermittent recovery test after 12 weeks and improve maximal oxygen uptake and glycolytic enzyme activity [28].

On our opinion, the development of new programs for building the training process of highly qualified football players involves, first, studying the features of changes in the main indicators of their physical preparedness within the framework of the annual training cycle under the influence of existing training programs. It is obvious that knowledge of such patterns in general, as well as at certain stages of the annual training cycle, is a necessary basis for scientifically based correction of the educational and training process, increasing its effectiveness to achieve the maximum possible sports results. HIIT can be beneficial to training aerobic capacity. It is recommended that fitness trainers consider implementing field based HIIT at very high intensities, as an effective tool to improve the aerobic capacity of football players in a short period. HIIT is a time-effective training method that can efficiently improve the cardiorespiratory dynamics of football players in a limited time [29, 30]. The effectiveness of our authors' training programs has been confirmed by increasing the volume and redistribution of physical loads within individual micro- and mesocycles [31], optimizing training and recovery modes [9], as well as using additional training tools [26, 32]. This conclusion fully coincides with the opinion of reputable experts in the field of high-performance football [3, 5]. Izzo et al. (2022) identified the differences in training load both within and between microcycles during the competition phase in an elite professional football team [4]. Such information is beneficial to improve our understanding of weekly and seasonal load distribution in elite football and to understand the periodization strategies employed in professional football. Therefore, when evaluating microcycle and macrocycle load, a combination of internal and external training load is needed. Our results



confirmed the conclusions by Jagielski (2022) that to avoid a drastic decrease in physical performance in the final part of season, it is necessary to create the specific bases from the aerobic-anaerobic system during in-season week and increase the all-out sprint training at least once a week (about 20-25 training session to improve and to maintain performance) [33]. The findings also confirm the results of studies that revealed the effects of various training programs on the level of physical and technical fitness of young football players [34, 35, 36, 37, 38].

Conclusions

For the first time, the innovative means of fitness techniques: MAX®, Tabata, HIIT, TRX/TRX-Rip, Strenflex, 6D Sliding, in addition to the classic methods of exercises were included to the program of physical training of highly qualified football players in micro- and mesocycles of the preparatory period of the annual macrocycle.

For the first time, the technique of myofascial relaxation was proposed for practical use, which provides appropriate sets of physical exercises with the use of auxiliary equipment (roles of different configurations) to reduce recovery time and increase the flexibility of highly qualified football players.

The implementation of experimental program in the training process of highly qualified football players of FC "Zorya" (Luhansk) contributed to the improvement of the level of general and special physical preparedness and the achievement of high sports results (bronze medals of the championship of the Ukrainian Premier football league and entry to the UEFA European League).

The authors' program was introduced into the training process of "Metallurg IFC" municipal football club (Zaporizhzhya), "Orbita-ZNU" volleyball club (Zaporizhzhya), handball club «Motor» (Zaporizhzhya).

Compliance with ethical requirements

The study was conducted in accordance with the principles of the Helsinki Declaration of the World Medical Association «Ethical principles of medical research involving a person as an object of research». All study participants provided informed consent in writing to participate in the study.

Conflict of interest

The authors declare that there is no conflict of interest.

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