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CONTENT

Influence of fitball aerobics on the development of individual coordinating abilities of girls 14–15 years old

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Abstract

Purpose: to determine the change in the level of development of the dynamics of the coordination abilities of girls 14–15 years old under the influence of fitball aerobics exercises.

Material & Methods: the study was carried out on the basis of general secondary education in Kharkov. It was attended by 46 girls aged 14–15. The following methods were used in the course of the study: theoretical analysis and generalization of scientific and methodological literature, pedagogical testing, pedagogical experiment, methods of mathematical statistics.

Results: the level of development of coordination abilities of girls aged 14–15 was assessed by such manifestations of coordination abilities as the ability for spatial orientation, the ability to assess and regulate the spatial and dynamic characteristics of movements, the ability to maintain static balance and the ability to adapt and restructure motor actions. A comparison of the indicators of the development of coordination abilities in the age aspect with the corresponding norms before and after the use of fitball aerobics exercises is presented. The results of the study indicate a trend towards an increase in the level of manifestation of coordination abilities after the experiment. The most significant increase was observed in the indicators of a jump with a turn: from 23,1% to 62,4% and the results of the Bondarevsky test: from 18.6% to 30.6%. Comparison of the indicators of coordination abilities in the age aspect showed that girls of 14 years old in most cases demonstrate higher results than girls of 15 years old. Comparison of the studied indicators with the relevant standards showed that the results correspond to the "average" level.

Conclusions: the dynamics of the results indicates the stability of the level of development of coordination abilities and the trend towards their improvement. This confirms the expediency of organizing fitball aerobics classes in the sports section of the school.

Анотація

Ірина Кузьменко, Анджей Островський, В'ячеслав Жук. Вплив занять фітбол-аеробікою на розвиток окремих координаційних здібностей дівчат 14–15 років. Мета: визначити зміну рівня розвитку динаміку координаційних здібностей дівчат 14–15 років під впливом вправ фітбол-аеробіки. **Матеріал і методи:** дослідження здійснювалося на базі закладу загальноосвітньої середньої освіти м. Харкова. В ньому брали участь 46 дівчат 14–15 років. Під час проведення дослідження застосовувалися наступні методи: теоретичний аналіз і узагальнення наукової та методичної літератури, педагогічне тестування, педагогічний експеримент, методи математичної статистики. **Результати:** рівень розвитку координаційних здібностей дівчат 14–15 років оцінювався за такими проявами координаційних здібностей як здатність до просторової орієнтації, здатність до оцінки й регуляції просторово-динамічних характеристик рухів, здатність до збереження статичної рівноваги та здатність до пристосування і перебудови рухових дій. Представлене порівняння показників розвитку координаційних здібностей у віковому аспекті, з відповідними нормами до та після застосування вправ фітбол-аеробіки. Результати дослідження свідчать про тенденцію до підвищення рівня прояву координаційних здібностей після експерименту. Найбільш суттєвий приріст спостерігався у показниках стрибка з поворотом: від 23,1% до 62,4% та результатах проби Бондаревського: від 18,6% до 30,6%. Порівняння показників координаційних здібностей у віковому аспекті виявило, що дівчата 14 років у більшості випадків демонструють результати вищі, ніж учениці 15 років. Співставлення досліджуваних показників з відповідними нормами показало, що результати відповідають «середньому» рівню. **Висновки:**

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Key words:
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adaptation and restructuring of motor actions

Ключові слова:
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статична рівновага
пристосування та перебудова рухових дій

динаміка результатів свідчить про стабільність рівня розвитку координаційних здібностей, та тенденцію до їх покращення. Це підтверджує доцільність організації занять фітбол-аеробікою у спортивній секції школи.

Introduction

Motor activity is one of the most important components of a healthy lifestyle and is essential for full physical and mental health, especially in childhood, adolescence and youth (Kolokoltsev et al., 2020; Podrihalo et al., 2022).

Modern conditions of human life contribute to a decrease in physical activity, which causes significant harm to health. The younger generation is especially vulnerable. To meet the biological need of a growing organism to move, the system of the educational process should provide for various forms of physical education, since even three physical education lessons a week do not provide the optimal level of physical activity for children (Denysenko et al., 2007; Platonova et al., 2013; Kuzmenko, 2020). Therefore, one of the ways to solve this problem is to organize various forms of physical exercises, including sports sections, in an educational institution.

To increase motivation for physical exercises, a number of authors note the importance of introducing modern innovative types of physical activity into the process of physical education of schoolchildren: cheerleading (Bala et al., 2018); modern dance (Kuzmenko & Tymchenko, 2019); health fitness (Matukhno, 2016; Chekhovskaya, 2020); workout (Nahorniuk & Masliak, 2018), etc.

Specialists in the field of physical culture and sports offer different ways to develop the coordination abilities of the younger generation: floorball means (Bilan, 2017); increasing the functional state of sensory systems (Kuzmenko, 2010); introduction of a multi-level system of differentiated learning (Mameshyna, 2018), etc.

One of the most common areas of physical activity among girls is fitball-aerobics. Fitball aerobics is one of the varieties of aerobics, where large, light, elastic balls – fitballs are used as the main projectile for performing exercises. Fitball-aerobics, as a modern type of physical activity, has an advantage over traditional ones, since it allows solving a variety of tasks (Chekhaniuk, 2013; Ilin & Kuchma, 2020).

Suvorova et al. (2018) note that exercises on fitballs have a positive effect on the functioning of the cardiovascular and respiratory systems, train the vestibular apparatus, improve mobility in the joints, increase efficiency, muscle strength and overall endurance, develop coordination abilities.

The diversity of fitball-aerobics exercises, its health-improving, educational, educational aspects and the possibility of attracting a contingent of people with different levels of physical fitness and health status are noted Bazylevych & Horbenko (2016), Bermudes (2016).

In our opinion, fitball-aerobics exercises can be considered as an effective tool for increasing the motivation of girls for physical exercises, achieving a harmonious physical and mental state, improving health, developing physical qualities, in particular, various types of coordination abilities.

It should be noted that a high level of development of coordination abilities is quite important in various fields of activity: educational, sports, labor, professional, etc. (Kolumbet, 2014; Chernykh et al., 2021; Serhiienko, 2021).

However, scientific works aimed at studying the effectiveness of the use of fitball aerobics for the development of coordination abilities of girls of secondary school age in the sports section of an institution of general secondary education were not found in the literature available to us, which determined the relevance of our study.

Purpose of the study: to determine the dynamics of the development of coordination abilities of girls aged 14-15 under the influence of fitball-aerobics exercises.

Material and Methods of the research

Participants

The study involved 46 people aged 14-15 years (22 girls 14 years old and 24 girls 15 years old). The girls who participated in the study were practically healthy and had a doctor's permission to engage in the sports section. Girls and parents gave informed consent to participate in the study.

Methods

The following methods were used in the course of the study: theoretical analysis and generalization of scientific and methodological literature; pedagogical testing; pedagogical experiment and methods of mathematical statistics.

Theoretical analysis and generalization of scientific and methodological literature was carried out to study the relevance of the problem under study.

Pedagogical testing was carried out to determine the state and dynamics of the level of development of individual manifestations of the coordination qualities of girls 14–15 years old. The tests proposed by Serhiienko (2001) and Skalii (2006) were used.

During the study, the following manifestations of coordination abilities were assessed: the ability for spatial orientation in complicated conditions – a jump with a turn, running towards numbered balls; the ability to assess and regulate the spatial and dynamic characteristics of movements – throwing rings on the rack, throwing the ball at the target; the ability to maintain static balance – Bondarevsky's test, Yarotsky's test; the ability to adapt and restructure motor actions – performing three somersaults forward, Kopylov's test "ten eights".

The control exercise "Jump with a turn" involved a jump with a 360° turn over the gymnastic bench from five steps of the run and then continued running. Each jump was rated with points from 0 to 2,0 – the turn failed. 1 – the turn was made only partially, there was no transition to running without stopping, landing on both legs was observed, and not in the step position. 2 – good coordination of jumping and turning with a slow transition to running.

The exercise "Running to numbered balls" was performed as follows: the student stood in front of the counter, behind her lay 5 balls numbered from 1 to 5 in circles. The number was called, the student returned 180°, ran to the return ball, touched it with her hand and returned back to the counter. Then another number was called, etc., the exercise ended after the student completed it 3 times and touched the rack. The time of the exercise was determined. The exercise had to be completed in 8,0 s for the "excellent" rating, 9,1 s for the "good" rating, 10,3 s for the "satisfactory" rating, and 11,2 s for the "enough" rating.

The exercise "Throwing a ring on a rack" involved throwing a rubber ring (diameter 20 cm) with one hand onto a rack 10 cm high out of 10 attempts from a distance of 1.5 m. The total number of hits was recorded. In girls aged 14, the "low" level corresponded to a result of <4 points, "below average" – 5–6 points, "average" – 7–9 points, "above average" – 10–11 points, "high" – 12> points. Schoolgirls aged 15 had <4 points, 5-6 points, 7-8 points, 9-10 points and 11> points, respectively.

The control exercise "Throwing a tennis ball at a target" was performed by a participant with the leading hand at a target with a total diameter of 60 cm, an average diameter of 40 cm, an inner diameter of 20 cm. A tennis ball was thrown at a target from five distances) from 4 m – 5 attempts; 2) from 16 m – 5 attempts; 3) from 7 m – 5 attempts; 4) from 13 m – 5 attempts; 5) from 10 m – 5 attempts. The result was determined by the total number of hits from 25 attempts. When the ball hit the inner circle, there were 3 points, in the second circle – 2 points, in the third circle – 1 point, outside the target – 0 points. In girls aged 14, the "low level" corresponded to the result <10 points, "below average" – 11–13 points, "average"

– 14–16 points, "above average" – 17–19 points, "high" – 20> points. For girls aged 15 – <10, 11-13, 14-16, 17-19, 20>, respectively.

The Yarotsky test was performed from the initial position of the main stance, eyes closed, the test participant made head turns in one direction at a pace of two movements per second. The time from the beginning of head movement to the moment of loss of balance was determined. Maintaining balance for 35 s was assessed as "excellent", 20 s – "good", 16 s – "satisfactory".

The Bondarevsky test involved keeping the balance with closed eyes, standing on one leg, hands on the belt. Registration of time began after finding a stable position, and ended at the moment of loss of balance. The time of holding a static posture was determined. The average indicators of static balance for students in grades 8-9 were 18,5 s.

The exercise "Three somersaults forward" was performed as follows: the participant stood on the edge of the mats, taking the main stance. On command, she took a crouching position and sequentially, without stopping, performed 3 somersaults forward, trying to do this in the minimum amount of time. The time to complete the task was fixed. In girls aged 14, the "low" level corresponded to the result of 5,2 s, "below average" – 5,1–4,9 s, "average" – 4,8–4,3 s, "above average" – 4,2 -4,0 s, "high" – 3,9 s; in girls aged 15: 5,4 s, 5.3–5,1 s, 5,0–4,5 s, 4,4–4,2 s, 4,1 s, respectively.

Kopylov's test "Ten Eights" provided for the fastest performance by a participant of an imaginary eight, which was carried out by passing the ball from hand to hand between the legs at the level of the knees. The exercise time was recorded. For female students of the 8th grade, the score "excellent" corresponded to the result of 8,4–10,5 s, "good" – 10,6–12,5 s, "satisfactory" – 12,6–14,5 s; for girls of grade 9: 8,0–10,0 s, 10,1–12,0 s, 12,1–14,0 s, respectively.

Girls of 2 ages participated in the pedagogical experiment: the first group – girls of 14 years old, the second group – girls of 15 years old. At the beginning of the academic year, preliminary testing was carried out to determine the initial level of development of coordination abilities. After that, during the school year, the girls were engaged in fitball-aerobics in the sports section of the school. Classes were held 3 times a week, their duration was 60 minutes. At the end of the academic year, a final test was conducted to determine the impact of classes on the level of development of coordination abilities.

The structure of the fitball aerobics lesson consisted of an introduction, main and final parts. The introduction included exercises of a general developmental nature, varieties of walking, running, basic aerobic movements, their combinations in combination, dance exercises. The main part of the lesson consisted of various sets of exercises with fitballs, performed from different starting positions. In the final part, breathing exercises, muscle relaxation exercises, attention, and ideomotor exercises were carried out. Musical accompaniment was used in the classes.

Procedure

The study was carried out in stages. At the first stage, the analysis and generalization of scientific and methodological literature was carried out, which made it possible to study the state of the problem under study, develop a research program, determine the contingent of those studied and select informative methods. At the second stage, preliminary testing of the level of development of coordination abilities of the studied contingent and a pedagogical experiment were carried out. At the third stage, final testing was carried out to determine the degree of change in the studied indicators under the influence of fitball-aerobics exercises. The results were processed and compared, and the conclusions of the study were drawn.

Statistical analysis

The obtained data were processed using the statistical package of Excel XP. Mathematical and statistical methods included: calculation of arithmetic average characteristics – $\bar{X}$; standard error of the mean – m; t-criterion, which determined the degree of reliability of the difference in indicators according to the Student's table.

Results of the research

Considering the indicators of coordination abilities by age before the experiment, it should be noted that 14-year-old girls demonstrate higher results in such exercises as throwing a tennis ball at a target, the Yarotsky, Bondarevsky test, three forward somersaults and in the Kopylov "Ten Eights" test. And girls 15 years old – in exercises jumping with a turn, running to numbered balls and throwing a ring on the rack.

Comparison of the results of the level of development of the coordination abilities of girls aged 14-15 at the beginning of the academic year with the relevant standards revealed the "average" level of their development.

At the end of the academic year, after the use of fitball-aerobics exercises, there was a positive trend towards improving the level of development of coordination abilities in the studied contingent. Thus, the analysis of indicators of jumps with a turn and running to numbered balls of girls aged 14–15 revealed (Table 1) that there was an increase in the studied indicators. At the same time, the results of 14-year-old female students in the exercise jumping with a turn have significant differences ($p<0,01$).

Table 1

Results of the ability to spatial orientation of girls of middle school age before and after the experiment

Age	n	Before the experiment $\bar{X}_1 \pm m_1$	After the experiment $\bar{X}_2 \pm m_2$	$t_{1,2}$	p
Jumping with a turn (points)					
14	22	1,03±0,24	1,65±0,17	4,28	<0,01
15	24	1,11±0,22	1,31±0,18	1,12	>0,05
Run to numbered balls (s)					
14	22	9,97±0,44	9,73±0,47	0,32	>0,05
15	24	9,98±0,46	9,80±0,49	0,28	>0,05

Analysis of the results of jumps with a turn in percentage terms indicates an improvement in this type of coordination qualities: for 8th grade girls by 62,4%, for 9th grade girls by 23,1%; data on running to numbered balls also slightly increased: for 8th grade schoolgirls by 2,1%, for 9th grade – by 1,8%.

Comparison of the performance of jumps with a turn with the standards proposed by Serhiienko (2001) showed that the results correspond to the «average» level, and the performance of running to numbered balls – to the assessment of «satisfactory».

Consequently, the introduction of fitball aerobics exercises had a positive trend towards increasing the indicators of the ability for spatial orientation of 14–15-year-old schoolgirls.

Analyzing the results of the ability to assess and regulate the spatial and dynamic parameters of movements after the use of fitball aerobics exercises (Table 2), it should be noted that the data of throwing rings on the rack and throwing a tennis ball at the target improved somewhat. However, no

significant differences were observed in the scores (p>0,05).

Table 2

Results of the ability to assess and regulate the spatial and dynamic parameters of movements in girls of middle school age before and after the experiment

Age	n	Before the experiment $\bar{X}_1 \pm m_1$	After the experiment $\bar{X}_2 \pm m_2$	$t_{1,2}$	p
Throwing rings on the rack (times)					
14	22	5,03±0,74	5,80±0,56	1,18	>0,05
15	24	7,15±0,90	8,76±0,95	1,54	>0,05
Throwing a tennis ball at a target (points)					
14	22	15,95±1,20	16,01±0,98	1,16	>0,05
15	24	14,76±1,52	15,84±1,35	0,54	>0,05

Considering the dynamics of indicators in the ratio, it should be noted that in the exercise of sketching rings for stable results improved as follows: for schoolgirls aged 14 – 16,1%, for girls aged 15 – by 8,7%; in the exercise of throwing a tennis ball – by 0,6% and 7,3%.

Comparison of the obtained results with the standards proposed by Skalii (2006) revealed that the indicators of the exercise of throwing rings on the rack among schoolgirls of 14 years correspond to "below average", in girls of 15 years old – "above average", and the data of throwing a tennis ball at a target – "average" level for girls 14-15 years old.

The use of fitball aerobics exercises ensured the constancy of the indicators of the ability to assess and regulate the spatial and dynamic parameters of movements.

Analyzing the data on the level of development of the ability to maintain static balance in girls aged 14–15 years after the use of experimental exercises (Table 3), it should be noted that there was an improvement in the results. It should be noted that the indicators of the Bondarevsky test in 15 years old increased significantly (p<0,05).

Table 3

Results of the ability to maintain static balance in girls of middle school age before and after the experiment

Age	n	Before the experiment $\bar{X}_1 \pm m_1$	After the experiment $\bar{X}_2 \pm m_2$	$t_{1,2}$	p
Yarotsky test (s)					
14	22	23,02±1,97	26,76±2,09	1,34	>0,05
15	24	22,87±1,84	25,85±1,77	1,03	>0,05
Bondarevsky test (s)					
14	22	21,02±1,88	24,93±1,85	0,61	>0,05
15	24	18,63±1,37	23,59±0,91	3,04	<0,05

Comparing the dynamics of the obtained results in the ratio, it should be noted that in the Yarotsky test, the indicators increased by 16,2% for 14-year-old schoolgirls, by 13,1% for 15-year-old schoolgirls; in the Bondarevsky test, the data increased by 18,6% and 30,6%, respectively.

Comparison of the data on the maintenance of the static balance of girls aged 14–15 years with the norms proposed by Serhiienko (2001) showed that in the Yarotsky test the indicators correspond to the "good" assessment, and in the Bondarevsky test the results are "above average".

Therefore, the proposed means had a positive trend to improve the ability to maintain static balance in the study population.

An analysis of the indicators of three forward somersaults and the Kopylov test "Ten eights" in girls aged 14–15 after doing fitball aerobics (Table 4) showed that the results improved somewhat, but there were no significant differences (p>0,05).

Table 4

The results of the ability to adapt and restructure motor actions in girls of middle school age years before and after the experiment

Age	n	Before the experiment $\bar{X}_1 \pm m_1$	After the experiment $\bar{X}_2 \pm m_2$	$t_{1,2}$	p
Three somersaults forward (s)					
14	22	4,52±0,17	4,43±0,18	0,41	>0,05
15	24	4,64±0,11	4,55±0,15	0,44	>0,05
Kopylov's test "Ten eights" (s)					
14	22	10,95±0,44	10,82±0,43	0,17	>0,05
15	24	11,72±0,68	11,52±0,69	0,18	>0,05

Considering the indicators of the ability to adapt and reorganize motor actions in the ratio, it should be noted that in the exercise three somersaults forward, the results of fourteen-year-old girls improved by 2 %, girls of 15 years old – by 1,8%; in Kopylov's Ten Eights test, 14-year-old schoolgirls improved their performance by 1,1%, and fifteen-year-olds – by 1,5%.

Comparison of the data obtained with the standards proposed by Serhiienko (2001) showed that in the exercise three somersaults forward, the indicators of girls aged 14–15 correspond to the "average" level, the results of Kopylov's test "Ten Eights" are assessed as "good".

It should be noted that the means of fitball aerobics had a positive trend, but the ability to adapt and restructure motor actions was not significantly affected.

The trend of the level of development of coordination abilities in the age aspect did not change after the experiment: girls of 14 years old have indicators slightly higher than girls of 15 years old. With the exception of the results of the exercise throwing rings on the rack, where the indicators of 15-year-old girls are significantly higher than those of 14-year-old students (p<0,05). The positive trend of changes in the indicators of the level of development of coordination abilities in girls was not reflected on the rating scale either: the results correspond to the "average" level.

Discussion

Coordination abilities are an important physical quality of a person, since a high level of their development contributes to faster mastery of various motor skills and abilities, better performance of technical elements in various sports, better orientation in space and time, and more effective development of other physical abilities (Serhiienko, 2001; Skalii, 2006; Chernykh et al., 2021).

Specialists in the field of physical culture and sports offer a variety of ways to develop coordination among schoolchildren (Kuzmenko, 2010; Kolumbet, 2014; Bilan, 2017; Mameshyna,

2018). The results of our study supplemented the knowledge about the current level of development of certain types of coordination abilities in girls aged 14–15 and expanded the arsenal of increasing their level of development by means of fitball aerobics.

Studies by Bazylevych & Tonkonoh (2019), Ilina & Kuchmy (2020) indicate that fitball aerobics classes contribute to a significant increase in female students' indicators of physical fitness, functional state, as well as health promotion, involving them in a healthy lifestyle. increase interest in exercise. The results of our study complement the data of the authors on the positive effect of fitball aerobics on the level of development of physical qualities, in particular, the coordination abilities of girls of middle school age.

Chekhaniuk (2013), Suvorova and others (2018) consider fitball aerobics one of the effective means of strengthening and maintaining health, increasing the level of physical condition and interest in physical education and sports for high school students. In their opinion, fitball-aerobics exercises have a healing effect, train the vestibular apparatus, develop coordination of movements, stimulate metabolism, and activate motor reflexes. In the process of doing fitball aerobics, the authors note an improvement in the level of development of physical qualities in high school girls, in particular, such a manifestation of coordination abilities as a sense of balance. The experimental data of our study supplement the knowledge of the authors about the change in the level of development of various types of coordination abilities of school-age girls under the influence of fitball aerobics in the sports section of the school.

Bazylevych & Horbenko (2016) offers fitball aerobics as a new, innovative means of physical education for children assigned to special medical groups. Fitball aerobics exercises are offered by the authors as a means of complex impact on the physical condition of schoolchildren of all ages. In our opinion, the health-improving orientation, moderation of physical activity, the possibility of strict adherence to the principle of an individual approach in fitball aerobics classes is a good option for increasing the motor activity of girls in the puberty period.

Our study is consistent with the data of specialists in the field of physical culture, sports, medicine on the positive effect of exercises with fitballs on increasing motivation, changing the level of development of physical qualities, in particular, coordination abilities, and confirms the expediency of introducing fitball aerobics classes into the sports section of the school.

Conclusions

Fitball aerobics classes in the sports section of the school had a positive effect on the indicators of the coordination abilities of girls aged 14–15, which is confirmed by the stability of the results and the tendency to increase them. However, the ambiguity of the obtained results in dynamics requires further research in this direction. A significant improvement in the results was noted in the manifestation of the ability to orientate in space according to the data of a jump with a turn in schoolgirls of 14 years old and the ability to maintain static balance according to the Bondarevsky test in girls of 15 years old.

The most significant increase occurred in the indicators of a jump with a turn: from 23.1% to 62.4% and the data of the Bondarevsky test: from 18,6% to 30,6%.

Comparison of indicators of coordination abilities in the age aspect revealed that the results of 14-year-old girls in most cases are higher than those of 15-year-old schoolgirls.

Comparison of indicators of coordination abilities of girls aged 14-15 with the relevant standards showed that the results correspond to the «average» level.

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Irina Kyzmenko: data collection, input, data analysis, statistics, data interpretation, manuscript preparation, Andrzej Ostrowski: design, research planning, Viacheslav Zhuk: analysis, literature search.

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References

Bala, T., Krivoruchko, N., Masliak, I., Stasyuk, R., Arieshyna, Y., & Kuzmenko, I. (2018). Influence of cheerleading classes on functional state of respiratory system of 10-16 year old teenagers. Journal of Physical Education and Sport (JPES), 18 (Supplement issue 4), Art 271, 1850-1855. doi: 10.7752/ jpes..s 4271.

Bazylevych, N. O., & Horbenko, M. I. (2016). Orhanizatsiino-metodychni osoblyvosti vykorystannia elementiv fitbol-aerobiky na zaniattiakh v spetsialnykh medychnykh hrupakh zi shkoliaramy. Naukovyi chasopys Natsionalnoho pedahohichnoho universytetu imeni M. P. Drahomanova. Seriia 15: Naukovo-pedahohichni problemy fizychnoi kultury (fizychna kultura i sport): zb. nauk. prats. Kyiv: NPU im. M. P. Drahomanova, 10, 288-292.

Bazylevych, N. O., & Tonkonoho, O. S. (2019). Vplyv, zaniat fitbol-aerobikoiu na riven fizychnoi pidhotovlenosti ta funktsionalnoho stanu studentok. Visnyk Prykarpatskoho universytetu. Seriia: Fizychna kultura, 31, 3-8.

Bermudes, D. V. (2016) Teoriia i metodyka vykladannia aerobiky: navchalno-metodychnyi kompleks: navchalno-metodychnyi posibnyk. Sumy: FOP Tsoma S. P.

Bilan, Ya. O. (2017). Sutnist i zmist metodyky rozvytku koordynatsiinykh yakostei uchniv osnovnoi shkoly zasobamy florbolu u pozaurochnii roboti. Naukovyi chasopys Nats. ped. un-tu imeni M. P. Drahomanova. Zb. nauk. pr. Kyiv, 3K(84), 57-59.

Chekhaniuk, L. (2013). Vplyv zaniat fitbol-aerobikoiu na riven fizychnoi pidhotovlenosti starshoklasnyts. Fizychne vykhovannia, sport i kultura zdorovia u suchasnomu suspilstvi: zbirnyk naukovykh prats, 2 (22), 93-96.

Chekhovska, M., Shevtsiv, L., Zhdanova, O., & Chekhovska, L. (2020). Fitness in school physical education lessons. Journal of Physical Education and Sport, Vol 20 (Supplement issue 1), Art. 60, 420 – 424. doi:10.7752/jpes.2020.s1060

Chernykh, T., Mulyk, V., Mulyk, K., Skaliy, A., Ostrowski, A., & Skaliy, T. (2021). The relationship between the effectiveness of

performing technical elements and indicators of static and dynamic balance in young acrobats 6-7 years old. Health, Sport, Rehabilitation, 7(4), 58-68. https://doi.org/10.34142/HSR.2021.07.04.05

Denysenko, N., Pedik, L., & Fuks, L. (2007). Osoblyvosti rivnia zdorovia, fizychnoi pidhotovlenosti, samopochuttia ta vedennia zdorovoho sposobu zhyttia v uchniv zahalnoosvitnikh shkil i himnazii. Teoriia i metodyka fizychnoho vykhovannia i sportu, 3, 44-46.

Ilin, A., & Kuchma, A. (2020). Vplyv zaniat step-aerobikoiu i fitbol-aerobikoiu na fizychnu pidhotovlenist studentok. Problemy aktyvizatsii rekreatsiino-ozdorovchoi diialnosti naselennia: materialy KhII Mizhnar. nauk.-prakt. konf. (23–24 kvitnia 2020 r., m. Lviv). Lviv, 109-111

Kolokoltsev, M. M., Iermakov, S. S., Tretyakova, N. V., Kraynik, V. L., & Romanova, E. V. (2020). Physical Activity as a Factor to Improve the Quality of Student Life. The Education and science journal, 22(5), 150-168. doi: https://doi.org/10.17853/1994-5639-2020-5-150-168

Kolumbet, O. M. (2014). Rozvytok koordynatsiinykh zdibnostei molodi: monohrafiia. K.: Osvita Ukrainy.

Kuzmenko, I. (2020). Suchasni pidkhody do pidvyshchennia rukhovoi aktyvnosti shkoliariv osnovnoi shkoly. Fizychna aktyvnist i yakist zhyttia liudyny: zb. tez dop. IV Mizhnar. nauk.-prakt. Internet-konf. Lutsk: Skhidnoievrop. nats. un-t im. Lesi Ukrainky.

Kuzmenko, I. O. (2010). Zmina rivnia rozvytku okremykh koordynatsiinykh zdibnostei shkoliariv serednikh klasiv pid vplyvom spetsialno spriamovanykh vprav. Moloda sportyvna nauka Ukrainy: zb. nauk. prats z haluzi fizychnoi kultury ta sportu. Vyp. 14: u 4-kh t. L. LDUFK,2, 124-130.

Kuzmenko, I. O., & Tymchenko, V. V. (2019). Vplyv elementiv suchasnykh tantsiv na pokaznyky hnuchkosti uchniv 10–11-ty rokiv. Fizychna kultura, sport i zdorovia: stan, problemy ta perspektyvy: zbirnyk naukovykh dopovidei KhIKh Mizhnarodnoi naukovo-praktychnoi konferentsii, Kharkiv: KhDAFK.

Mameshyna, M. A. (2018). Dynamika pokaznykiv rozvytku koordynatsiinykh zdibnostei shkoliariv 7–9-kh klasiv pid vplyvom bahatorivnevoi systemy dyferentsiiovanoho navchannia. Naukovyi chasopys Nats ped. un-tu imeni M. P. Drahomanova. Zb. nauk. pr. Kyiv, 10(104), 49-55.

Matukhno, O. V. (2016). Formuvannia motyvatsii do zaniat fizychnoiu starshoklasnykiv zasobamy ozdorovchoho fitnesu. Naukovyi chasopys Natsionalnoho ped. un-tu imeni M. P. Drahomanova. Zb. nauk. pr. Kyiv, 11(81), 77-79.

Nahorniuk, V. Yu., & Masliak, I. P. (2018). Vplyv vorkautu na proiav sylovykh zdibnostei shkoliariv serednikh klasiv. Aktualni problemy fizychnoho vykhovannia riznykh verstv naselennia. Zbirnyk naukovykh prats, Kharkiv, 180-190. http://hdafk.kharkov.ua/ua/naukova-robota/naukovo-teoretichni-vidannya/aktualni-problemi-fizichnogo-vikhovannya-riznikh-verstv-naselennya

Platonova, A., Podrigalo, L., & Sokol, K. (2013). Rational for the use of children's motor activity as a criterion for the effectiveness of rehabilitation and recreation. Pedagogics, psychology, medical-biological problems of physical training and sports, 17(11), 72-76. https://doi.org/10.6084/m9.figshare.817929

Podrihalo, O., Jagiełło, W., Podrigalo, L., Iermakov, S., & Yermakova, T. (2022). The influence of health-improving fitness classes on the degree of fat deposition in women of the second mature age. Pedagogy of Physical Culture and Sports, 26(1), 19-25. https://doi.org/10.15561/26649837.2022.0103

Serhiienko, L. P. (2001). Testuvannia rukhovykh zdibnostei shkoliariv: [Uchebnyk]. Kyiv: Olimpiiska literatura.

Skalii, T. V. (2006). Pedahohichnyi kontrol rozvytku koordynatsiinykh zdibnostei ditei i pidlitkiv (dysertatsiia kandydata nauk z fizychnoho vykhovannia ta sportu). Khersonskyi derzhavnyi universytet. Kherson.

Suvorova, T. I., Radchenko, O. V., & Konstankevych, V. P. (2018). Pidvyshchennia rivnia fizychnoi pidhotovlenosti divchat-starshoklasnyts zasobamy fitbol-aerobiky. Molodyi vchenyi, № 12.1 (64.1), 68-71.

Model characteristics of competitive activity of female MMA mixed martial arts fighters of different weight classes

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Abstract

Purpose: to determine model characteristics of the competitive activity of female MMA mixed martial arts athletes of different weight classes.

Material & Method: the study involved 150 top female mixed martial arts MMA fighters. Participants were divided into 3 groups according to the weight class of 50 athletes each: Strawweight (48 kg to 52 kg), Flyweight (52 kg to 56 kg), and Bantamweight (56 kg to 61 kg). The following methods were used: analysis of scientific and methodological information and Internet sources; generalization of best practices; analysis of protocols and videos of competitive activities; methods of mathematical statistics.

Results: female athletes of each weight class have their characteristics in terms of competitive activity indicators. Thus, the finish of the fight with a striking differential, attempts, and accuracy of takedowns is significantly better ($p<0.05$-0.01) in women`s strawweight fighters. Strawweight female fighters perform a large number of sig strikes landed, which have high accuracy, due to which they win the fight, and this is explained by a large arsenal of technical and tactical actions. Women's flyweight fighters need more time to finish the fight early. They also have the least number of sig strikes landed during the fight, which are performed with little accuracy, and this is due to the rational distribution of strength in a fight. Women's bantamweight fighters conduct a large number of knockdowns landed and submissions during the entire fight, this can be explained by the high level of development of special endurance. It was found that the representatives of all weight classes perform mostly distance strikes landed and their sig head strikes landed are the best ones.

Conclusions: applying methods of pedagogical observation and mathematical statistics allowed us to determine the structure and model characteristics of modern competitive activities of elite female mixed martial arts MMA athletes for each weight class. The model characteristics obtained during the study can be used to plan the training process of qualified female athletes and to solve the issues of managing their preparation for competitions.

Анотація

Юрій Тропін, В'ячеслав Романенко, Войцех Й. Цинарський, Наталія Бойченко, Юлія Коваленко. Модельні характеристики змагальної діяльності спортсменок змішаних єдиноборств ММА різних вагових категорій. Мета: визначити модельні характеристики змагальної діяльності спортсменок змішаних єдиноборств ММА різних вагових категорій. **Матеріал і методи:** у дослідженні взяли участь 150 топових спортсменок змішаних єдиноборств ММА. Учасниці були розділені на 3 групи за ваговими категоріями по 50 атлеток в кожній: мінімальна (від 48 кг до 52 кг), найлегша (від 52 кг до 56 кг), легка (від 56 кг до 61 кг). Використовувалися наступні методи: аналіз науково-методичної інформації та джерел Інтернету; узагальнення передового практичного досвіду; аналіз протоколів і відеозаписів змагальної діяльності; методи математичної статистики. **Результати:** у спортсменок кожної вагової категорії спостерігаються свої особливості в показниках змагальної діяльності. Так закінчення бою за позитивної різниці в ударах, спроби й успішність виконання тейкдаунів достовірно краще ($p<0,05$-$0,01$) у спортсменок мінімальної ваги. Спортсменки мінімальної ваги в бою виконують велику кількість акцентованих ударів, які мають високу

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жінки

точність, за рахунок чого і досягають перемоги в бою, це пояснюється великим арсеналом техніко-тактичних дій. Більш часу для дострокового завершення бою потребує спортсменкам найлегшої категорії. Також у них під час бою найменша кількість акцентованих ударів та невелика їх точність, це пояснюється раціональним розподілом сил в бою. Спортсменки легкої ваги виконують велику кількість нокаутирующих ударів і проводять сабмішен під час всього бою, це пояснюється високим рівнем розвитку спеціальної витривалості. Встановлено, що представниці всіх вагових категорій більш всього проводять акцентованих ударів на дистанції та у них найкраще удари проходять в голову. **Висновки:** застосування методів педагогічного спостереження та математичної статистики дозволили визначити структуру та модельні характеристики сучасної змагальної діяльності елітних спортсменок змішаних єдиноборств ММА для кожної вагової категорії. Модельні характеристики, які були отримані в ході дослідження можна використовувати для планування тренувального процесу кваліфікованих спортсменок та для вирішені питань керування їх підготовкою до змагань.

Introduction

Mixed Martial Arts is a sport that includes a variety of ways to defend and attack in the fights. The basis of mixed martial arts is classical wrestling (Greco-Roman and Freestyle Wrestling, Judo, Jujutsu, etc.) and classical striking technique (Boxing and Kickboxing) (Sohor & Pityn, 2017; Tropin et al., 2021).

The popularity of MMA in the world and the growing competition among fighters require careful study of the competitive activities of leading athletes to find new ways to improve the effectiveness of the training process and competitive activity (Katykhin et al., 2021; Latyshev et al., 2021).

The competitive activity of athletes in contact martial arts has a high motor activity, which requires a fighter to show the ability to perform various technical and tactical actions with a high degree of accuracy and adequacy of the strategy of the entire fight.

The level of technical and tactical actions of a fighter mainly determines his success in a competitive duel. Scientific and methodological support for the training of qualified martial arts requires, above all, the choice of the most effective actions and their further improvement. This is since the composition and structure of effective technical and tactical actions are changing rapidly in sports practice. To train qualified athletes it is important to timely inform about the promising areas of development of a particular type of martial arts (Romanenko et al., 2020; Starikov et al., 2021).

In mixed martial arts MMA, there is a very large number of techniques from different types of martial arts. It plays a key role in the way how an athlete can combine different disciplines and change from striking technique to wrestling (Pityn et al., 2013; James et al., 2017).

In terms of preparing for competitions, some mixed martial arts fighters try to conduct most training sessions in basic classical types (boxing, kickboxing, or wrestling), mistakenly try to adjust this technique to the rules of mixed martial arts, which violates the principle of competition, its structure and also the content of athletes' preparation program.

Analysis of competitive activity in mixed martial arts MMA is essential for predicting the success of skilled athletes, which is extremely important and relevant at the present stage of their development.

Purpose of the study is to determine model characteristics of the competitive activity of female MMA mixed martial arts athletes of different weight classes.

Material and Methods of the research

Participants: The study involved 150 top female athletes of mixed martial arts MMA, who have their records in terms of competitive activity. These figures reflect the statistics of all fighters in the UFC 28 tournament (since 2000) up to date (UFC 28 was the first tournament to apply the Unified Rules of MMA). Participants were divided into 3 groups according to the weight class of 50 athletes each: Strawweight (48 kg to 52 kg), Flyweight (52 kg to 56 kg), and Bantamweight (56 kg to 61 kg). The initial data on the performances of the strongest female athletes in mixed martial arts MMA are taken from the UFC sites (http://statleaders.ufc.com/ru/fight?weight_class=WSW; https://fightnews.info/rejtingi-mma).

Methods. The following methods were used in the study: analysis of scientific and methodological information and Internet sources; generalization of best practices; analysis of protocols and videos of competitive activities of female fighters; methods of mathematical statistics.

Procedure. 150 title fights were analyzed, including 50 fights in the strawweight, flyweight, and bantamweight weight classes. To analyze the competitive activity the following indicators were investigated: time of the fight (s); the total number of performed and missed significant strikes in the fight (number); the number of takedowns and submissions attempts in the fight (number); sig strike accuracy (was determined by dividing the number of effective strikes by the number of sig strikes landed and multiplied by 100 %); the accuracy of takedowns (was determined by dividing the number of successful takedowns by the number of takedowns attempted and multiplied by 100 %).

Takedown is taking an opponent to the ground. At the same time, each of the fighters tries to take a dominant position to further strike or successfully conduct choking techniques.

Submission occurs when one of the opponents admits his defeat. A feature of the submission – is a victory achieved through painful, or suffocating holds, as a result of which one of the fighters gives up, visibly tapping the floor or the opponent with the hand or in some cases with the foot, or verbally.

Statistical analysis of the obtained data was performed using the licensed program MS Excel (2010). Indicators of descriptive statistics were determined: arithmetic mean, standard deviation, and mean absolute error (Antomonov, 2006). The significance of mean differences was assessed with Student's t-test; withdrawal was considered reliable at ($p<0.05$).

Results of the research

Table 1 presents the model characteristics of the competitive activity of female mixed martial arts MMA athletes of different weight classes.

The analysis of the data obtained showed that women's bantamweight fighters spend less time finishing the fight early and have the fastest knockout (technical knockout), and

Table 1

Model characteristics of the competitive activity of female mixed martial arts MMA athletes of different weight classes (n=150 fights)

№	Indicators	Weight class Strawweight (n=50 fights) $\bar{X}$±m	Flyweight (n=50 fights) $\bar{X}$±m	Bantamweight (n=50 fights) $\bar{X}$±m
1	Fastest Finish, s	69,7±8,91 [1]	116,4±13,05	51,3±12,04 [3]
2	Fastest KO/TKO (knockdowns/technical knockdowns), s	122,4±28,61 [1]	223,9±25,62	69,9±15,78 [3]
3	Fastest Submission, s	118,0±10,93	129,8±11,07	128,7±29,83
4	Latest Finish (time left until the end of the fight), s	117,2±14,66	132,2±27,32	69,5±13,81 [2]
5	Latest KO/TKO (time left until the end of the fight), s	113,0±23,22	164,6±22,87	112,3±20,50
6	Latest Submission (time left until the end of the fight), s	134,3±14,6	99,8±27,14	80,6±6,83 [2]
7	Striking Differential, number	107,6±6,03	76,8±4,96 [1]	79,9±7,52 [2]
8	Largest Comeback Finish, number	11,5±4,19	7,0±1,97	15,9±2,33 [3]
9	Sig Strikes Landed, number	176,6±8,83	151,4±10,76	157,9±9,56
10	Sig Strikes Attempted, number	365,2±10,86 [2]	357,4±16,74	327,0±13,16
11	Sig Strike Accuracy, %	73,7±1,61	70,3±1,70	71,4±1,13
12	Distance Strikes Landed, number	154,6±8,36	138,5±11,40	139,7±8,40
13	Sig Clinch Strikes Landed, number	50,8±2,77 [1]	27,9±1,82	44,5±5,09 [3]
14	Sig Grounded Strikes Landed, number	49,9±4,76	42,0±5,67	41,3±2,56
15	Sig Head Strikes Landed, number	100,9±2,25	115,1±10,61	110,7±8,63
16	Sig Body Strikes Landed, number	48,6±1,57	43,0±2,48	42,1±3,14
17	Leg Kicks Landed, number	55,9±5,14 [2]	43,7±3,62	36,6±2,84
18	Takedowns Landed, number	6,6±0,58	5,8±0,33	5,5±0,31
19	Takedowns Attempted, number	14,7±0,60	12,0±0,60 [1]	12,0±0,89 [2]
20	Takedowns Accuracy, %	54,5±5,98	26,54±5,09 [1]	29,76±7,24 [2]
21	Submission Attempts, number	3,9±0,35	3,2±0,36	3,2±0,2

***Note*:** 1 – the differences between groups 1 and 2 are accurate ($p<0.05$); 2 – the differences between groups 1 and 3 are accurate ($p<0.05$); 3 – the differences between groups 2 and 3 are accurate ($p<0.05$).

women's strawweight fighters conduct the fastest submission. Women's flyweight athletes need more time to finish the fight early, and they also need more time at the beginning of the fight to perform a knockout (technical knockout) and submission.

Time indicators of competitive activity «Latest Finish», «Latest KO/TKO», «Latest Submission» are higher in women's bantamweight athletes, and indicators «Latest Finish», and «Latest KO/TKO» are the lowest in women's flyweight fighters and «Latest Submission» in women's strawweight.

Women's strawweight fighters finish the fight early with the largest striking differential, and the largest comeback finish is observed in women's bantamweight fighters. These indicators are the lowest for women's flyweight athletes.

Women's strawweight fighters perform a large number of significant strikes accuracy in the fight. Women's flyweight athletes have the lowest number of significant strikes landed that reach the goal and low accuracy strikes.

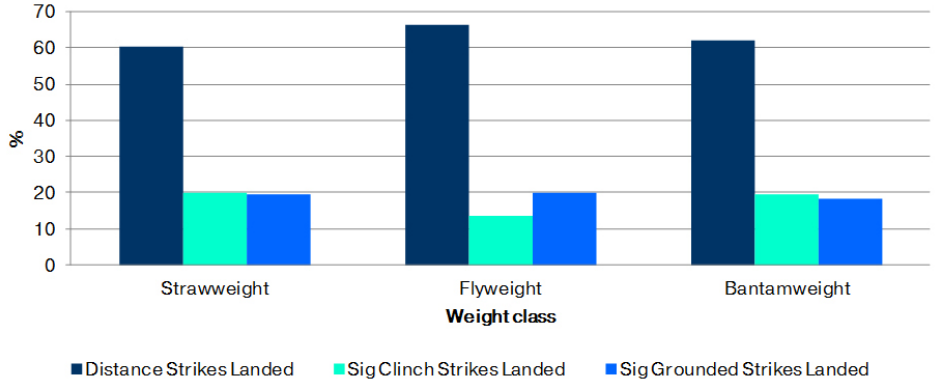

Figure 1. Ratio of the number of significant strikes in different positions at fighters of different weight classes, %

Figure 2. Ratio of the number of significant strikes to different targets at fighters of different weight classes, %

Submission attempts, takedowns attempted and takedowns accuracy are better conducted by women's strawweight fighters. These indicators do not differ significantly in women's flyweight and bantamweight athletes.

Fighters of all weight classes perform mostly distance strikes landed (Fig. 1) and sig head strikes (Fig. 2), this is due to the high possibility of knocking out the opponent.

Discussion

Many scientists have analyzed the competitive activity in various types of martial arts, so Aleksyeyev et al. (2021) analyzed the competitive activities of veteran judokas and established the motivation and psycho-emotional state of the athletes.

Khatsayuk et al. (2020) conducted a study of the technical arsenal of highly qualified MMA mixed martial arts fighters using the Katsumoto Martial Arts Express Computer Analysis System and divided all athletes into two groups of wrestlers and strikers.

Basing on competitive activity Boyko et al. (2014) established the main technical and tactical actions in the rack, which are carried out by elite freestyle wrestlers.

Ouergui et al. (2014) analyzed the temporal structure of high-level kickboxing fights and provided practical guidance on how to structure training sessions to mimic competitive physical activity.

Tunnemann (2017) examined the final fights in three styles of wrestling (Greco-Roman, Freestyle, and Women's) at the 2012 and 2016 Olympic Games and recommended the concepts for improving technical and tactical training to develop more attractive methods for the spectacle of wrestling.

According to James et al. (2017), the indicators of competitive activity of mixed martial arts MMA fighters were processed using statistical methods and found that wrestling activity and accuracy of technique were of particular importance to achieve victory in mixed martial arts competitions of the elite level.

Models were also made with the help of competitive activity analysis, so Boychenko (2017) developed models of technical and tactical training of karate specialists in the «power" and "tempo" manner of fighting and offered training tasks for them.

Katykhin et al. (2021) determined the profiles of the strongest mixed martial arts MMA fighters with TOP-10 regardless of weight and found that the strongest fighters had individual equipment and made a tactical plan of the fight considering the future opponent.

Martsiv (2015) developed model characteristics of indicators of boxers' competitive activity for the specialized basic training phase and recommended approaches to improve various aspects of athletes' training.

Slimani et al. (2017) identified models of elite kickboxers based on gender, weight class, rounds, and match outcome and found that training programs needed to be adapted to the specific requirements of weight class and gender of kickboxers to improve technical and tactical skills that increase the athlete's chances of winning.

Tropin and Chuev (2017) developed model characteristics of technical and tactical training of elite Greco-Roman style wrestlers based on which evaluation criteria were developed.

Miarka et al. (2018) highlighted the features and time parameters of each round of mixed martial arts MMA fighters. Basing on them it was found that the minimum time spent on low-intensity bouts in the rack, regardless of the round, and the strength of action on the ground in the first and second rounds, increase the probability of success in professional MMA fights. These factors are important for the development of a program to improve technical and tactical training.

Summing up, we can say that the process of training qualified female mixed martial arts MMA fighters should be based on the laws of competition and model characteristics of the best fighters in the world. If these conditions are met, there is a high probability of forming an effective style of confrontation at the stage of preparation for higher achievements.

Prospects for further research will be aimed at developing sets of tasks for women's fighters, considering the features of the model characteristics of competitive activities of mixed martial arts MMA athletes of different weight class and their implementation in the training process.

Conclusions

Applying methods of pedagogical observation and mathematical statistics allowed us to determine the structure and model characteristics of modern competitive activities of elite mixed martial arts MMA fighters for each weight class. The model characteristics obtained during the study can be used to plan the training process of qualified athletes and to address issues of managing their preparation for the competitions.

Our results showed that athletes of each weight class have their characteristics in terms of competitive activity. Thus, the finish of the fight with a striking differential, attempts, and

accuracy of takedowns is significantly better ($p<0.05$-0.01) in women`s strawweight fighters than in women's flyweight and bantamweight. Strawweight female fighters perform a large number of sig strikes landed, which have high accuracy, due to which they win in the fight, and this is explained by a large arsenal of technical and tactical actions.

Women's flyweight fighters need more time to finish the fight early. They also have the least number of sig strikes landed during the fight, which are performed with little accuracy, and this is due to the rational distribution of strength in a fight.

Women's bantamweight fighters conduct a large number of knockdowns landed and submissions during the entire fight, this can be explained by the high level of development of special endurance.

It was found that the representatives of all weight classes perform mostly distance strikes landed and their sig head strikes landed are the best ones, this is due to the high possibility of knocking out the opponent.

Author Contributions
Yuriy Tropin: data collection, input, data analysis, manuscript preparation, statistics; Vyacheslav Romanenko: design, interpretation of data; Wojciech J. Cynarski: interpretation of data, analysis of literature search; Natalia Boychenko: design, research planning; Julia Kovalenko: research planning, translation.

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References

Aleksyeyev, A. F., Ananchenko, K. V., & Holokha, V. L. (2021). Motyvatsiya ta psykhoemotsiynyy stan v zmahal'niy diyal'nosti dzyudoyistiv-veteraniv. Yedynoborstva, 1, 4-12. doi:10.15391/ed.2021-3.01

Antomonov, M. (2006). Mathematical processing and analysis of biomedical data. Kyiv. Retrieved from http://www.health.gov.ua/www.nsf/16a436f1b0cca21ec22571b300253d46/522e94120f630ce5c225803b004b3867/$FILE/Antomonov_monogr_titul%2BOGLAVL%2Bvvedenie.pdf

Boychenko, N. V. (2017). Model' tekhniko-taktychnoyi pidhotovky karatystiv «sylovoyi» ta «tempovoyi» maner vedennya poyedynku. Yedynoborstva, 2, 11-14. Retrieved from http://sportsscience.org/index.php/combat/article/view/520/541

Boyko, V. F., Malinsky, I. I., Andriitsev, V. A., & Yaremenko, V. V. (2014). Competitive activity of highly skilled freestyle wrestlers at the present stage. Physical education of students, 4, 13-19. doi:10.6084/m9.figshare.923391

Fightnews. Novyny boyovykh mystetstv. Reytynhy MMA. Retrieved from https://fightnews.info/rejtingi-mma.

James, L. P., Robertson, S., Haff, G. G., Beckman, E. M., & Kelly, V. G. (2017). Identifying the performance characteristics of a winning outcome in elite mixed martial arts competition. Journal of science and medicine in sport, 20(3), 296-301. doi:10.1016/j.jsams.2016.08.001

Katykhin, V. N., Tropin, YU. N., & Latyshev, N. V. (2021). Profili sil'neyshikh boytsov smeshannykh yedinoborstv MMA. Kdinoborstva, 1(19), 22-32. doi:10.15391/ed.2021-1.03

Khatsayuk, O. V., Ananchenko, K. V., Khurtenko, O. V., Dmytrenko, S. M., & Boychenko, N. V. (2020). Doslidzhennya tekhnichnoho arsenalu biytsiv MMA vysokoyi kvalifikatsiyi. Yedynoborstva, 1, 92-105. doi:10.15391/ed.2020-3.09

Latyshev, S., Latyshev, M., Tsarevskaya, I., Krivtsova, N., Ryzhin, N., & Nemceva, E. (2021). Determination of model characteristics of martial mixed arts fighters. In E3S Web of Conferences, 273, 09035. doi: 10.1051/e3sconf/202127309035

Martsiv, V. P. (2015). Model characteristics of average skill boxers' competition functioning. Physical education of students, 4, 17-23. doi: 10.15561/20755279.2015.0403

Miarka, B., Brito, C.J., Moreira, D. G., & Amtmann, J. (2018). Differences by ending rounds and other rounds in time-motion analysis of mixed martial arts: Implications for assessment and training. The Journal of Strength & Conditioning Research, 32(2), 534-544. doi: 10.1519/JSC.0000000000001804

Ouergui, I., Hssin, N., Haddad, M., Franchini, E., Behm, D. G., Wong, D. P. & Bouhlel, E. (2014). Time-motion analysis of elite male kickboxing competition. The Journal of Strength & Conditioning Research, 28(12), 3537-3543. doi: 10.1519/JSC.0000000000000579

Pityn, M., Briskin, Y., & Zadorozhna, O. (2013). Features of theoretical training in combative sports. Journal of Physical Education and Sport, 13(2), 195-198. doi: 10.7752/jpes.2013.02032;

Romanenko, V., Goloha, V., Aleksieiev, A., & Kovalenko, J. (2020). Evaluation methods of competitive activity of wrestlers with the use of computer technologies. Slobozhanskyi herald of science and sport, 8(6), 121-134. doi:10.15391/snsv.2020-6.010

Slimani, M., Chaabene, H., Miarka, B., & Chamari, K. (2017). The activity profile of elite low-kick kickboxing competition. International journal of sports physiology and performance, 12(2), 182-189. doi:10.1123/ijspp.2015-0659

Sohor, O., & Pityn, M. (2017). Vidminnosti struktury ta zmistu rehlamentatsiyi zmahal'noyi diyal'nosti u zmishanykh odnoborstvakh. Naukovyy chasopys Natsional'noho pedahohichnoho universytetu imeni M. P. Drahomanova, 1(82), 62-67. Retrieved from http://enpuir.npu.edu.ua/handle/123456789/20598

Starikov, V. S., Holovach, I. I., Rybak, L. O., & Buhayov, M. L. (2021). Vdoskonalennya tekhnichnoyi pidhotovlenosti sport · smeniv pry perekhodi u pankration z inshoho vydu sportu. Yedynoborstva, №2(20), 83-92. doi:10.15391/ed.2021-2.07

Tropin, Y., & Chuev, A. (2017). Technical and tactical readiness model characteristics in wrestling. Slobozhanskyi herald of

science and sport, 3(59), 64-67. doi:10.15391/snsv.2017-3.019
Tropin, YU. M., Latyshev, M. V., Pylypets', O. V., & Ponomar'ov, V. O. (2021). Pokaznyky zmahal'noyi diyal'nosti naysyl'nishykh biytsiv-zhinok zmishanykh yedynoborstv MMA. Yedynoborstva, 3(21), 69-83. doi:10.15391/ed.2021-3.07
Tunnemann, H. (2017). Technical-tactical combat behavior in the wrestling finals of the 2016 Olympic Games Rio in comparison to the 2012 OG London. Applicable Research in Wrestling, 13, 69-78. Retrieved from https://www.iat.uni-leipzig.de/datenbanken/iks/tokio2020/Record/4043133
UFC. Sayt federatsiyi UFC. Lidery statystyky. Retrieved from http://statleaders.ufc.com/ru/fight?weight_class=WSW.

Dynamics of change of high-speed and strengt preparedness of volleyball players under the influence of a set of exercises according to Tabata protocol

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Abstract

Purpose: to determine changes in indicators of speed-strength abilities of volleyball players under the influence of a set of exercises according to the Tabata protocol.

Material & Method: 10 volleyball players of the male student team "KhSAPC", aged 17-21, took part in the pedagogical experiment, they have the first category in volleyball. The experiment lasted 2 months and consisted in using the Tabata protocol in the educational and training process of volleyball players. In the dynamics of the experiment, the speed-strength abilities of a selected group of volleyball players were tested. The assessment of the statistical reliability of the results of a comparative analysis of the indicators studied in this work was carried out using a nonparametric sign test.

Results: at the beginning of the pedagogical experiment, volleyball players had the following test results: push-ups for 20 s 17,30±0,45 times; standing long jump with push of two legs 229,20±2,98 cm; lifting the torso from the prone position in 30 s 30,40±1,37 times; throwing a stuffed ball weighing 1 kg from behind the head with two hands in a jump of 11,20 ± 0,93 m; jump up from a place (according to V. M. Abalakov) 49,60±2,51 cm. After the pedagogical experiment, the values of indicators of the speed-strength abilities of volleyball players for each of the five tests turned out to be significantly higher compared to the results of the corresponding tests obtained before the start of the experiment.

Conclusions: the proposed sets of exercises according to the Tabata protocol turned out to be effective, as they made it possible to significantly improve ($p>0.01$) the speed-strength abilities of volleyball players in all tests. The results obtained allow us to recommend the use of exercise complexes according to the Tabata protocol for the training activity of volleyball players.

Анотація

Аліна Мельник, Єжи Скробецький, Тамара Ляхова, Наталія Пащенко, Сергій Лебедєв. Динаміка зміни показників швидкісно-силових здібностей волейболістів під впливом комплексу вправ за протоколом Табата. Мета: визначити зміни показників швидкісно-силових здібностей волейболістів під впливом комплексу вправ за протоколом Табата. **Матеріал і методи:** в педагогічному експерименті приймали участь 10 волейболістів чоловічої студентської команди «ХДАФК», віком 17-21 років, мають перший розряд з волейболу. Експеримент тривав 2 місяці та полягав у використанні протоколу Табата у навчально-тренувальному процесі волейболістів. В динаміці експерименту проведено тестування швидкісно-силових здібностей обраної групи волейболістів. Оцінка статистичної достовірності результатів порівняльного аналізу показників, які досліджувалися у даній роботі, проводилась за допомогою непараметричного критерію знаків. **Результати:** на початку педагогічного експерименту волейболісти мали наступні результати виконання тестів: згинання і розгинання рук в упорі лежачи за 20 с 17,30±0,45 разів; стрибок в довжину з місця поштовхом двох ніг 229,20±2,98 см; підйом тулуба із положення лежачи за 30 с 30,40±1,37 разів; кидок набивного м'яча вагою 1 кг із-за голови двома руками у стрибку 11,20±0,93 м; стрибок угору з місця (за В. М. Абалаковим) 49,60±2,51 см. Після проведення педагогічного експерименту значення показників швидкісно-

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Ключові слова:
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цикл
серія

силових здібностей волейболістів по кожному з п'яти тестів виявилися значно вищими у порівнянні з результатами відповідних тестів отриманих до початку експерименту. **Висновки:** запропоновані комплекси вправ за протоколом Табата виявилися ефективними, так як дали змогу достовірно покращити (p>0,01) швидкісно-силові здібності волейболістів за всіма проведеними тестами. Отримані результати дають нам змогу рекомендувати використання комплексів вправ за протоколом Табата тренувальній діяльності волейболістів.

Introduction

In modern volleyball, in connection with the expansion of the arsenal of technical and tactical actions of players, an increase in the intensity of the game, the speed of flight and the trajectory of the ball when performing the relevant technical elements, perfect physical preparedness of athletes is of particular importance. Therefore, the assessment of the level of special physical training of volleyball players is a significant scientific problem, where the main attention is paid to the development of speed-strength qualities of players (Borysova et al., 2018).

The implementation of most of the technical and tactical elements of volleyball, such as serving, attack hit, block, requires accuracy and purposefulness of movements, as well as the manifestation of explosive strength. Therefore, the physical training of a volleyball player should be aimed at developing the athlete's speed-strength abilities. Speed-strength abilities of volleyball players are determined by a complex of functional properties of the organism, which ensure the performance of motor actions in the minimum possible period of time (Kudriashov, 2002; Shvai et al., 2016; Kostyukevich et al., 2017; Hrynchenko et al., 2019).

One of the promising directions for solving the problem of increasing the efficiency of the training process of team sports athletes can be the use of the Izumi Tabata technique in physical training. Tabata is a high intensity interval training. It can include dynamic exercises in different sports, and the load should be sharp and explosive. (Kokareva & Kokarev, 2016; Kokareva, 2017.).

So, the authors of Kokareva & Kokarev (2016) experimentally proved the high efficiency of the Tabata technique using TRX-training exercises in the process of physical training of futsal players. The results of testing the indicators of physical fitness of the football players of the experimental group significantly improved ($p<0,001$, $p<0,05$). The results of the 30-meter run (increase by almost 1,20 s, $p<0,001$) and throwing the ball 2 kg with two hands from behind the head from the initial sitting position (increase by 200,50 cm, $p<0,001$) increased especially significantly.

The analysis of literary sources showed that the search for effective means and methods, as well as the introduction of new specialized training programs to improve the speed-strength abilities of volleyball players, will optimize their training process, which is an urgent problem today. Therefore, we decided to test the effectiveness of exercise complexes according to the Tabata protocol for improving the speed-strength preparedness of volleyball players of the "KhSAPC" student team.

Connection of work with scientific plans, themes. The study was carried out in accordance with the initiative theme of the Department of Sports and Outdoor Games of the KhSAPC "Improvement of the educational and training process in sports games." State registration number of research and development: 0119U101644 (2019-2023).

Purpose of the work: to determine the changes in the indicators of speed-strength abilities of volleyball players under the influence of a set of exercises according to the Tabata protocol.

Material and Methods of the research

Participants

10 volleyball players aged 17-21 years old took part in the pedagogical experiment, the average age was 18,9±1,19. They are players of the male student team "KhSAPC", the level of sportsmanship is the first category in volleyball.

Methods

At the beginning of the study for the pedagogical experiment, we conducted a test to determine the initial indicators of the development of speed-strength abilities of the selected group of volleyball players. Repeated testing made it possible to determine these indicators after the pedagogical experiment. The following tests were carried out in the experiment: push-ups for 20 s, the number of times; long jump from a place with a push of two legs, cm; lifting the torso from a prone position in 30 s, number of times; throw of a stuffed ball weighing 1 kg from behind the head with two hands in a jump, m; jump up from a place (according to V. M. Abalakov), cm.

Procedure

The pedagogical experiment lasted two months, was carried out in order to establish the effectiveness of the use of the proposed sets of exercises in the educational and training process of volleyball players. Complexes of exercises of speed-strength orientation according to the Tabata protocol were used. Tabata protocol is the principle of building interval training. It consists of a series of short 30-second intervals: 20 seconds of maximum effort and 10 seconds of rest. One Tabata cycle is eight such repetitions performed for 4 minutes. Volleyball players performed two cycles of 4 minutes, the break between cycles was 2 minutes. An obligatory methodological condition was the performance of each repetition with the highest possible result, that is, the level of tension in the performance of subsequent repetitions is close to the first result. It was proposed to use two sets of exercises alternately, in each other training. Volleyball players alternately used these sets of exercises twice a week in a specially preparatory part of the training session for two months. Each complex consisted of eight different exercises.

During the study, the rights of athletes were taken into account in accordance with the requirements of the Helsinki Convention. All participants gave informed consent to participate in the study.

Statistical analysis

Statistical analysis was performed using licensed MS Excel. The indicators of descriptive statistics were determined: arithmetic mean and standard deviation. The statistical significance of the results of a comparative analysis of the indicators studied in this work was assessed using a nonparametric sign test (G).

Results of the research

To identify the initial indicators of the development of speed-strength abilities of volleyball players of the «KhSAPC» student team, we used five tests and obtained the following

results of their implementation: flexion and extension of the arms in the lying position for 20 s 17,30±0,45 times; standing long jump with push of two legs 229,20±2,98 cm; lifting the torso from the prone position in 30 s 30,40±1,37 times; throw of a stuffed ball weighing 1 kg from behind the head with two hands in a jump of 11,20±0,93 m; jump up from a place (according to V. M. Abalakov) 49,60±2,51 cm. The athletes were given three attempts to complete each test, the best result was counted. After the initial testing, the complexes of speed-strength exercises proposed by us according to the Tabata protocol were introduced into the educational and training process of volleyball players. Volleyball players alternately used these sets of exercises twice a week in a specially preparatory part of the training session for two months. The complexes included such exercises as: burpees, Power Jacks, plank jumps, high hip running in place, jumping from two legs to the box, etc. The recommended sets of exercises are described in detail in the work Melnyk & Strelnykova (2022).

After the pedagogical experiment, the level of development of the speed-strength abilities of volleyball players who participated in our study was re-tested and the corresponding results obtained are given in Table 1.

An assessment was made of the reliability of the difference between the average statistical values of the indicators of these tests, determined before and after the pedagogical experiment using a nonparametric sign test. Since the number of non-zero shifts G(0)=0, it can be used when comparing the test results of the same group of athletes over time. The results of a comparative analysis are presented in Table 1. Analysis of the results for all five tests showed that the number of improvements, deteriorations and lack thereof corresponds to: G(+)=10, G(–)=0, G(0)=0, n=10. Hence, an improvement in test scores is typical. With reliability p≤0,01, G_{cr}=0. Since G_{cr} does not exceed G(–), this confirms the reliability of the increase in results and proves the effectiveness of using the proposed sets of exercises according to the Tabata protocol to improve the speed-strength abilities of volleyball players.

Discussion

In the special physical training of team sports players, special attention should be paid to improving their speed-strength readiness, as this has a positive effect on the effectiveness of their competitive activities (Bykova et al., 2015; Horchaniuk et al., 2015; Shvai et al., 2016; Medvedieva & Dorokhova, 2017; Paievskyi et al., 2018; Nesen & Pryimak, 2018; Petrov, 2019).

Table 1

Results of assessing the statistical significance of changes in the indicators of speed-strength abilities of volleyball players of the student team "KhSAPC" in a pedagogical experiment using the sign criterion G (n_1=10 i n_2=10)

№ i/o	Definition of the test	Before the experiment	After the experiment	G(+)	p
		$\bar{X}\pm\sigma$			
1	Push-ups for 20 s (number of times)	17,30±0,45	18,50±0,34	10	≤0,01
2	Standing long jump (cm)	229,20±2,98	243,10±3,11	10	≤0,01
3	Lifting the body from a prone position in 30 s (number of times)	30,40±1,37	33,20±2,48	10	≤0,01
4	Throwing a stuffed ball weighing 1 kg from behind the head with two hands in a jump (m)	11,20±0,93	12,84±0,45	10	≤0,01
5	Jump up from a place (cm)	49,60±2,51	53,80±3,11	10	≤0,01

We share the opinion of Kostyukevich et al. (2017), Imas et al. (2018), Shlonskaya and Hammudi (2019), Mario Terol-Sanchis et al. (2021) that it is the improvement of speed-strength abilities that will allow volleyball players to effectively perform such techniques as a power serve in a jump, a block and an attack hit, which are carried out due to the speed of movements and the preservation of the kinematic structure in space and time. Based on this, we have chosen the purpose and direction of our research.

In the course of our study, we used a longitudinal method, with the help of which we found out the effectiveness of using the proposed sets of exercises according to the Tabata protocol in the training activities of volleyball players of the student team of the "KhSAPC" to improve their speed-strength abilities. Since the changes in test scores before and after the pedagogical experiment have significantly improved. The longitudinal research method was used in the works Rezaeimanesh & Amiri-Farsani (2011), Sheppard et al. (2011), Imas et al. (2018), Borysova et al. (2018), Hrynchenko et al. (2019), Shlonska & Khammudi (2019), Mario Terol-Sanchis et al. (2021).

When selecting tests to determine changes in the speed-strength abilities of volleyball players, we relied on the studies of the authors Kudriashov (2002), Bishop (2003), Bykova et al. (2015), Karatnyk et al. (2016), Nesen & Pryimak (2018), Shevchenko et al. (2018) and Moshenska & Petrov (2020). Most of all, they preferred tests: a standing ling jump with a push of two legs, a jump up from a place, a throw of a stuffed ball weighing 1 kg from behind the head with both hands from different initial positions.

Expanded and supplemented the results of research by Pashkevych et al. (2015), Kokareva & Kokarev (2016), Kokarev et al. (2017) and Kokareva (2017) on the use of exercise complexes according to the Tabata protocol in the educational and training process of athletes and students. Their effectiveness was confirmed by positive changes in testing indicators during the pedagogical experiment. Analysis of the scientific and methodological literature showed that not enough attention was paid to the use of Tabata in the training process of athletes in team sports.

During our research, we received an improvement in volleyball players' jumping performance, which is the main manifestation of the speed-strength abilities of volleyball players. This problem was solved Pushparajan (2010), Sheppard et al. (2011), Sattler et al. (2012) and Özkan, Çđmenlđ, et al. (2016).

Conclusions

A consistent pedagogical experiment was carried out, aimed at increasing the level of speed-strength abilities of volleyball players of the student team «KhSAPC». At the beginning of the pedagogical experiment, volleyball players had the following test results: push-ups for 20 s 17,30±0,45 times; standing long jump with push of two legs 229,20±2,98 cm; lifting the torso from the prone position in 30 s 30.40±1.37 times; throw of a stuffed ball weighing 1 kg from behind the head with two hands in a jump of 11,20±0,93 m; jump up from a place (according to V. M. Abalakov) 49,60±2,51 cm. After the pedagogical experiment, the values of indicators of the speed-strength abilities of volleyball players for each of the five tests turned out to be significantly higher compared to the results of the corresponding tests obtained before the start of the experiment.

The proposed sets of exercises according to the Tabata protocol turned out to be effective, as they made it possible to significantly improve (p>0,01) the speed-strength abilities of volleyball players in all tests. The results obtained allow us to recommend the use of exercise complexes according to the Tabata protocol for the training activity of volleyball players.

Prospects for further research. The study of the influence of the increase in the indicators of the speed-strength abilities of the volleyball players of the student team of the "KhSAPC" on the quantitative indicators of the effectiveness of the performance of the power serve in the jump in their competitive activity.

Author Contributions

Melnyk Alina: design / research planning, data collection / input, manuscript preparation, literature analysis; Jerzy Skrobecki: data analysis / statistics, data interpretation; Liakhova Tamara: analysis / search of literature, data collection, fundraising; Pashchenko Natalia: data collection, literature search, fundraising; Lebedev Sergey: statistics, analysis / search of literature, fundraising.

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Conflicts of Interest

The authors declare no conflict of interest.

References

Bishop, D. (2003). A comparison between land and sand-based tests for beach volleyball assessment. Journal of Sports Medicine and Physical Fitness, 43(4), 418–423. Retrieved from: https://www.researchgate.net/publication/8883111

Bykova, O. O., Pomeshchykova, I. P., Strelnykova, E. Ya. & Liakhova, T. P. (2015). Zminy rivnia shvydkisno-sylovykh zdibnostei handbolistiv-pliazhnykiv 14–15 rokiv pid vplyvom spetsialno pidibranykh vprav. Slobozhanskyi naukovo-sportyvnyi visnyk, 6, 30–34. Retrieved from: http://nbuv.gov.ua/UJRN/snsv_2015_6_6

Borysova, O., Shlonska, O., Shutova, S., & Muntadar, F. (2018). Otsinka spetsialnoi fizychnoi pidhotovlenosti kvalifikovanykh voleibolistiv. Fizychna kultura, sport ta zdorovia natsii, 5, 167–173. Retrieved from: http://eprints.zu.edu.ua/id/eprint/27483

Horchaniuk, Yu. A., Shevchenko, O. O., & Kryvets, Yu. I. (2015). Znachennia shvydkisno-sylovykh zdibnostei u pidhotovtsi voleibolistiv. Sportyvni ihry, 11, 21–24. Retrieved from: http://repo.khdafk.kh.ua/bitstream/123456789/1192/1/MAT.КОНФ.%202015.pdf

Hrynchenko, I. B., Kobzar, M., & Lysenko, V. V. (2019). Vplyv rozvytku shvydkisno-sylovykh zdibnostei na riven tekhniko-taktychnoi pidhotovlenosti yunykh voleibolistiv. Tekhnolohii zberezhennia zdorovia, reabilitatsiia i fizychna terapiia, 31–35. Retrieved from: http://sportsscience.org/index.php/vuz/article/viewFile/967/968#page=31

Imas, Y., Borysova, O., Dutchak, M., Shlonska, O., Kogut, I. & Marynych, V. (2018). Technical and tactical preparation of elite athletes in team sports (volleyball). Journal of physical Education and Sport, 18(2), 972-979. Retrieved from: http://reposit.uni-sport.edu.ua/handle/787878787/2282

Karatnyk, I.V., Hrechanyuk, O.O., Bubela, O.Y.& Pityn, M.P. (2016). Perfection of badminton players' speed-power fitness with the help of training means' variable modules. Pedagogics, psychology, medical-biological problems of physical training and sports, 3, 18–24. doi: 10.15561/18189172.2016.0301

Kokareva, S., & Kokarev, B. (2016). Obgruntuvannia vykorystannia vprav TRX ta metodyky Izumi Tabata dlia orhanizatsii zaniat iz zahalnoi fizychnoi ta spetsialnoi rukhovoi pidhotovky sportsmeniv u ihrovykh vydakh sportu. Fizychna kultura, sport ta zdorovia natsii: zb. nauk. prats, (2), 69–73. Retrieved from: https://web.znu.edu.ua/herald/issues/2017/2017-sport-1.pdf#page=49

Kokareva, S. M. (2017). Obgruntuvannia efektyvnosti vykorystannia vprav iz zastosuvanniam trenazhernoho prystroiu TRX (suspension professional trainer) ta metodyky Tabata dlia pokrashchennia fizychnoi pidhotovky futbolistiv. Visnyk Zaporizkoho natsionalnoho universytetu. Fizychne vykhovannia ta sport, (1), 265–271. Retrieved from: https://web.znu.edu.ua/herald/issues/2017/2017-sport-1.pdf#page=265

Kokarev, B. V., Shcherbii, S. A., Danylchenko, S. I., & Shekhovtsova, K. V. (2017). Obhruntuvannia efektyvnosti vykorystannia metodyky Tabata na zaniattiakh z fizychnoho vykhovannia studentiv VNZ. Visnyk Zaporizkoho natsionalnoho universytetu. Fizychne vykhovannia ta sport, (1), 49–56. Retrieved from: https://web.znu.edu.ua/herald/issues/2017/2017-sport-1.pdf

Kostyukevich, V., Imas, Y., Borysova, O., Shlonska, O., Kogut, I. & Marynych, V. (2017) Technical and tactical training of qualified Volleyball players by improving attacking actions of players in different roles. Journal of physical Education and Sport,

1(17), 441–446. Retrieved from: http://reposit.uni-sport.edu.ua/handle/787878787/355
Kudriashov, E. V. (2002) Kontrol za urovnem razvytyia bыstrotы y skorostno-sylovыkh kachestv u voleibolystok razlychnoi kvalyfykatsyy. Fyzycheskoe vospytanye studentov tvorcheskykh spetsyalnostei, 5, 27–31. Retrieved from:https://sportedu.org.ua/html/physical-edu/Pdf2002/FV-2002-05.pdf#page=28
Mario Terol-Sanchis, Carlos Elvira-Aranda, Marна Josй Gomis-Gomis & Josй Antonio Pйrez-Turpin (2021). The Relationship Between Speed and Strength in the Beach Volleyball Serve. Journal of Human Kinetics, 80, 39–47. doi:10.2478/hukin-2021-0099
Medvedieva, I. M., & Dorokhova, O. V. (2017). Metodyka rozvytku shvydkisno-sylovykh zdibnostei studentiv VNZ u protsesi zaniat voleibolom. Naukovyi chasopys Natsionalnoho pedahohichnoho universytetu imeni MP Drahomanova, 3K(84), 292–296. Retrieved from**:** http://enpuir.npu.edu.ua/handle/123456789/17471
Melnyk, A. & Strelnykova, Ye. (2022). The development of high-speed power abilities of volleyball players through the use of a set of exercises according to Tabata protocol. Naukovyi chasopys Natsionalnoho pedahohichnoho universytetu imeni M. P. Drahomanova, 85, 118–122. doi: 10.31392/NPU-nc.series5.2022.85.25
Moshenska, T. & Petrov, D. (2020). Udoskonalennia fizychnykh yakostei voleibolistiv z vykorystanniam zasobiv aerobiky na etapi spetsializovanoi bazovoi pidhotovky. Slobozhanskyi naukovo-sportyvnyi visnyk, 1(75), 122–126. doi:10.15391/snsv.2020-1.021
Nesen, O. O., & Pryimak, S. V. (2018). Zminy pokaznykiv shvydkisno-sylovykh zdibnostei basketbolistiv 14-15 rokiv pid vplyvom vprav iz obtiazhenym miachem ta oporom partnera. Sportyvni ihry, 4, 30–39. Retrieved from: http://www.sportsscience.org/index.php/game/article/view/792
Özkan, Çđmenlđ, Hürmüz, Koç, Fatma, Çđmenlđ, & Celil Kaçoğlu (2016). Effect of an eight-week plyometric training on different surfaces on the jumping performance of male volleyball players. Journal of Physical Education and Sport, 16(1), 162–169. doi:10.7752/jpes.2016.01026
Paievskyi, V. V., & Perevoznyk, V. I. (2018). Osnovy metodyky vdoskonalennia shvydkisno-sylovykh zdibnostei sportsmeniv v ihrovykh vydakh sportu. Problemy i perspektyvy rozvytku sportyvnykh ihor i yedynoborstv u vyshchykh navchalnykh zakladakh, 2, 55–59. Retrieved from: http://repo.khdafk.kh.ua/bitstream/123456789/1177/1/мат%20конф.%202018.pdf
Pashkevych, S., Bondarenko, N., & Nikulina, H. (2015). Vplyv metodyky Tabaty yak variantu intervalnoho treninhu na riven fizychnoi pratsezdatnosti studentiv pedahohichnoho universytetu. Teorмв Ta Metodika Fмzičnogo Vihovannв, (2), 47–51. doi: 10.17309/tmfv.2015.2.1142
Petrov D. (2019). Udoskonalennia shvydkisno-sylovykh yakostei voleibolistiv z urakhuvanniam ihrovoho amplua. Vitchyzniana nauka na zlami epokh: problemy ta perspektyvy rozvytku, 189–194. Retrieved from: https://www.academia.edu/49195431
Pushparajan, A. (2010). Effects of plyometric training on the development the vertical jump in volleyball players. Journal Of Physical Education & Sport/Citius Altius Fortius, 28(3), 65–69. Retrieved from: https://www.researchgate.net/publication/47278117
Rezaeimanesh, D. & Amiri-Farsani, P. (2011). The effect of a 6 week isotonic training period on lower body muscle EMG changes in volleyball players. Social and Behavioral Sciences, 30, 2129–2133. doi: 10.1016/j.sbspro.2011.10.413
Sattler, T., Sekulic, D., Hadzik, V., Uljevic, O. & Dervisevic, E. (2012). Vertical jumping tests in volleyball: reliability, validity, and playing-position specifics. Journal of Strength and Conditioning Research, 26, 1532–1538. doi: 10.1519/JSC.0b013e318234e838
Sheppard, J. M., Dingley, A. A., Janssen, I., Spratford, W., Chapman, D. W. & Newton, R. U. (2011). The effect of assisted jumping on vertical jump height in high-performance volleyball players. Journal of Science and Medicine in Sport, 14(1), 85–89. doi: 10.1016/j.jsams.2010.07.006
Shlonska, O., & Khammudi, M. F. K. (2019). Optymizatsiia trenuvalnoho protsesu kvalifiko-vanykh voleibolistok na osnovi vdoskonalennia shvydkisno-sylovykh zdibnostei sportsmenok. Teoriia i metodyka fizychnoho vykhovannia i sportu, 4, 21–29. doi: 10.32652/tmfvs.2019.4.21-29
Shevchenko, O., Paievskyi, V. & Horchanyuk Y. (2018). Influence of the level of speed-strength preparedness on the agility of volleyball players 12–13 years old. Slobozhanskyi herald of science and sport, 1(63), 83–86. Retrieved from: http://journals.uran.ua/sport_herald/article/view/127946
Shvai, O., Poliakovskyi, V., Hnitetskyi, L., & Prystupa, Ie. (2016). Rol shvydkisno-sylovykh zdibnostei u formuvanni tekhnichnoi pidhotovky voleibolistiv 10–14 rokiv. Physical Education, Sport and Health Culture in Modern Society, 1(13), 73–76. Retrieved from: https://www.sport.vnu.edu.ua/index.php/sport/article/view/948

Ukrainian folk outdoor games in the system of physical training facilities for gymnasts aged 6-7 years

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Abstract

Purpose: to substantiate the effectiveness of the use of Ukrainian outdoor games to increase the level of physical preparedness of 6-7 year old gymnasts.

Material & Methods: the study involved 22 female athletes aged 6-7 years old involved in artistic gymnastics. The main and control groups included 11 female gymnasts each. Ukrainian outdoor games were included in the training process of the main group.

Results: the results of the study indicate that the proposed methodology, by which female gymnasts of the main group (MG) trained, contributed to a more pronounced ($p<0,05$; $p<0,01$) increase in the level of physical fitness compared to the results of female athletes of the control group (CG) who trained according to the traditional program for the development of physical qualities, except for the development of flexibility, where there was a statistically unreliable difference between the performance of female gymnasts of the main and control groups ($p>0,05$).

Conclusions: results of the implementation of the methodology for increasing the level of physical preparedness of female gymnasts aged 6-7 years using Ukrainian folk outdoor games testify to its effectiveness. The results obtained allow us to recommend the developed methodology for use in the training process of young female gymnasts at the stage of initial training.

Анотація

Альфія Дейнеко, Мірослава Цеслицька, Інна Красова, Ірина Біленька. Українські народні рухливі ігри у системі засобів фізичної підготовки гімнасток 6-7 років. Мета: обґрунтувати ефективність використання українських народних рухливих ігор для підвищення рівня фізичної підготовленості гімнасток 6-7 років. **Матеріал і методи:** у дослідженні прийняли участь 22 спортсменки 6-7 років, які займаються спортивною гімнастикою. В основну і контрольну групи входило по 11 гімнасток. В тренувальний процес основної групи були включені українські народні рухливі ігри. **Результати:** отримані результати дослідження свідчать, що запропонована методика, за якою тренувалися гімнастки основної групи (ОГ), сприяла більш вираженому ($p<0,05$; $p<0,01$) підвищенню рівня фізичної підготовленості порівняно з результатами спортсменок контрольної групи (КГ), які тренувалися за традиційною програмою розвитку фізичних якостей, окрім розвитку гнучкості, де спостерігалися статистично не достовірна різниця між показниками гімнасток основної і контрольної групи ($p>0,05$). **Висновки:** результати впровадження методики для підвищення рівня фізичної підготовленості гімнасток 6-7 років з використанням українських народних рухливих ігор свідчать про її ефективність. Отримані результати дають підставу рекомендувати розроблену методику для використання в тренувальному процесі юних гімнасток на етапі початкової підготовки.

Introduction

In the context of growing competition in gymnastics, the physical training of athletes is of particular importance as one of the main factors in the high efficiency of the training and competitive process (Gaverdovskij, 2014; Platonov, 2015; Deyneko et al., 2021). As you know, performance in elite sport is determined not by one physical quality, but by their combination (Gaverdovskij, 2014; Deyneko & Bilen□ka, 2021; Podrihalo, 2021). Therefore, the problem of the development of physical properties is relevant in all sports from the moment of early specialization, including in gymnastics. The analysis of scientific and methodological literature showed that in the practice of

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physical education and sports a large number of methods are used aimed at developing physical qualities, one of which is the game (Danish, 2002; Vil'chkovs'kyy & Kurok, 2005; Hardman, 2008; Vil'chkovs'kyy, 2009; Deyneko, 2017; Deyneko et al., 2022). It is well known that children of 6-7 years old, due to ontogenetic features of development, are characterized by increased motor activity and a pronounced need for it (Danish, 2002; Bohinich, 2003; Vil'chkovs'kyy & Kurok, 2005; Bar – Or, 2009; Kraemer, 2011; Isayeva & Konyk, 2018; Deyneko et al., 2022). That is why the use of outdoor games helps the coach improve physical qualities, give emotional coloring and introduce elements of competition into the training process, which has a positive effect on the sports training of female gymnasts (Vil'chkovs'kyy & Kurok, 2005; Koval'chuk & Sanyuk, 2018; Deyneko et al., 2021; Deyneko et al., 2022). This fact actualizes the use of a wide range of outdoor games, including folk ones, as a key aspect of not only an integral part of the national culture and patriotic education, but also the formation of a sustainable sports interest in training and improving the motor skills of young athletes. Through the comprehension of folk gaming culture, the child enters the world of interpersonal relationships with peers, enriches spiritual experience, learns the history of his native people, his customs, traditions, national characteristics, gains knowledge about the world around him, develops and improves motor skills and abilities (Kraft, 1987; Kolyshkin, 1999; Danish, 2002; Shevchenko, 2003; Bohinich, 2003; Vol'chyns'kyy, 2009; Deyneko, 2017; Deyneko et al., 2022). However, in the practical sports activities of female gymnasts 6-7 years old, there are no methods for introducing Ukrainian folk outdoor games, despite the fact that the program material suggests their use. Therefore, replenishment of the content of the educational and training process in artistic gymnastics with Ukrainian folk outdoor games is relevant and is of interest to scientific research.

An analysis of scientific literature has shown that most specialists in Western European countries recognize the important role of the motor activity of a child aged 5-8 years with the help of games (Kraft, 1987; Danish, 2002; Bar-Or, 2009; Turchyk, 2017). In many European countries, especially in England, since the end of the last century, in order to strengthen the gaming orientation of children's and youth sports, it has been proposed to use not only traditional outdoor games, but also folk, story, adventure, sports-dynamic and intellectual games, relay races and national sports, etc. (Williams, 1985; Kraft, 1987; Hardman, 2008). In almost all European countries (England, France, Germany, Denmark, Ireland, Austria, etc.), in educational programs related to the physical education of children in preschool education and primary school, there are outdoor and sports games, which are regulated by classroom and extracurricular forms of taking into account the interests of children (Williams, 1985; Kraft, 1987; Balz et al., 2005; Dallermassl, 2007; Hardman, 2008; Turchyk, 2017). It is important to emphasize that in each program of play activities about 50-70% of the total study time is devoted. Thus, most children under the age of 5-6 go through a program of planned and structured play situations (Kraft, 1987; Bar – Or, 2009).

Connection with scientific programs, plans, topics. The study was conducted in accordance with the initiative topic of the scientific research of the Department of Gymnastics, Dance Sports and Choreography of the KhSAPC: "Theoretical and methodological foundations for the development of backbone components of physical culture (sports, fitness and recreation) for 2020-2025, state registration number 0120U101215».

Purpose of the study: to evaluate the effectiveness of the use of Ukrainian folk outdoor games to increase the level of physical fitness of female gymnasts 6-7 years old.

Material and Methods of the research

Participants

The study involved 22 female athletes aged 6-7 years who train in the initial training group of the first year of study. Two groups were formed from the study participants: the main group (MG) and the control group (CG) of 11 female gymnasts in each. All gymnasts and their parents were informed about the nature of the study and gave their informed consent to participate and process the data obtained.

Methods

To achieve the goals set during the study, pedagogical testing, a pedagogical experiment, and methods of mathematical statistics were used. To assess the level of physical fitness of female athletes aged 6-7, 7 tests were selected, five of which are offered by the Artistic Gymnastics Curriculum for Youth Sports Schools, schools of higher sportsmanship: "raising straight legs in the hang", "pulling in the hang" - to assess the strength abilities of athletes; tests "long jump from a place", "running 20 meters" and "jumping rope in 1 minute." were used to assess the speed-strength abilities; test "performing three twines" - to assess flexibility. To assess the coordination abilities, the test "static balance according to the Yarotsky method" was used. Rope jumping is offered by the training program as a general physical fitness exercise.

Procedure

According to the results of the initial testing, the group of female gymnasts was divided into the main (n=11) and control (n=11) groups, taking into account the absence of significant differences in the indicators of the proposed test exercises. Testing the level of physical fitness of female gymnasts aged 6-7 was carried out twice - at the beginning (October) and at the end of the training year (May). Both groups of young female gymnasts trained in accordance with the Curriculum for Youth Sports Schools, schools of the highest sportsmanship in artistic gymnastics. However, more than 20 specially selected Ukrainian folk outdoor games aimed at developing physical qualities were included in the training sessions of female gymnasts of the main group (n=11). It should be noted that in the first year of study, the program material involves the use of outdoor games and relay races as the main means of general physical training of gymnasts. But the time that you need to spend on games in the tutorial is not indicated. The developed methodology involved the use of folk outdoor games in all three parts of the lesson. The total time is 25-30 minutes for each workout, depending on his tasks. Once every 2 weeks, a training session consisted exclusively of playing multidirectional activities.

During the study, Ukrainian folk outdoor games were one of the main means of physical training for young gymnasts. Of great importance was the choice of the content of the game. Most often, games were used that were aimed at the complex development of physical qualities: speed, strength, speed-strength qualities, coordination abilities. But when selecting games, the tasks of training and the direction of the exercises used on it were taken into account. If the training was dominated by strength exercises, then the games were used, for example, to develop flexibility, coordination abilities

and endurance. Such a mandatory alternation of the focus of games on different muscle groups was taken into account at each lesson in order not to interfere with mastering the program material on gymnastic devices due to the development of fatigue from the work of the same muscles.

It is known that time changes the content of games, creates many different options, but their motor basis remains unchanged. Therefore, all the proposed games were adapted to the educational and training process of young female gymnasts and became more difficult as they mastered them. Such games were used as "Zaporozhets in the Sich", "Gopak", "Panas", "Competition of strongmen", "Kreschik", "Grey cat", "Wolf and goats", "Hawk and mother hen", "Through the forest", " Crooked Duck", "Avalanche", "Goose", "Circle", "Pits", "Hatchling", "Jumps", "Patch", "Fifteen With Revenue", "Hares", "Tangled Horses", "Sharpshooter", "Kvach with a ball", "Spider", "Hunter and ducks", "Tunnel", etc. In these games, a variety of general developmental exercises, running, jumping, throwing, climbing, elements of struggle and dance, exercises with objects, with throwing and catching objects, and orientation in space were widely used. Also, games to maintain balance were used: "Swing", "Crane", "Swallow", "Cancer - Poor Man", "Twist - Twist", "Mill"; games with elements of acrobatics. "Crab", "Cuttlefish", "Recats field", "Spider", "Frog", "Duck"; competition games. To develop flexibility, a special approach was proposed that allows introducing some elements of novelty into the content of already existing traditional games, such as "Chaplya", "Needle - Thread", "Poppy Poppy", "Shagardai": movements of arms and legs with a large amplitude, performance of tasks games in the leaning position and during turns, deep lunges, etc. This is due to the fact that there are very few Ukrainian outdoor games for the development of flexibility, so the changes that already existed were made, which made it possible to complicate the movements and increase the interest of gymnasts in the game.

An important component of the methodology was prepared in advance and adapted to the training process, folk musical games with the words of the song ("Sawmill", "And we sowed millet, sowed", "Oh, the cuckoo flew", "Pear", "Poppy", "Winter", "Spring", "Summer", "Autumn"), held in the preparatory part of the lesson in the form of sets of exercises for the development of physical qualities. Certain movements were performed to the words of the song: squats, lunges, stops, leg swings, tilts, turns, jumps, transitions from a standing position to a sitting position, lying down and back, the content of postures, stylized varieties of walking and running in place and in motion, the content of various poses with and without visual control, elements of acrobatics, etc. During the games, their meaning did not change, the idea of the game was always preserved, but the motor actions were constantly renewed and complicated. Thus, not only the training effect from the use of folk outdoor games was achieved, but also the interest and motivation for classes increased. In the final part of the lesson, calm musical games were used for attention, relaxation, holding postures, and flexibility. During the games, the desire of athletes to display creative initiative, activity and improvisation was encouraged.

Thus, the content of Ukrainian folk outdoor games used in training sessions to improve the physical fitness of female gymnasts met the following requirements: firstly, it contributed to mastering the exercises of the classification program for elementary training groups; secondly, it corresponded to the morphofunctional and mental characteristics of the development of children aged 6-7 years, the level of their physical and technical readiness; thirdly, it corresponded to the features characteristic of the game method. Consequently, the use of Ukrainian folk games throughout the study has become the main method of complex improvement of physical qualities in the educational and training process of young female athletes.

Statistical analysis

Statistical analysis of the results was carried out using descriptive statistics indicators using licensed Excel spreadsheet packages and a set of built-in functions. The characteristics of descriptive statistics were determined: the arithmetic mean and the standard deviation. The assessment of the statistical significance of the results of a comparative analysis of the indicators of the main and control groups that were studied was carried out using the non-parametric Rosenbaum test (Q).

Results of the research

At the beginning of the study, the level of physical fitness of female gymnasts aged 6-7 years of the main and control groups was tested, the characteristics of which are presented in Table 1.

Table 1

Indicators of the level of physical fitness of female gymnasts aged 6-7 years at the beginning of the study ($t_{gr.}$ = 2,08 at p<0,05)

Test №	Tests		Main group (*n*=11) $\bar{X}\pm m$	Control group (*n* =11) $\bar{X}\pm m$	t_p	P
T1	**Strength qualities** «Rise of straight legs in the hang» (number of times)		6,90±0,73	6,45±0,39	0,55	p>0,05
T2	**Strength qualities** «Pull-ups» (number of times)		7,36±0,47	6,81±0,69	0,66	p>0,05
T3	**Speed-strength qualities** «Standing long jump» (cm)		129,90±4,20	118,72±4,69	1,78	p>0,05
T4	**Flexibility**«Performing three twines» (points)	1)ontherightleg	3,54±0,41	3,10±0,38	0,78	p > 0,05
		2)ontheleftleg	4,39±0,38	3,90±0,37	0,91	p > 0,05
		3)transverse	5,36±0,39	5,72±0,51	0,57	p > 0,05
T5	**Coordination abilities** «Static balance according to the Yarotsky method» (s)		19,09±1,44	18,36±1,18	0,39	p>0,05
T6	**Speed** «Running 20 m» (s)		4,28±0,31	4,10±0,16	0,53	p>0,05
T7	**Speed-strength endurance** «Jumping rope for 1 min» (number of times)		41,72±3,14	36,45±1,52	1,51	p>0,05

Table 2

Indicators of the level of physical fitness of female gymnasts aged 6-7 years at the final stage of the study

Test №	Tests		Main group (*n*=11) $\bar{X}$±m	Control group (*n* =11) $\bar{X}$±m	Q (S1+S2)	Qcr
T1	**Strength qualities** «Rise of straight legs in the hang» (number of times)		9,18±0,67	7,18±0,63	6	p<0,05
T2	**Strength qualities** «Pull-ups» (number of times)		10,18±0,62	7,72±0,73	7	p<0,05
T3	**Speed-strength qualities** «Standing long jump» (cm)		150,63±3,15	131,27±3,78	12	p<0,01
T4	**Flexibility** «Performing three twines» (points)	1) ontherightleg	2,37±0,24	2,73±0,33	5	p >0,05
		2) ontheleftleg	3,44±0,28	3,02±0,22	0	p >0,05
		3) transverse	4,32±0,32	4,57±0,24	0	p >0,05
T5	**Coordination abilities** «Static balance according to the Yarotsky method» (s)		25,63±1,06	21,63±1,45	6	p<0,05
T6	**Speed** «Running 20 m» (s)		3,60±0,11	3,97±0,14	11	p<0,01
T7	**Speed-strength endurance** «Jumping rope for 1 min» (number of times)		51,72±2,50	42,00±2,22	7	p<0,05

As a result of the analysis of statistical indicators of the level of physical fitness of female athletes from the MG and CG, carried out at the beginning of the study, the unreliability of the differences in the results obtained for all the proposed tests was revealed. Thus, we state the acceptable difference in the initial level of physical fitness of athletes of both groups (Table 1).

After 6 months of training according to the developed method of using Ukrainian folk outdoor games, a re-testing of the level of development of physical fitness of young female gymnasts of the main and control groups was carried out. The results obtained are presented in Table 2.

With the help of non-parametric criterion of signs of Rosenbaum at the final stage of the study, an assessment was made of the reliability of differences in the average statistical values of physical fitness indicators of female gymnasts of the main and control groups. So in the tests T1 “Rise of straight legs in the hang” (number of times); T2 “Pulling up” (number of times); T5 “Static balance according to the method of Yarotsky” (s); T7 “Jumping rope in 1 minute” (number of times) significant differences in test scores were found with a probability of 95% at p≤0,05 between the main and control groups. In tests T3 “ Standing long jump” (cm) and T6 “Running 20 m” (s), significant changes in the results between the main and control groups were also determined with a probability of 99% at p≤0,01. Obtained significant improvement in the results of these tests prove the effectiveness of the use of Ukrainian outdoor games to increase the level of physical fitness of female gymnasts 6-7 years old, in addition to the development of flexibility. So, in T4 “Performance of three s twines” (points), an unreliable difference was obtained between the indicators of female gymnasts of the main and control groups (p>0,05), although their improvement occurred in both groups. Such results can be explained by the fact that at the stage of initial training a large number of effective exercises for the development of flexibility are used, provided for by the training program and which were widely used in the training process, both in the main and in the control group. And the games for the development of flexibility, which were used in the methodology, did not have such exercises, which is primarily related to safety, because performing movements with a large amplitude in the game or in a state of excitement can lead to injury. Therefore, the improvement in flexibility indicators in both groups, in our opinion, is associated with the effectiveness of the training process, and not with the use of outdoor folk games (Table 2). As for the development of flexibility at the stage of initial training in artistic gymnastics, traditionally in the training process special exercises, children’s simulators and devices are used to effectively and safely develop this quality and reach the level that is required individually for each female gymnast. And folk outdoor games for the development of flexibility do not give a training effect that can be achieved by using them for the complex development of physical qualities, which is confirmed by significant changes in indicators for all other tests.

Discussion

An analysis of literary sources revealed the unanimous opinion of domestic and foreign experts regarding the statement that in order for a child to develop normally, he must be taught to play, therefore outdoor games are an ideal means of physical education (Kraft, 1987; Kolyshkin, 1999; Danish, 2002; Bohinich, 2003; Vil′chkovs′kyy & Kurok, 2005; Vol′chyns′kyy, 2006; Vol′chyns′kyy, 2009; Deyneko et al., 2022). The results of the conducted research complement the data of Bohinich (2003), Volchnskinkyy (2009), Shevchenko (2003), Vilchkovskovkyy and Kurok (2005), Danish (2003), Bar-Or (2009) and others on the need to introduce folk outdoor games into the practice of educational institutions which in a complex solve cognitive, educational, developing and educational tasks. We confirm the opinion of these scientists that folk outdoor games are an important means of educating children, contribute to the expansion of knowledge about the world around them, provide aesthetic pleasure from movements, create prerequisites for consolidating motor skills and developing physical qualities. Danish (2003), emphasizes that play activity stimulates the social and personal development of everyone, is a source of entertainment and success for everyone, allows the acquisition and improvement of skills, and also cultivates the characteristic “sporting traits”: self-control, discipline, cooperation, tolerance and respect to others.

We share the opinion of experts that the most effective method of conducting classes in initial training groups is the game (Bohinich, 2003; Vil′chkovs′kyy & Kurok, 2005;

Martinek et al., 2006; Bar – Or, 2009; Gaverdovskij, 2014). It is considered the most effective in solving the problems of developing the physical qualities of young athletes. Bar – Or (2009), Smolevskyy & Haverdovskyy (1999), Vil'chkovs'kyy & Kurok (2005), Bohinich (2003) note that game elements are used in all parts of the training session.

The data of Bar - Or (2009), Vil'chkovs'kyy & Kurok (2005), Bohinich (2003), Kraemer (2011), Weinberg and Gould (2003) on the effectiveness of using game and competitive methods in the physical training of female athletes of 5–6 years of age have been confirmed.

We also agree with the statement of experts (Smolevskyy & Haverdovskyy, 1999; Weinberg & Gould, 2003; Kraemer, 2011; Gaverdovskij, 2014; Platonov, 2015; Turchyk, 2017; Deyneko & Bilen'ka in direct proportion to the means used in the classroom, according to physiological characteristics of children of primary school age.

An analysis of the scientific literature allows us to state that in European countries, in almost every educational program of general education and sports schools, special attention is paid to sports and outdoor games and they are held in class and extracurricular forms, taking into account the interests of children. (Williams, 1985; Kraft, 1987; Balz et al., 2005; Dallermassl, 2007; Broeke et al., 2007; Hardman, 2008; Bar – Or, 2009; Turchyk, 2017). We agree with specialists from England, France, Austria, Denmark, Germany, etc., who, in order to strengthen the gaming orientation of children's and youth sports, propose to use not only traditional motor games, but also folk games, national sports, story, adventure, sports-dynamic and intellectual games, relay games, etc. Also, students are encouraged to compose new outdoor games and competitions, which allows children to develop their creative abilities (Kraft, 1987). In most Western European countries, the important role of the motor activity of a child under the age of 7-8 years with the use of games is recognized (Williams, 1985; Kraft, 1987; Bar-Or, 2009; Turchyk, 2017). W. Laporte (1999), Analyzing the physical education program in the EU countries, we came to the conclusion that there is no significant difference between them. All contain physical improvement, motor competencies, sports skills, educational and valeological values of motor activity.

Nevertheless, it should be noted that there are opposing opinions regarding the importance of play and competitive activities in teaching children of primary school age. Stolyarov (1997) quotes F. Fielding in his writings: "I reject the use of competition in schools: competition as a social ideal seems to me disgusting, they are morally unacceptable". But the results of our study confirm the opinion of many of the above-mentioned authors that play activity is an ideal means of physical education for children of primary school age (Kraft, 1987; Kolyshkin, 1999; Danish, 2002; Bohinich, 2003; Vil'chkovs'kyy & Kurok, 2005; Vol'chyns'kyy, 2009; Deyneko et al., 2022).

Conclusions

According to the results of the study, it was found that the use of Ukrainian folk outdoor games in the training process of female gymnasts 6-7 years old is an important means for increasing the level of physical fitness. The value of folk outdoor games lies in the fact that the acquired motor experience creates the necessary prerequisites for further successful sports activities.

The results of the study indicate that the proposed methodology, by which the female gymnasts of the CG trained, contributed to a more pronounced ($p<0,05$; $p<0,01$) increase in their level of physical fitness compared to the results of female athletes from the CG who trained according to the traditional program for the development of physical fitness. qualities. The results obtained confirmed the effectiveness of the use of Ukrainian folk outdoor games as the main means of developing the physical qualities of female gymnasts aged 6-7, which allows us to recommend the developed methodology for use in the training process of young female gymnasts at the stage of initial training.

Prospects for further research are the introduction of Ukrainian folk outdoor games in the educational and training process of the Youth Sports School, clubs and specialized educational institutions for further improvement and study of the impact on the competitive result of young female gymnasts.

Author Contributions
Alfiia Deineko: data collection, input, statistics; Miroslawa Cieslicka: design, research planning; Inna Krasova: interpretation of data, preparation of the manuscript; Iryna Bilenka: analysis, literature search, fundraising.

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Conflicts of Interest
The authors declare no conflict of interest.

References

Balz, E., Neumann, P., Puhse, U., & Gerber, M. (2005). Physical Education in Germany. Inter-national Comparison of Physical Education, 292-309.

Bar-Or, O. (2009). Zdorov'e detej i dvigatel'naya aktivnost': ot fiziologicheskih osnov do prakticheskogo primeneniya. Kiev, Olimpijskaya literatura, 528.

Bohinich, O. L. (2003). Fizychne vykhovannya ditey doshkil'noho viku zasobamy hry: navch. posib. 2-he vyd., ster. Kyyiv: NPU, 140.

Broeke, A., Van Dalfsen, G., Klein, G., & Hardman, K. (2007). Physical Education and Sport Education in the European Union: The Netherlands. Physical Education and Sport Education in the European Union. Editions Revue EP.S., Paris.

Dallermassl, K. (2007). Physical Education and Education through Sport in Austria. Physical Education and Sport Education in the European Union. Editions Revue EP.S., Paris.

Danish, S. J. (2002). Teaching life skills through sport. Paradoxes of youth and sport. Albany, NY: State University of New

York Press, 49-59.
Deyneko, A. Kh. (2017). Efektyvnist' vykorystannya ihrovoho metodu dlya rozvytku shvydkisno-sylovykh zdibnostey sport·smeniv-batutystiv na etapi pochatkovoyi pidhotovky. Slobozhans'kyy naukovo-sportyvnyy visnyk, 3(59), 22-25, doi: https://doi.org/10.15391/snsv.2017-3.004
Deyneko, A. Kh., & Bilen'ka, I. H. (2021). Vdoskonalennya rozvytku hnuchkosti himnastok 8-9 rokiv z vykorystannyam «STRETCHING» prohramy. Naukovyy chasopys Natsional'noho pedahohichnoho universytetu imeni M.P. Drahomanova, 10(141)21; 42-46, doi: https://doi.org/10.31392/NPU-nc.series15.2021.10(141).10
Deyneko, A. Kh., Shcherbak, R. M., & Fishev, Yu. O. (2021). Sylova pidhotovlenist' khloptsiv 6-7 rokiv v sportyvniy himnastytsi: dosvid vykorystannya ihrovoho metodu. Naukovyy chasopys Natsional'noho pedahohichnoho universytetu imeni M.P. Drahomanova, 1 (129) 21; 31-34, doi: https://doi.org/10.31392/NPU-nc.series15.2021.1(129).07
Deyneko, A.Kh., Marchenkov, M. K., & Pavlenko, A. O. (2022). Ukrayins'ki narodni rukhlyvi ihry yak zasib rozvytku fizychnykh yakostey yunykh himnastok. Aktual'nye nauchnye yssledovanyya v sovremennom myre: zhurnal. Pereyaslav, 1(80)2; 40-44.
Gaverdovskij, Yu. K. (2014). Teoriya i metodika sportivnoj gimnastiki. T1. Moskva: Sovetskij sport, 368.
Hardman, K. (2008). The situation of Physical Education in schools: a European perspective. Human Movement, 9(1):5-18, doi:10.2478/v10038-008-0001-z
Isayeva, M. V., & Konyk, L. V. (2018). Osoblyvosti metodyky provedennya rukhlyvykh ihor v molodshyy shkoli. Zdorov"ya natsiyi i vdoskonalennya fizkul'turno-sportyvnoyi osvity v Ukrayini: tezy dopov. V Vseukr. nauk.-prakt. konfer., Kharkiv, 57-60.
Kolyshkin, O. V. (1999). Ukrayins'ki natsional'ni rukhlyvi ihry u fizychnomu vykhovanni shkolyariv molodshoho viku : metodychni rekomendatsiyi. Sumy : redaktsiyno-vydavnychyy viddil SDPI imeni A. S. Makarenka, 85.
Koval'chuk, N. M., & Sanyuk, V. I. (2018). Rukhlyvi ihry na zanyattyakh iz himnastyky: metodychna rozrobka. Luts'k: Vezha-Druk, 92.
Kraemer, W. (2011). Exercise Physiology: Integrating Theory and Application. Baltimore: Lippincott Williams & Wilkins, 512 p.
Kraft, R. (1987). Learning through games discovery. The Physical Educator, №4, 18-22.
Laporte, W. (1999). Physical Education in European Union in harmonisation process. European Physical Education Association: Newsletter, 4; 12.
Martinek T., Schilling, T. & Hellison, D. (2006). The development of compassionate and caring leadership among adolesce. Physical Education and Sport Pedagogy. № 11(2); 141-157.
Matviyenko, C. I, & Zaplishnyy, I. I. (2017). Ukrayins'ki narodni rukhlyvi ihry u doshkil'nomu navchal'nomu zakladi : navch. posib, Nizhyn : NDU im. M. Hoholya, 152.
Platonov, V. N. (2015). Sistema podgotovki sportsmenov v olimpijskom sporte. Obshchaya teoriya i ee prakticheskie prilozheniya: uchebnik dlya trenerov. Kn. 1. Kiev: Olimpijskaya literatura, 680.
Podrihalo, O. O, Podrigalo, L. V., Kiprych, S. V., Galashko, M. I., Alekseev, A. F., Tropin, Y. M., Deineko, A. Kh., Marchenkov, M. K, & Nasonkina, O. Yu. (2021). The comparative analysis of morphological and functional indicators of armwrestling and street workout athletes. Pedagogy of Physical Culture and Sports, 25(3); 188-193.
Sergienko, L. P. (2010). Sports metrology: theory and practical aspects. Kyiv, 776.
Shevchenko, O. V. (2003). Rukhlyvi ihry ta zabavy: navch.-metod. posib. Kirovohrad : RVV KDPU im. V. Vynnychenka, 106.
Smolevskyy, V. M., & Haverdovskyy, Yu. K. (1999). Sportyvnaya hymnastyka: pidruchnyk. Kyyiv, Olimpiys'ka literatura, 463.
Sportyvna himnastyka (2003). Navchal'na prohrama dlya DYUSSH, DYUSHOR, SHVSM / Eretyk A. A., Tereshchenko I. A., & Dobrovol'skyy E. S. Kyev, 139.
Stolyarov, V. I. (1997). Sport and modern culture: methodological aspect Theory and practice of physical culture, 7; 2-5.
Turchyk, I. Kh. (2017). Fizychne vykhovannya i sport u shkil'niy osviti Yevropy: monohrafiya. Drohobych: Shvydkodruk, 138.
Vil'chkovs'kyy, E. S., & Kurok, O. I. (2005). Teoriya i metodyka fizychnoho vykhovannya ditey doshkil'noho viku: navch. posib. 2-he vyd., pererob. ta dopov. Sumy: Universytet·s'ka knyha, 428.
Vol'chyns'kyy, A. Ya. (2009). Ukrayins'ki narodni rukhlyvi ihry v systemi fizychnoho vykhovannya doshkil'nyat: monohrafiya. Luts'k, 148.
Weinberg, R. S, & Gould, D. (2003). Foundations of Sport & Exercise Psychology: Third Edition. Human Kinetics, 586.
Williams, T. (1985). School health education in Europe. Southamption: Universyty of Southamption, 34-38.

Features of the development of strength training of highly qualified football referees in the competitive period

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Abstract

Purpose: to identify the features of the development of strength training of highly qualified football referees in the competitive period.

Material & Methods: the study involved 30 highly qualified football referees aged 35-42: 4 FIFA referees, 15 Premier League referees and 11 First League referees.

Results: the training program for strength development in the competitive period included new fitness training tools using TRX® functional loops, step platform, *BOSU* hemisphere, 6D sliding. In the preparatory and final part of the training session, we included MFR exercises to fill the muscles with the maximum volume of blood and activate the nerve centers for their additional stretching. The results of testing the physical fitness of highly qualified referees at the beginning and end of the competitive period indicate that the training program developed by us, aimed at developing strength in competitive microcycles, most significantly influenced the increase in the manifestation of strength qualities in flexion and extension of the arms in emphasis. 8% and speed endurance in the YO-YO test - by 15,1%. There was also an improvement in the results in the manifestations of speed by 7.4% and by 2.3% in the 40 m run and the 4x10 m shuttle run, as well as by 5,7% in the speed-strength abilities in the standing long jump test.

Conclusions: the results of the study indicate the effectiveness of the strength training program for referees of different levels and qualifications and its use in training microcycles of the competitive period to improve physical fitness.

Анотація

Анатолій Абдула, Андрій Перцухов, Крцисцтьоф Вноровський, Світлана Можаровська, Юрій Можаровський. Особливості розвитку силової підготовки футбольних арбітрів високої кваліфікації у змагальному періоді. Мета: виявити особливості розвитку силової підготовки футбольних арбітрів високої кваліфікації у змагальному періоді. **Матеріал і методи:** у дослідженнях приймали участь 30 футбольних арбітрів 35-42 років високої кваліфікації: 4 арбітри FIFA, 15 арбітрів Прем'єр-ліги та 11 арбітрів Першої ліги. **Результати:** в програму тренувань для розвитку сили у змагальному періоді були включені нові засоби фітнес-тренування з використанням функціональних петель TRX® , степ-платформи, полу-сфери *BOSU,* 6D sliding. В підготовчій та заключній частинах тренувального заняття нами були включені вправи МФР, щоб наповнити м`язи максимальним об`ємом крові та активізувати нервові центри для додаткового їх розтягування. Результати тестування фізичної підготовленості арбітрів високої кваліфікації на початку та наприкінці змагального періоду свідчать про те, що розроблена нами програма тренувань, спрямована на розвиток сили у змагальних мікроциклах, найбільш суттєво вплинула на приріст прояву силових якостей у згинанні та розгинанні рук в упорі лежачи на 27,8 % та швидкісної витривалості в тесті YO-YO - на 15,1 %. Також спостерігалося покращення результатів в проявах швидкості на 7,4 % та на 2,3 % у бігу на 40 м та човниковому бігу 4х10 м, а також на 5,7 % швидкісно-силових здібностей в тесті стрибок у довжину з місця. **Висновки:** результати дослідження свідчать про ефективність програми силової підготовки та використання її у тренувальних мікроциклах змагального періоду арбітрів різного рівня і кваліфікацій для покращення фізичної підготовленості.

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змагальний період
тестування

Introduction

Football arbitrage, first of all, depends on the dynamics and development of modern football. The speed of attacks, the movement of players, the ability of players to use long passes - all this requires the referee to have appropriate physical fitness (Lisenchuk et al., 2021, Pertsukhov & Perevoznik 2019). In order to make the right decisions on the football field, the referee must always be near the game episode, which is determined by proper physical activity during the game.

Many leading experts were engaged in the study of the physical training of referees in football. Some believe that the level of physical fitness of referees largely depends on such physical qualities as endurance and speed (Helsen & Bultynck., 2004).

In addition, Vykhrov (2005) argues that the psychological state of the referee has a significant influence on the physical preparation during the match.

In turn, Nikolaienko & Chopilko (2020) emphasize that when changing the direction and running technique, the football referee is significantly affected by the development of agility and coordination.

Baydemir et al., (2021) argue that high-intensity running and sprinting should be the main means of football referee training.

In recent years, in the educational and training process of athletes whose activities are related to motor activity, exercises are often used to develop strength (Kokareva et al., 2018, Mac Innis & Gibala, 2017, Platonov, 2017, Seluianov et al., 2019). In football arbitration, a sufficient level of strength training is necessary for a constant change of direction, jerks, and unexpected stops. Also, the presence of a certain margin of strength of muscles and ligaments significantly reduces the possibility of injury during a game or training (Bangsbo, 2004, Pacholek & Zemkova, 2020, Cherepanov & Mukhamadyev, 2012, Pamela et al., 2018).

In our opinion, strength exercises can affect not only the strength development, but also other types of football referees' physical fitness. However, there were no scientific works related to the study of the strength training of referees in football, which determined the relevance of our study.

Purpose of the study: to identify the features of the development of strength training of highly qualified football referees in the competitive period.

Material and Methods of the research

Participants

The study involved 30 highly qualified football referees aged 35-42 (average age 37,4 years): 4 FIFA referees, 15 Premier League referees and 11 First League referees. All referees gave informed consent to participate in the study.

Methods

To solve the tasks set in the work, the following research methods were used: analysis of scientific and methodological literature, pedagogical testing of referees' physical fitness, methods of mathematical statistics.

Pedagogical testing was carried out at the beginning and end of the competitive period in order to identify the effectiveness of means and methods of strength training, which were included in the training process of football referees.

To assess the level of physical fitness of referees, control studies were carried out using a battery of tests recommended by the committee of referees of the Ukrainian Football Association (UAF) and approved by the European Union of Football Associations (UEFA) to diagnose the level of physical fitness of referees in accordance with age limits and the level of sports qualification. The selection of tests and control exercises for the study of the physical fitness of referees was made taking into account the FIFA requirements for referees and assistant referees of various categories, previously and now being introduced into practice (Derdo et al., 2019).

To assess the speed qualities, the run time of 40 meters and the shuttle run 4x10 m from a high start were determined. Two attempts were given, the best result was chosen and the corresponding calculations were carried out. The referee started the movement from a high start. The run time of 40 m must be at least 6,0 s, and the run time of 4x10 m must be at least 9,6 s.

To assess the speed-strength qualities:

- measured the length of the jump from the place by pushing off two legs. The referee stood on the line of the jump, after a preparatory semi-squat he jumped up and forward, using the swinging movements of his arms, and landed at the maximum possible distance. The best result of two attempts was recorded. The result of the jump must be at least 23,5 cm.

To assess special endurance, the total time of running the Yo-Yo test was determined. The referee ran a distance of 2x20 m with rest pauses and a gradual increase in speed. Referees conducting matches of professional teams must run up to the level of 18,2 – 14,33 minutes.

Push-ups were used to assess strength development. The starting position is an emphasis lying on a support (field), the body is straightened, without bending at the hip joints, the shoulders are above the hands, the hands are at a shoulder-width distance from each other and directed forward. Result not less than 40 times (Derdo et al., 2019).

Procedure

The study was carried out in several stages. At the first stage, the analysis and generalization of scientific and methodological literature was carried out, which made it possible to study the state of the problem under study. At the second stage, a program of strength training of training microcycles was developed using modern fitness training tools and testing of the level of physical fitness of referees at the beginning of the competitive period was carried out. At the third stage, final testing was carried out at the end of the competitive period to determine the effectiveness of the implemented strength training program, processing and comparative analysis of the results obtained were carried out, and conclusions of the study were drawn.

Statistical analysis

The obtained data were processed using the statistical package of Excel XP. Mathematical and statistical methods included: calculation of arithmetic average characteristics - $\bar{X}$; standard error of the mean - m; Student's t-test, which determined the degree of significance of the difference in indicators.

Results of the research

To develop the strength training of football referees, we developed a special program that we used in the training microcycles of the competitive period. The training microcycles of the competition period included new fitness training tools using TRX® functional loops, a step platform,

Table 1

Indicators of physical fitness of referees in football during the competitive period (n 30)

Tests	At the beginning of the competition period $\bar{X}_1 \pm m_1$	At the end of the competition period $\bar{X}_2 \pm m_2$	t	p
Running 40 m, s	5,84±0,09	5,41±0,1	3,20	<0,01
YO-YO test, min	14,33±0,23	16,44±0,11	2,86	<0,01
Standing long jump, m	2,31±0,05	2,44±0,03	2,23	<0,05
Push-ups, number of times	41,9±2,20	53,5±3,70	2,76	<0,01
Running 4x10, s	9,51±0,03	9,32±0,06	2,83	<0,01

BOSU hemispheres, 6D sliding, rubber shock absorbers and myofascial relaxation rolls (MFR).

The results of testing the physical fitness of football referees at the beginning of the competitive period are presented in Table 1. Thus, the average test results were as follows: 40 m run was 5,84±0,09 s, YO-YO test execution time was 14,33±0,23 min, standing long jump – 2,31±0,05 m, push-ups – 41,9±2,20 times and shuttle run 4x10 – 9,51±0,03 s. The level of indicators of physical fitness of referees after testing at the beginning of the competition period was average, and the 40 m run was below average according to the FIFA test evaluation scale (Petrov & Abdula, 2007).

After the implementation of the strength training program at the end of the competitive period, the physical training of football referees was retested. The test results are presented in Table 1. It should be noted that the selected means and methods of strength training significantly improved performance in all types of test exercises. Thus, in the 40m run, the result was 5,41±0,1 s, which is 0,43 s, 7,4% better than at the beginning of the competition period ($p<0,01$); the results improved by 15,1% in the YO-YO test and amounted to 16,44±0,11 min, ($p<0,01$), as well as by 5,7% in the standing long jump – 2,44±0,03 m ($p<0,01$), by 27,8% in push-ups – 53,5±3,70 times ($p<0,01$) and by 2.3% in running 4x10 m - 9,32±0,06 s ($p<0,01$).

Thus, a significant difference in the results of the physical fitness of referees in various types of testing allows us to assert the effectiveness of this technique not only in the manifestation of strength r and speed-strength qualities (push-ups and standing long jump), but also in the development of speed endurance (YO-YO test) and speed (40m run and 4x10m run). Therefore, the development of strength according to our program with the use of new means of fitness training is positive and can be used in the training process of football referees.

Discussion

The training of a sports referee directly depends on the modern development of the sport in which the arbitration of competitions takes place. Research by Sant'anna et al., (2021) on the fitness of rugby referees suggests the need for more high-intensity training aimed at developing speed endurance, which is driven by playing activities during the game. Breklen et al., (2021) state that high-intensity training 3 times a week for basketball referees results in improved speed performance and reduced reaction time when making decisions on the basketball court. In turn, studies of the physical fitness of referees in handball proved that improving the results of special endurance in the training process significantly improves the efficiency of making the right decisions during the game (Blob et al., 2022). The studies conducted by us in the competitive period of football referees confirm the need to include high-intensity exercises for the development of different types of endurance in the training microcycles, but in contrast to this, the referee must have a certain reserve of strength of the muscle groups that are most involved in such work, which will enable the body to withstand such a load. The results of our research have proved that the development of strength training in the competitive period also contributes to the improvement of the level of other physical qualities necessary for the high-quality work of the referee during the game.

Strength is fundamental to all aspects of fitness in most sports, especially those that involve various forms of running such as sprinting, turning, and changing direction. By including strength development tools in the training process, one can not only increase muscle power, but also improve the athlete's physical qualities and prevent the occurrence of most mechanical injuries (Cherepanov & Mukhamadyev, 2012, Paes et al., 2011). The results of our research have shown the need to use means of strength training to improve the level of strength, as well as speed and endurance.

When planning the training process, the development of general strength training is carried out mainly in the preparatory period. In the competitive period, special strength training comes to the fore (Platonov, 2017, Petrov & Abdula, 2007). However, a complete rejection of the development of maximum strength is a mistake, first of all, in those sports where special requirements are placed on high-speed movement. The strength qualities of an athlete, brought to a high level of development in the preparatory period, cannot remain at the proper level during the playing season, therefore, in the competitive period, due attention should be paid to the development of maximum strength, speed-strength qualities and strength endurance at least twice a week (Pamela et al. 2018, Abdula 2018). The experimental data of our study supplement the knowledge of the authors about the features of strength development in the training process of the competitive period of athletes and confirm the need to include strength-oriented training 2-3 times a week.

According to experts in the field of theory and methodology of sports training (Charmi et al., 2020, Pacholek & Zemkova, 2020, Paul et al., 2018), new approaches to the functional training of athletes using modern training devices: TRX®, BOSU hemispheres, 6 -D Sliding, rubber shock absorbers are among the hottest trends in recent years and promote the development of all muscles, combining stability, mobility, strength and flexibility into a single whole - everything that athletes need, especially in sports with complex movements (Bangsbo 2004, Paul et al 2018). Our study is consistent with the data of specialists on the positive impact of modern

training devices in the training of athletes, but it should be noted that their selection should be generally accessible and easy to use, since each football referee spends most of the time of the training process independently and complex new fitness equipment. workout. do not give a positive effect due to the lack of constant control over the correct technique for performing exercises.

Testing the physical fitness of Ukrainian referees takes place 4 times a year under the FIFA referee training program and includes speed endurance in the YO-YO test and speed in the 6 40-meter run test (Derdo et al., 2019). LaPlaca et al., (2020) recommend that testing the physical fitness of football players include exercises of speed-strength qualities (high jump, long jump), which is informative for team sports. It should be noted that the spectacular test tasks of the physical fitness of athletes whose activities are associated with a change in the direction of movement are shuttle running and its varieties, which includes manifestations of speed-strength qualities (Pamela et al., 2018). The selection of the battery of tests of our study was first developed in such a way as to be able to conduct a deep analysis and dynamics of the development of the main physical qualities of football referees in the competitive period, as well as include them in the control of the physical fitness of referees of various qualifications.

Subsequent studies will be devoted to the peculiarities of the construction of the training process of referees in the annual training cycle.

Conclusions

The results of our research have revealed the peculiarities of using the means of strength training of football referees in the competitive period. Thus, the development of strength training in the competitive period with the help of new means of fitness training helps to improve the level of indicators of other physical qualities necessary for the effective work of the referee during the game. The most significant increase occurred in the manifestation of strength qualities in push-ups by 27,8% and speed endurance in the YO-YO test – by 15,1%. There was also an improvement in the results in the manifestation of speed by 7,4% and by 2,3% in running 4x10 m, as well as by 5.7% in speed-strength abilities in the standing long jump. The results of the study indicate the need to include a strength training program in the training microcycles of referees of different levels and qualifications in order to improve physical fitness and prevent injuries during the playing season.

Author Contributions
Abdula Anatoliy: data analysis, statistics, data interpretation, manuscript preparation; Pertsukhov Andrii: data collection, input; Krzysztof Wnorowski: design, research planning; Mozharovska Svitlana: data analysis, literature search; Mozharovskyy Yuriy: data analysis, literature search.

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Conflicts of Interest
The authors declare no conflict of interest.

References

Abdula, A. B. (2018). Kontrol fizychnoi pidhotovlenosti futbolistiv na etapi spetsializovanoi bazovoi pidhotovky. Naukovyi chasopys Natsionalnoho pedahohichnoho universytetu imeni M. P. Drahomanova. Naukovo-pedahohichni problemy fizychnoi kultury (fizychna kultura i sport), 15(5), 9-12. http://nbuv.gov.ua/UJRN/Nchnpu_015_2018_5_4

Bangsbo, J. (2004). Fitness training in football: a scientific approach. Br J. Sports Med, 191–196.

Baydemir, B., Yurdakul, H., & Aksoy S. (2021). The Effect of Different Training Strategies Applied to Football Referees On Max(vo2) and Running Performance. Pakistan Journal of Medical & Health Sciences, 15 (10), 2933-2937. 10.53350/pjmhs2115102933

Blob, N., Schorer, J., Loffing, F., & Busch, D. (2022). Decisions and reasonings of top-class handball referees under physical load. German Journal of Exercise and Sport Research, 2(52), 221-223. https://doi.org/10.1007/s12662-021-00794-8

Breklen, R., Deandra, M., Sakina, Abdurachman, & Purwo, S. (2021). Comparison of High-Intensity Interval Training and Moderate-Intensity Continuous Training on VO2max and Response Reaction Time in Basketball Referees. Indian Journal of Forensic Medicine & Toxicology, 15(3), 2021-05-17. DOI: https://doi.org/10.37506/ijfmt.v15i3.15715

Charmi S., Sathya, P., & Jibi, P. (2020). Effects of Bosu ball exercise on jump performance in football players. International Journal of Physiotherapy, 7(10), 136-139. https://doi.org/10.15621/ijphy/2020/v7i4/740

Cherepanov, P., & Mukhamadyev M. (2012). Sylovaia podhotovka futbolystov. Skorost atakuiushchykh deistvyi v futbole. Profyzdat, 88.

Derdo, V. H., Petrov, V. D., Abdula, A. B., Lyshen R. Y., Yarmolynskyi L. M., & Likarenko, A. O. (2019). Pytannia ta vidpovidi do pravyl hry u futbol 2019/20. Kyiv, 187.

Helsen, W., & Bultynck, J. B. (2004). Physical and perceptual-cognitive demands of top-class refereeing in association football. J Sports Sci, 22(2), 179-189. https://doi.org/10.1080/02640410310001641502

Kokareva, S. M., Kokarev, B. V., & Doroshenko E. Y. (2018). Analysis of the state of highly skilled football players' musculoskeletal

system at the beginning of the 2nd preparatory period of the annual macrocycle. Physical Education, Sports and the Culture of Public Health in Modern Society. 4 (44), 64-68. https://doi.org/10.29038/2220-7481-2018-04-05-64-68

LaPlaca, D. A., & McCullick, B. A. (2020). National Football League Scouting Combine Tests Correlated to National Football League Player Performance. Journal of strength and conditioning research, 34(5) 1317-1329. https://doi.org/10.1519/JSC.0000000000003479

Lisenchuk, G., Mulik, V., Shamardin, V., Kraynik Y., Bairachny, O., & Slavitiak, O. (2021). Physical and technical training of 13–14-year-old football midfielders. Journal of Physical Education and Sport. 21, 1798 – 1805. http://reposit.uni-sport.edu.ua/handle/787878787/3314

Martin J. MacInnis, & Martin, J. Gibala (2017). Physiological adaptations to interval training and the role of exercise intensity. The Journal of Physiology, 595(9), 2915-2930, https://doi.org/10.1113/JP273196

Nikolaienko, V., & Chopilko T. (2020). Indyvidualizatsiia spetsialnoi fizychnoi pidhotovky arbitriv vysokoi kvalifikatsii u futboli. Nauka v olympyiskom sporte. 4, 4-15. https://doi.org/10.32652/olympic2020.4_1

Pacholek, M., & Zemkova, T. (2020). Effect of Two Strength Training Models on Muscle Power and Strength in Elite Women's Football Players. Sports, 8(4),42. https://doi.org/10.3390/sports8040042

Paes, M., Peres, R., & Silva, A. (2011). Injuries ocurred with football (soccer) referees during the match, training and physical test. International Sportmed Journal, 12(2), 74-84. https://www.researchgate.net/publication/268512482

Pamela, R., Tiago, V., Rozвngela M., Hdico, L., Marcelo, C., Mбrcio, A., Alex H., Marcelo, S., & Charles, R. (2018). Effect of linear and undulating training periodization models on the repeated sprint ability and strength of soccer players. Motriz. Revista de Educaзго Fнsica, 24(4), https://doi.org/10.1590/S1980-6574201800040013

Paul, J., Nagaraj, M., & Solomon, J. (2018) Effectiveness of coordination exercise on proprioception of knee injured male professional footballers. Drug Invention Today. 10(10), 1887-1891, https://doi.org/10.5958/0976-5506.2019.02807.9

Pertsukhov, A., & Perevoznik, V. (2019). Dvyhatelnaia aktyvnost futbolystov vыsokoi kvalyfykatsyy v uslovyiakh sorevnovatelnoi deiatelnosty. Sportyvni Ihry, 1(11), 32-39. https://doi.org/10.5281/zenodo.2543561

Petrov, V. D., & Abdula, A. B. (2007). Fyzycheskaia podhotovka futbolnykh arbytrov. Kharkov, 96.

Platonov, V. N. (2017). Dvigatelnye kachestva i fizicheskaia podgotovka sportsmenov. Kiev: Olimpiiskaia literatura, 656.

Sant'ana, R., Roberts S., & Stokes, K. (2021). Rugby union referees' physical and physiological demands across different competitive levels. Journal of Sports Medicine and Physical Fitness, 61(6) 788-796. DOI: 10.23736/S0022-4707.20.11447-6

Seluianov, V. N., Sarsanyia, S. K., & Sarsanyia, K. S. (2019). Fyzycheskaia podhotovka futbolystov: monohrafyia. 3-e yzd. Teoryia y praktyka futbola. M.: TVT Dyvyzyon, 192.

Vykhrov, K. L. (2005). Kompanon futbolnoho arbytra. Federatsyia futbola Ukrayiny, Komby LTD, 192.