

The individualization of the educational and training process in fencing in the context of improving efficiency and health of young athletes of different ages

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Abstract

Background and Study Aim Optimizing the training process in fencing for athletes of different ages, genders, and levels of preparedness is key to achieving high results without compromising health. The aim of the study is to evaluate the effectiveness of a physical and technical-tactical readiness program for young fencers in mixed age groups.

Material and Methods The study involved 22 epee fencers, aged between 6 to 17 years. Athletes were divided into two groups by age and level of preparedness: group 1 (10-16 years) and group 2 (6-12 years). The training program lasted for 12 months, including specialized exercises and tests to evaluate progress in physical and technical-tactical readiness. The experiment was conducted in Kharkiv, Ukraine, located in a war zone since February 2022. Requirements of the military administration for ensuring the safety of the experiment participants were met.

Results As a result of the study, both groups showed significant improvement in physical fitness and technical-tactical skills. In group 1, improvements were identified in the "Shuttle Run" and "Standing Long Jump" tests ($p < 0.05$), while in group 2, there was an alignment among participants in test indicators ($p < 0.05$). The increase in the level of technical-tactical preparedness and coordination abilities was also confirmed by the improvement in test results ($p < 0.01$).

Conclusions The proposed program underscores the importance of adapting the training process to the individual needs of fencers from various age groups. Such an approach not only facilitates their athletic development but also enhances health levels and overall physical fitness. These results offer valuable insights for coaches aiming to maximize their students' potential while simultaneously reducing health risks.

Keywords: fencing, fencers, training, mixed learning groups

Introduction

In modern sports, technically complex and physically intensive disciplines such as fencing require a special approach to individualizing the training process. Adapting training methods to the specific needs of young athletes is a key element in achieving high sports results and minimizing health risks. However, the current military situation in Ukraine has made significant adjustments to athletes' preparation, forcing many to move to safer regions and adapt to conditions after the destruction of sports facilities. These circumstances necessitate the development of new training methods adapted to mixed group conditions and ensuring effective skill development in a changing environment.

Fencing, as a highly technical sport, requires not just physical preparation but also the development of athletes' intellectual qualities. At the basic stage of fencer training, particular attention is paid to personality development and understanding the goals of executing technical moves. Research emphasizes the importance of such an approach for athletes of all ages and levels of preparation, highlighting the necessity of enhancing sportsmanship against the backdrop of physical development [1, 2, 3]. In the context of the current challenges faced by Ukrainian sports, the task of finding optimal solutions for the training process that can adapt to new conditions and ensure the continuation of successful sports training is highlighted [4, 5, 6].

Fencing attracts young people with unique opportunities for physical activity, highlighting the role of this sport in enhancing health and social

integration [7]. Research on brain dominance among professional fencers points to the importance of intellectual and strategic preparation, as well as the ability to think analytically, which contributes to the improvement of sports achievements [8].

Another study found that mobility restrictions significantly affected the training process of young fencers [9]. At the same time, maintaining contact between coaches and athletes was key to preserving athletes' physical and psychological qualities [9]. Research among Korean fencers highlighted the importance of stress management and emotional state for achieving high sports results [10]. These results underscore the importance of psychological preparation in addition to physical training.

Special attention is paid to the anthropometric and physical characteristics of athletes, as they play a significant role in competition success. Research on the connection between physical indicators and sports performance has confirmed the importance of a comprehensive approach to assessing the readiness of fencers, including measurements of physical performance and coordination of movements [11, 12]. This emphasizes the need for individualized training programs that take into account the age and gender characteristics of athletes to optimize their sports results. Based on this understanding, the aim of the study is to evaluate the effectiveness of a physical and technical-tactical preparedness program for young fencers in mixed age groups.

Materials and Methods

Participants

The study involved 22 epee fencers, aged 6 to 17 years, including 8 beginner athletes and 14 athletes who had previously engaged in fencing and had training experience. Participants were divided into two groups by age and level of preparedness: group EG1 (10-16 years) and group EG2 (6-12 years). Consent for the participation of their children in the experiment was provided by the parents. This study was conducted in accordance with the Declaration of Helsinki and approved by the University Ethics Committee.

Special Conditions of the Experiment

The experiment was conducted in Kharkiv, Ukraine, located in a conflict zone since February 2022. The military administration's security requirements for experiment participants were observed. Participants were informed about specific actions during the announcement of citywide alarms (loud siren sounds and a message on the mobile phone) and already had practical skills for such actions.

Study Design

The experiment lasted for 12 months from September 2022 to October 2023. To assess the

overall and special physical preparedness, the following tests were used:

1. Test 1. Shuttle Run 4 x 9 m - to determine the level of speed qualities;
2. Test 2. Standing Long Jump - to determine power properties;
3. Test 3. Target hitting, number of accurate thrusts - to determine coordination abilities;
4. Test 4. Throw (Flash attack) from a standing position - to determine technical abilities compared to power.
5. Test 5. This test was used to determine the technical-tactical preparedness and the level of agility development of the participant. The number of random thrusts in free fights was determined. During combat practice for 5 thrusts, the coach watches three random fights of each athlete and assesses the number of thrusts made in a specific duel. The number of thrusts made in the first action is counted, and thrusts made in a remise (repeated thrust) are not counted. The result is the percentage ratio of prepared thrusts to the number made in combat by the given athlete.

A training program was developed for athletes of both groups (Figure 1).

Figure 1 reflects the differences in approaches to the training process of two experimental groups of athletes. It showcases the types of training that were emphasized within the program. EG1 focused on refining and repeating already known techniques and skills, whereas for EG2, there was more focus on familiarization and training on the basics and new elements of the training process.

Statistical Analysis

For analyzing and visualizing the data, the integrated development environment PyCharm Community Edition was used. The code was written in Python, with a major focus on using the Matplotlib library to create graphs and charts. For processing statistical data, including calculating means, standard deviations, and determining the statistical significance of results, the Excel program was used. Differences were considered significant at a significance level of $p < 0.05$. The Student's t-test was used for comparing data between EG1 and EG2.

Results

The test results for EG1 are presented in Table 1. Table 1 reflects changes in test performance in the experimental EG1 over the year. All changes in test indicators are statistically significant, demonstrating the effectiveness of the training process in EG1.

Table 2 shows changes in test performance in the experimental EG2 over the year. It is evident that there have been statistically significant improvements in results across all tests, indicating

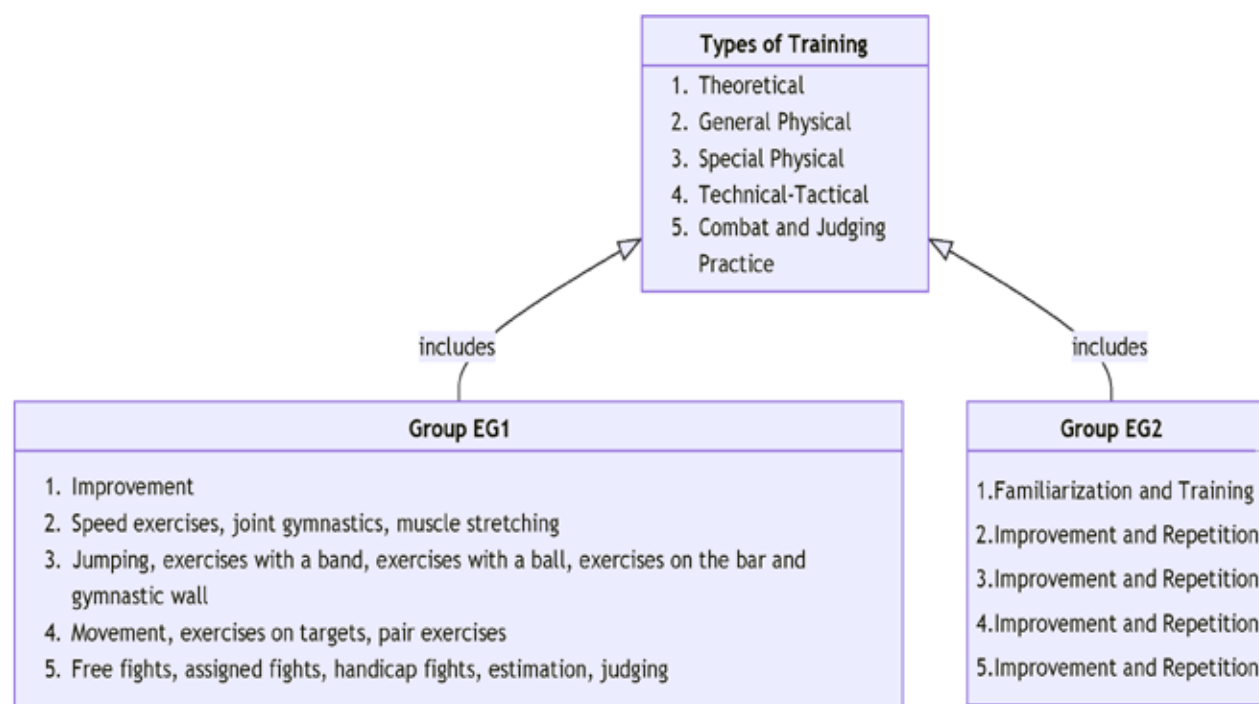


Figure 1. Types of training and features of the training process for experimental groups

Table 1. Test Results in experimental groups 1 (EG1)

Tests	Beginning of Experiment	End of Experiment	p
Test 1. «Standing Long Jump»			
Attempt 1, m	1.86±0.33	1.91±0.31	0.003
Attempt 2, m	1.84±0.35	1.91±0.28	0.003
Test 2. Shuttle Run 4x9 m			
Attempt 1, sec	10.72±0.95	10.46±0.7	0.01
Attempt 2, sec	10.72±0.97	10.31±0.8	0.001
Test 3. Flash Attack from a Stand			
Attempt 1, m	1.49±0.14	1.53±0.16	0.002
Attempt 2, m	1.47±0.12	1.53±0.12	0.0008
Test 4. Thrust into a Target within a 3 cm Diameter Circle (out of 10 attempts)			
Attempt 1, number of times	6.45±1.44	8.18±1.25	0.0000
Attempt 2, number of times	6.64±1.43	8.45±1.21	0.0005

the effectiveness of the approach to the training process in this group.

The data in Figure 2 illustrates the changes in the number of random thrusts and the total number of thrusts delivered in free fencing bouts for the two experimental groups (EG1 and EG2) over the experiment period. It also presents the percentage of random thrusts out of the total thrusts made. The table shows that in both groups, there were changes both in the number of random thrusts and in the total number of thrusts made, as well as in the percentage ratio of random thrusts to the total number of thrusts.

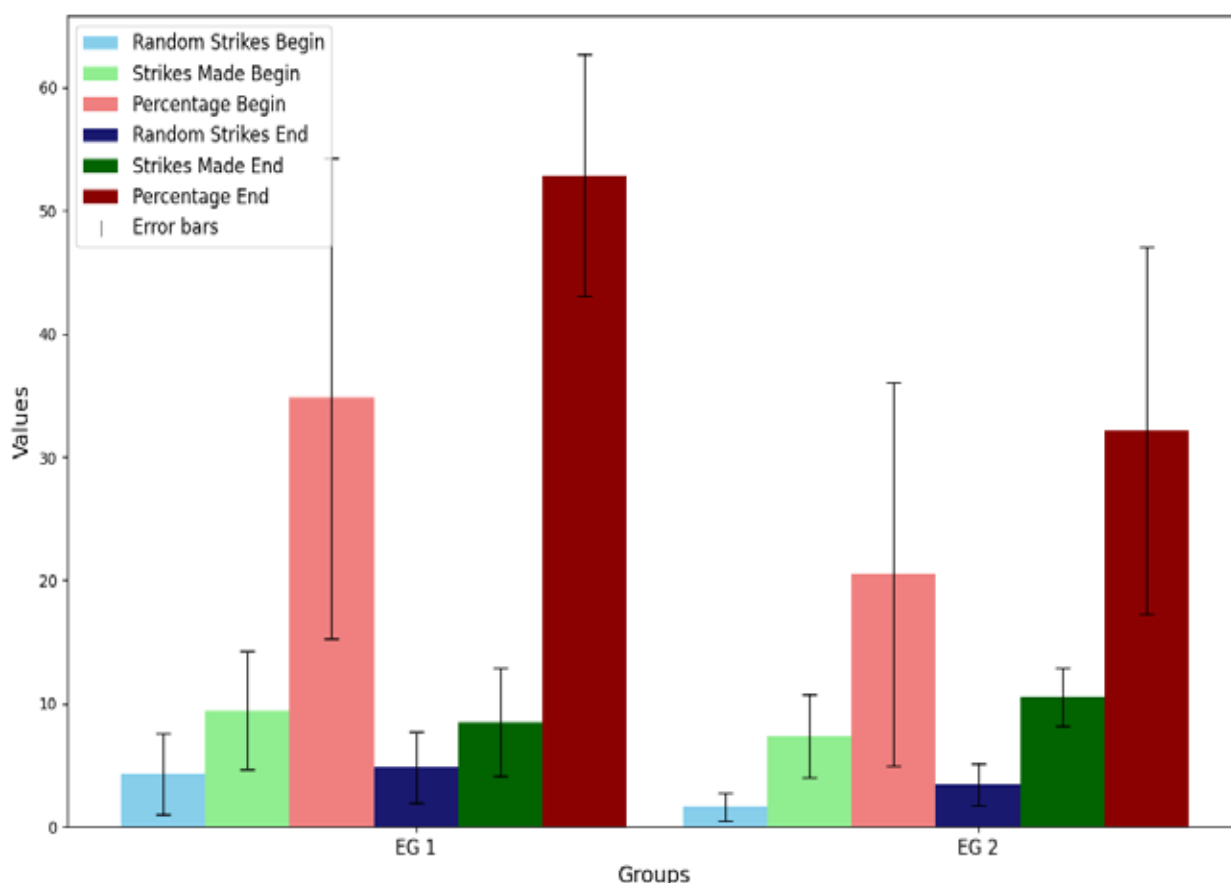
Discussion

In our study, we attempted to evaluate the effectiveness of a training program specifically adapted to the needs of young fencers training in mixed age groups. Special attention in the program was given not only to physical but also to technical and tactical preparedness of the athletes. The results obtained during the study are of interest from the perspective of assessing the dynamics of the number of random and delivered thrusts in free fencing bouts over the experiment period.

The analysis showed that in both experimental

Table 2. Test Results in experimental groups 2 (EG2)

Tests	Beginning of Experiment	End of Experiment	p
Test 1. «Standing Long Jump»			
Attempt 1, m	1.43±0.23	1.49±0.18	0.03
Attempt 2, m	1.43±0.22	1.50±0.19	0.005
Test 2. Shuttle Run 4x9 m			
Attempt 1, sec	12.4±1.22	11.95±1.15	0.0003
Attempt 2, sec	12.18±1.1	11.97±0.98	0.017
Test 3. Flash Attack from a Stand			
Attempt 1, m	1.23±0.14	1.27±0.12	0.01
Attempt 2, m	1.23±0.13	1.28±0.1	0.005
Test 4. Thrust into a Target within a 3 cm Diameter Circle (out of 10 attempts)			
Attempt 1, number of times	2.91±1.01	5.1±1.04	0.0000
Attempt 2, number of times	3.36±0.82	5.5±1.2	0.0000

**Figure 2.** Dynamics of Random Thrusts in Free Fencing Bouts

groups (EG1 and EG2), a change was recorded both in the number of random thrusts and in the total number of delivered thrusts. In particular, EG1 saw an increase in the percentage of successful thrusts from 34.8% to 52.9%. This indicates a significant improvement in technical and tactical preparedness and the purposefulness of the fencers' actions. A similar trend was recorded in EG2, where the

percentage of successful thrusts increased from 20.52% to 32.2%. These data testify to the positive impact of the implemented training program on the ability of young fencers to more effectively control the bout and achieve higher accuracy of thrusts. In turn, this can contribute to reducing health risks and increasing the overall effectiveness of preparation.

Comparing the results of our study with data

from other research, several key aspects can be highlighted. Our study emphasizes the importance of adapting the training process to the specifics of age groups and the individual needs of young fencers. This is reflected in the improvement of technical and tactical preparedness, an increase in the percentage of successful thrusts, and a reduction in the number of random thrusts. Such an approach finds confirmation in other studies [1, 2, 3, 13, 14, 15, 16, 17]. This directly correlates with conclusions made in research on personality development at the basic stage of preparation and the necessity of intellectual development of athletes [1, 2, 3, 18].

Comparing our results with observations on the impact of the COVID-19 pandemic on sports behavior [9], we found that constant communication between coaches and athletes, as well as adaptation to training conditions, play a crucial role in maintaining both physical fitness and the psychological state of athletes. This is especially relevant in the context of our experiment conducted during wartime conditions in Kharkiv, Ukraine, where specific restrictions and safety requirements apply. Thanks to the implementation of clear safety procedures, including training participants on how to behave during alarm signals, it was possible to ensure not only safe but also effective training sessions.

Our data confirm that flexibility and the ability to adapt to extreme and changing circumstances undoubtedly affect the success of the training process. This approach allows athletes not only to maintain a high level of preparedness but also to adapt to the psychological challenges that arise in crisis conditions.

Research on the relationship between stress, coping behavior, emotions, and motivations for practicing fencing [7, 10] underscores the significance of emotional and psychological components in sports training. In our study, attention is also given to the development of emotional resilience and psychological adaptation to competitive conditions, which is an advantage of the developed program.

Aspects of brain dominance and anthropometric data [8, 11, 12, 19, 20] confirm the need for a comprehensive approach to training that includes both physical and intellectual preparation. Our study further demonstrates how a specifically adapted program can effectively impact these aspects, ensuring improvement in both the physical and technical-tactical indicators of young fencers.

It should be noted that dividing into groups considering age and level of preparedness, as well as regulating the number of athletes [21, 22], allows the coach to distribute attention harmoniously to each athlete. However, in many small towns and settlements, fencing is «doomed» to have athletes train exclusively in mixed groups due to the limited population contingent. Therefore, we believe it is necessary to supplement the program with clear methodological recommendations on the specifics of working with fencers in mixed educational and training groups. Such a program could be utilized by coaches as needed.

Our study demonstrates a comprehensive approach to athlete preparation that covers both physical and psychoemotional aspects. Furthermore, our research highlights the necessity of a deep understanding of the importance of adapting the training process to complex external conditions. This becomes particularly significant in the context of our experiment conducted under the conditions of military actions in Kharkiv (Ukraine). In our study, considerable attention was paid to the psychological adaptation of participants to extreme situations.

Conclusions

The effectiveness of the proposed training program is confirmed by the improvement of the technical and tactical indicators of young fencers. The program demonstrates that a well-organized and flexibly adapted training process can achieve high results even under conditions where external circumstances are far from ideal. This approach allows athletes not only to refine their sports skills but also to develop resilience to stress. Such an approach is an invaluable quality in any life circumstances.

An important direction for future research is the development of detailed methodological recommendations for training in mixed groups. This will allow coaches to organize the educational and training process even more effectively and contribute to the comprehensive development of each athlete, regardless of their age and initial level of preparedness. Special attention should be given to the development of programs aimed at psychoemotional support and the adaptation of athletes to conditions of high competition and stress situations, typical for competitive activities.

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