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Article

Developing Coordination Abilities in Badminton Players at the Initial Training Stage

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Abstract: This article presents the methodology and pedagogical experiment results on developing coordination abilities in beginner badminton players aged 79. Forty athletes participated, with 20 in each of the experimental and control groups; the experiment lasted six months. Coordination exercises were combined with technical and tactical training. Statistical analysis used the arithmetic mean, standard deviation, coefficient of variation, percentage changes, Student's t-test, and p-values. Results are reported from the dissertation.

Keywords: movement accuracy, spatial orientation, reaction speed, kinesthetic sensitivity, pedagogical experiment

1. Introduction

Increasing competition in world sport requires the scientifically grounded improvement of athlete training systems, particularly the comprehensive development of athletes' physical, coordinative, technical, and tactical capacities from the initial stage. In badminton, rapidly changing game situations, identifying the shuttlecock's trajectory, making quick decisions, and moving efficiently around the court require a high level of coordination. Therefore, developing reaction speed, spatial orientation, balance, control of movement parameters, and the ability to adapt to changing situations in badminton players aged 7–9, while taking their age-related and individual characteristics into account, is an important scientific and pedagogical task. Badminton is a fast racket sport with high demands on movement, vision and decision-making [1]. Match-play studies describe it as a high-intensity intermittent sport [2]. Long-term athlete development models stress building movement skills in the early years [3]. Youth physical development models likewise stress fundamental movement skills and age-specific training [4]. Because children grow and mature at different rates, individual differences must be considered [5].

Uzbekistan places particular emphasis on developing physical education and sport, building a reserve of athletes, and introducing scientifically based methods of athlete preparation. In this regard, the objectives set out in Presidential Decrees No. PF-5924 of January 24, 2020, No. PF-6099 of October 30, 2020, and No. PF-60 of January 28, 2022, as well as Resolutions No. PQ-5279 and No. PQ-5281 of November 5, 2021, are important. These objectives make it necessary to develop a set of exercises that improves coordination abilities in badminton players aged 7–9 in combination with technical and tactical movements, manage training loads rationally, and determine the effectiveness of the methodology through a pedagogical experiment. This dissertation research contributes, to a certain extent, to addressing these objectives [6]–[10].

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1.1 Research objective

The objective is to improve a methodology for developing coordination abilities in badminton players at the initial training stage by integrating coordination development with technical and tactical training, while taking their age-related and individual characteristics into account.

1.2 Research tasks

To improve the training methodology, based on pedagogical monitoring, for the gradual development of coordination abilities in badminton players at the initial training stage and for adapting individual training loads.

To develop an integrated training system that combines coordination exercises aimed at improving badminton players' reaction speed, balance, spatial orientation, and kinesthetic sensitivity with technical and tactical training.

To develop a set of comprehensive special exercises that combines technical movements and sport-specific motor activities to improve badminton players' coordination preparedness.

To develop a model for the differentiated management of training loads that takes into account badminton players' psychological states and individual coordination-preparedness characteristics, and to determine its effectiveness through a pedagogical experiment.

2. Materials and Methods

The study used analysis and synthesis of scientific and methodological literature, pedagogical observation, questionnaire surveys, pedagogical testing, instrumental measurement, psychological testing, a pedagogical experiment, and mathematical-statistical analysis. Standardized instruments such as the Test of Gross Motor Development are widely used in this field [11].

A pedagogical experiment program was designed to evaluate the effectiveness of the improved methodology developed within this study. The program included 40 badminton players at the initial training stage: 20 athletes formed the experimental group and the remaining 20 formed the control group.

During training sessions, the experimental group was to use an improved training system aimed at developing coordination abilities, an integrated training block, a set of special coordination exercises, and a differentiated approach that took the athletes' individual psychological states into account. The control group's sessions were to be conducted according to the existing traditional training program.

3. Results and Discussion

The results of the pedagogical experiment aimed at developing coordination abilities in badminton players aged 7–9 at the initial training stage demonstrated the pedagogical potential of combining special coordination exercises with technical and tactical movements. Over the six-month study, the initial and final indicators of the experimental and control groups were compared. The experimental group followed a methodology based on the comprehensive use of coordination exercises, a gradual increase in exercise complexity, and consideration of athletes' age-related and individual capabilities. The results indicated that coordination preparedness should be developed in connection with badminton-specific motor activities. This agrees with motor-learning theory, which supports gradually progressive and varied practice [12].

Analysis of general coordination-preparedness indicators showed improvements in the experimental group in results related to movement speed, spatial orientation, and kinesthetic differentiation. Specifically, completion time in the 3 × 10 m shuttle-run test decreased by 4.49%, performance in the six-point movement test improved by 6.54%, the labyrinth-test result improved by 6.90%, and the error in the 45° movement-amplitude test decreased by 17.63%. Changes in these indicators were comparatively smaller in the control group. These results indicate greater improvements in movement coordination, changing direction, and controlling movement amplitude in the experimental group. However, the change in the labyrinth test was not reported as statistically significant ($p > 0.05$).

Indicators of special coordination and technical preparedness showed positive changes in the experimental group. In particular, results improved by 30.58% in the shuttlecock juggling test, 44.12% in the shuttlecock-lane test, 33.33% in the target-hitting test, 30.23% in the short- and high-clear shots test, and 27.45% in the shot-after-intense-movement test. In the control group, improvement in these indicators ranged from 7.69% to 10.14%. These results indicate relatively greater development in hand–eye coordination, shuttlecock control, shot accuracy, and the execution of technical movements in the experimental group.

The assessment of kinesthetic differentiation of movements, coordinative adaptability, and balance showed positive changes in the experimental group. In particular, the mean error decreased by 37.80% in the tests involving reproduction of a 90° movement amplitude and half of a jump distance. In addition, improvement was 60.47% in the target-hit test after a 180° turn, 76.32% in the test of catching two shuttlecocks consecutively, 60.78% in the test of adapting shots to shuttlecocks at different heights, and 66.40% in the test of standing on one leg with the eyes closed. These results describe improvements in accurately controlling movement parameters, adapting to changing situations, and maintaining static balance in the experimental group.

The overall analysis of the pedagogical experiment results indicated that a comprehensive and differentiated approach has potential for developing coordination abilities in badminton players at the initial training stage. Integrating coordination exercises with technical and tactical movements, gradually increasing training complexity, and accounting for athletes' individual capabilities were accompanied by greater positive changes than in the control group on most tests. These results may be considered preliminary evidence of the practical value of the improved methodology. To reach a final conclusion about its statistically confirmed superiority, differences in changes between the groups must be tested using individual-level results.

3.1 Mathematical-Statistical Analysis

Mathematical-statistical processing of the study results involved the arithmetic mean ($\bar{X}$), standard deviation (σ), coefficient of variation (V%), percentage changes, and Student's t-test. The statistical significance level (p) was determined, and the results were comparatively analyzed against scientific and theoretical conclusions. These procedures help assess the reliability of the study results. Effect size shows the magnitude of a difference, which the p value alone does not [13].

M. R. Rhea noted that reporting effect size helps interpret research results in practical terms [14, pp. 918–920]. In this study, within-group improvement must be distinguished from differences in effects between groups. Finding $p < 0.05$ in the experimental group and $p > 0.05$ in the control group does not, by itself, prove that the changes in the two groups differ statistically. The difference between "significant" and "not significant" is not itself statistically significant [15]. Comparisons against baseline within randomized groups can be highly misleading [16]. This requires an between-group comparison that accounts for baseline levels, or an assessment of the difference in changes, together with the calculation of the relevant confidence interval and effect size using individual data. Analysis of covariance that adjusts for the baseline value is recommended for this purpose [17].

However, these results are not sufficient to conclusively confirm the superiority of the improved methodology. To do so, within-group changes, differences between the experimental and control groups, and effect-size indicators must be calculated using the individual results of each athlete.

4. Conclusion

A training system adapted to the age and functional capabilities of badminton players at the initial training stage, together with an integrated training mechanism, was developed. It combines physical, technical, tactical, psychological, and theoretical training components and includes a set of 20 special exercises aimed at developing coordination abilities. A differentiated approach that takes athletes' psychological and individual characteristics into account was also proposed.

The overall analysis of the study results indicated that a comprehensive, integrated, and individual-differentiated approach is appropriate for developing coordination abilities in badminton players at the initial training stage. Greater positive changes than in the control group were observed in the experimental group on most tests. These results demonstrate the practical potential of the developed methodology and indicate that it may be used in initial-stage training sessions at sports schools.

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