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Abstract of the doctoral thesis:

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Title of the thesis: Contributions regarding the optimization of training periodization in performance fencing for world championships and Olympic Games in epee event

Introduction

The Olympic Games are the pinnacle of an athlete's career. Qualifying for this major competition involves discipline and seriousness in years of hard work and engaging athletes in a structured, phased and complex programme.

The biggest challenge in developing this work was caused by the Covid-19 pandemic. As a result, the aim of the research was to optimise the periodisation of fencers' training through the objectification and exploitation of internal factors of performance capacity, in order to achieve notable performances at European Championships, World Championships and Olympic Games.

Motivation and purpose

Recently, there has been a permanent modernisation of the training process and a multiplication of official competitions in fencing, visible at all levels of sport excellence, which represents a challenge for most fencing specialists and coaches.

The choice of this topic was influenced, on the one hand, by my activity for more than 20 years in the field of performance sport and, on the other hand, by the desire to optimize the training process at the level of the national women's epee team, by monitoring factors of biological and motric nature during the various stages of training in order to establish technical-tactical strategies for approaching competitions.

Theoretical, methodological and operational framework of the research

The research undertaken in this thesis was achieved under the aegis of the National University of Physical Education and Sports in Bucharest, within the Doctoral School. The thesis was structured in two parts and includes two studies.

Part I

The theoretical background

Epee is certainly the most complex and ancient of the fencing disciplines (Yang, 1990). The rational and scientifically based training system involves the accumulation of knowledge and skills by athletes for the purpose of solving various tasks of training components that are closely interrelated (Matveev, 2001; Platonov, 2004 cited by Zadorozhna, Briskin, Perederiy, Pityn, Stepanchenko, 2018). Zadorozhna O. et al. (2018) believe that current trends of fencing reveals that the success of a team depends on variety of methods and characteristics of technical, tactical and theoretical training.

During the Covid-19 pandemic sporting events, tournaments and championships around the world were cancelled and/or postponed, confirming that the preparation for the qualification for the Olympic Games in Japan presented unique challenges caused by the Covid-19 pandemic, Cardinale M. (2021). The work of the teams did not stop, athletes continued their training at home, even if some of them were limited in terms of space, conditions and lack of competition calendar.

Conclusions of the first part of the thesis

Training periods in performance fencing are systematically structured into macro-cycles, mesocycles and micro-cycles of training, with a competition season lasting approximately 10 months.

The optimal training and the achievement of the athletic form of the performance fencer requires the collaboration of all the components of an athlete's training: physical, technical, theoretical, tactical and psychological.

The scientific management of the training process represents the most important direction of tangible progress in the training of the athletes. Therefore, the storage of information on sports training, recovery, psychological support, medication, can be confirmed or invalidated at the complete scale, after interpretation from a statistical-mathematical point of view.

Part II of the thesis – First study

The research purpose

The purpose of the research is to highlight the factors that influence the performance in women's epee, based on the analysis of the components of the Romanian Olympic team.

The objectives of the first study

- To develop a somato-functional and motric profile of the fencers and to identify the essential factors in obtaining outstanding competitive results.
- Analysis of the training strategy in order to achieve significant performances at European and World Championships and Olympic Games.

As a result, it was necessary to develop and use a set of tests and control measurements (somatic, body analysis, functional, motor indices) in order to monitor and improve the level of training.

Hypotheses

Periodisation of training by using the relationships between somatic, functional and motric components ensures performance in objective competitions.

Secondary hypotheses:

- ✓ Correlation exists between somatic indicators (height, weight, muscle mass, wingspan) and performance.
- ✓ Correlation exists between speed, specific speed and performance.
- ✓ There is also correlation between hip mobility, speed and specific speed.
- ✓ There is correlation as well between functional components VO₂Max, VO₂/L, heart rate and performance.

Subjects and duration of the first study

The subjects of this research are members of the Romanian women's épée team, including A.M.P, who was the world leader in the FIE Epee rankings, during this study. The time period highlighted the qualification for the Tokyo Olympics, ending with the silver medal at the supreme competition obtained by A.M.P. (May 2019-August 2021).

Tests used in the first study

- Anthropometric measurements
- Cardio-respiratory capacity evaluation test VO₂Max, Bruce protocol - COSMED Treadmill ergometer (Km/h)
- Functional test to determine exercise zones and maximum recorded pulse, Bruce protocol - COSMED Treadmill ergometer (Km/h)
- Motricity tests
- OMRON BF electronic weight scale and body analyser.
- Competitions to validate performance

Conclusions of the first study

Considering that data from five performance athletes were analysed, this is an exploratory research.

According to the correlation matrix, a strong positive correlation is observed between VO₂Max index and somatic fat, muscle mass, visceral fat and wingspan indexes, which confirms the research hypothesis.

Comparing the VO₂Max records with the effort levels in the international normative table for this index, we concluded that all athletes recorded values above those specific to the upper level, therefore demonstrating a high level of training.

Regarding the correlation between Sprint 30m and specific movement speed in fencing position (2x14m), it is observed that Sprint 30m correlates strongly positively (0.96) with specific movement speed 2x14m (Specific speed), which confirms the hypothesis. If Sprint 30m increases by one unit, the 2x14m specific travel speed (Specific Velocity) increases by 0.96 units.

Heart rate correlates strongly positively with CEI ($r=0.98$) - European Individual Championships, Dusseldorf and with CM2 ($r=0.76$) - Individual World Cup, Havana.

For the Pearson correlation coefficient between the 3 tests (30m sprint, long jump, specific speed of movement), there is a strong negative correlation between the 30m sprint and the long jump while standing, a negative average correlation between the specific speed of movement and the long jump and a positive average correlation between the specific speed of movement and the 30m sprint.

According to the radar graph, in terms of the profile of the fencers with outstanding performances at the world championships, A.M.P. is 1.75m tall, has the smallest circumference at the bust (90cm) and low mobility (10.2), but high values were shown for wingspan (178.92cm), $VO_2\text{Max}$ (43.36 ml), VO_2/L (2.73 L/min) and also achieves the best places in the championships.

Second study

The purpose of the second study is to consolidate and unify a new team in the women's epee discipline, capable of challenging for the most important world medals, by restructuring the whole preparation through a more efficient periodization and training-recovery-competition relationship.

The objectives of the second study

- ✓ identifying collective oscillations of values recorded in physical and physical-specific training after approximately 6 months;
- ✓ highlighting the level of training recorded 7 days before the competition with the objective, the European U23 Championship in Estonia;
- ✓ validation of the training plan for fencing/epee athletes

Hypotheses

Periodisation of training based on the development of the physical condition of the fencers is a determining factor for performance in major competitions.

Secondary assumptions

- ✓ The training plan based on the development of the individual potential of fencers ensures the increase of strength, endurance strength and lower limb strength.
- ✓ The use of the data provided by Witty technology in training ensures the increase of the fencers reaction and execution speed.

Subjects and duration of the second study

The present research was performed between October 2021 and June 2022, with the activities being held in Bucharest and Poiana Brasov. The research sample consisted of 14 fencers, the average age at the time of the first test being almost 21 years old, all of them having potential for participating at the Olympic Games in 2028. All 14 fencers are national medal winners in different age categories.

Tests used in the second study

With the OptoJump we performed 10 tests (5 jumps single leg left drift, 5 jumps single leg right drift, 5 jumps single leg left front/back drift, 5 jumps single leg right front/back drift, 5 jumps single leg left right/left drift, 5 jumps single leg right left/right drift, 60 seconds jumps, 60 seconds jumps in fencing position, march in place with closed eyes (30 seconds), march in place with open eyes (30 seconds).

Using the Witty wireless training timer we performed two tests: one for reaction speed from fencing position to visual stimulus and the other for reaction speed and execution with lunge to visual stimulus.

Conclusions of the second study

A full analysis of the two OptoJump tests shows that there are strong correlations, both in the initial and final tests, between flight time and jump height, power and reactive resistance index and between ground contact time and tempo. Although the results were not homogeneous, from the point of view of the specific activity (fencing), useful elements can be extracted when establishing and structuring the types of training.

In both the initial and final tests, a considerable correlation can be observed between the strength indexes and the indexes for flight time, height and reactive force, with a stronger correlation in the final test, therefore demonstrating the progress of the athletes from a physical point of view after a period of approximately 6 months of training.

In the case of 60 seconds jumps and 60 seconds jumps in fencing position it can be seen that the result is statistically significant and that the results would be similar when the test is repeated. Athletes recorded a higher number of jumps than in the initial test, which shows that coordination ability, agility, physical condition, muscle tone and frequency improved.

For the test of reaction and execution speed with lunge to visual stimulus, although the results on time evolution were not statistically relevant, it can be observed that the average execution time still showed a slight decrease.

The research results confirmed the hypothesis that the level of physical training, materialized in the strength of the lower limbs, in all its variants, and the speed of reaction, movement and execution speed against a background of specific resistance influence fencing - epee performance.

The factor analysis performed confirmed the second hypothesis, that the characteristics/profile of the athlete influence the performance achieved.

The path coefficient (Path Analysis=0.522) confirms hypothesis H2: athlete characteristics/profile influence the performance obtained in the second OptoJump test.

Descriptive statistics - Analysing the data from the second OptoJump test we observe a very strong positive correlation between ground contact time and 3 other variables: jump height (0.943), power (0.92) and relative strength index (0.85). At the same time, a very strong negative correlation is observed between time in the air and tempo, jump height correlates strongly with power (0.97) and power correlates strongly with relative strength index (0.98).

In terms of performance, 4 of the 14 athletes who were part of Study II formed the Romanian team that obtained gold at the European U23 Championships in Estonia.

Personal contributions

The study included training periodization, testing of reaction and execution times to visual stimulus, body analysis, physiological testing, motric evaluations, participation in competitions, all with the purpose of creating a statistical-mathematical database including detailed analysis to maximize performance.

The research included the important periods of the Olympic cycle, and within the periodization, although the Olympic Games were postponed, there were means and methods of training applied that proved efficient for high performance.

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In terms of the profile of the épée fencer from a physiological point of view, the athletes in the women's épée squad had not been tested prior to this research, thereby representing a starting point for future tests in this category.