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OPTIMISING EFFORT CAPACITY IN TRIATHLON

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Abstract. *Background*. My personal triathlon practice inspired the creation of a specialized training regimen to improve triathlon training in Romania. This program aims to enhance performance, well-being, and injury prevention for athletes. At the INTERDISCIPLINARY RESEARCH CENTRE (CCI) "Dr. Alexandru Partheniu" of UNEFS, we used AEROSCAN technology to assess exercise capacity, measuring heart and breathing rates with the Bruce Protocol for precise physiological monitoring.
Objectives. This research demonstrates that tailored training cycles for swimming, cycling, and running can significantly enhance triathlon performance. The goal was to create a customizable, comprehensive training program to maximize the overall training process and provide a scientific foundation for triathlon training in Romania. This research aims to demonstrate that tailored training cycles can significantly enhance triathlon performance.
Methods. We used observation, experimental, statistical-mathematical, and bibliographic study methods to interpret the experiment's outcomes. The bibliographic study provided the theoretical basis, while observation and experimental methods enabled real-time data collection. Statistical analysis was crucial for interpreting the data.
Results. Using AEROSCAN and the Polar system, we evaluated exercise capacity and tracked heart rate. The Bruce protocol was applied for both initial and final tests. The data showed significant improvements in endurance, speed, and overall performance, supported by statistical analysis, after implementing the customized training program.
Conclusion: Our research indicates that tailored athletic training regimens for each triathlon discipline can significantly enhance performance and promote athletes' health and longevity. The results highlight the importance of individualized training plans and suggest potential improvements in Romanian triathlon training practices. Individualized training programs lead to notable improvements in performance and athlete well-being.

Keywords: triathlon, effort, Aeroscan.

Introduction

Triathlon is a sport that combines swimming, cycling and running into one. These events are done in that order and consecutively. Triathletes have a period of time before and after each event where they change equipment to prepare for the next event. Athletes must therefore switch from swimming to cycling (T1 – represents the first transition between events) and from cycling to running (T2 – represents the second and final transition between events).

"Triathlon is more than the sum of its parts" (Millet & Vleck, 2000) because it is a multidisciplinary activity. The interactions between the different components of triathlon (swimming, T1, cycling, T2 and running), somatotype, physiology, technique and running strategy are all factors that affect the overall performance of the triathlete (Ofoghi et al., 2016). Although triathlon was introduced into the Olympic program in the late 1990s, researchers focused more on long distance races when they started studying short distances. This was mainly due to the efforts of a group of French researchers who were recognised as pioneers (Bentley & Bishop, 2008). Since then, many researchers have studied the physiology and anthropometry of triathletes and race strategies. However, many research studies have included amateur or aspiring high performance triathletes rather than professional triathletes. It is essential to understand the elements that influence peak performance and to distinguish levels of performance. It is also necessary to distinguish between female and male triathletes. Thus, a systematic analysis that separates information by gender for top triathletes is of interest for sport development and serves as a reference for their unique characteristics. In order to create effective training programs and identify young talent with the potential to become elite athletes, it is essential to know the baseline characteristics of female and male triathletes who achieve peak performance (Vaeyens et al., 2008). The first step in creating appropriate talent development programs is to understand these characteristics, which combine a variety of elements and components to optimize triathlete performance. Predictors of talent in elite sports, especially women's sports, still have many unknowns (Johnston et al., 2018). Therefore, in order to aid the optimal development of talent identification programs - such as federations, sports institutions, coaches, national selectors, etc. – it is essential to provide valuable and scientifically rigorous information.

The research presents meta-analyses that expose how training alters cardiorespiratory fitness and how these changes affect the performance of triathletes. This is done by examining variations by age, gender, training level and competitive distance. A secondary goal is to develop a results-based training plan so that triathletes will be better in competition. In this branch of research, maximal oxygen consumption (VO2max) is considered a benchmark for assessing cardiovascular capacity (Dolezal et al., 2015). Getting an accurate measurement of VO2max requires specialised techniques that are available in exercise physiology labs and not available to all professionals. Because only one athlete can be assessed at a time, testing an entire team can take a long time. For this reason, alternative parameters for estimating VO2max have been developed, which allows simultaneous testing of multiple athletes without the use of sophisticated laboratory instrumentation (Green et al., 2013). Running efficiency (RE) is the ability of an athlete to maintain a high percentage of VO2max over a long period of time and move efficiently at the same time. A variety of physiological characteristics contribute to both athletic performance and visual perception (Barnes & Kilding, 2014). Oxygen consumption under steady state conditions at a given running speed is known as RE and represents the energy cost required to run at a specific intensity (Mayoralas et al., 2018). Runners who are trained have better REs than those who are less trained, indicating a positive adaptation to regular training. It is possible for an athlete to have good RE by nature, but there are a variety of strategies that can further improve RE by improving metabolic, cardiorespiratory, biomechanical and neuromuscular responses (Barnes & Kilding, 2014).

Research methodology

The research objectives are:

- To highlight important scientific research studies related to the topic under investigation;
- Establishing the research design and identifying appropriate scientific research methods;
- Determining the participants to be included in the research;
- Establishing a training programme with athletic means to optimise exercise capacity;
- Establish the evaluation tests to be applied in the initial and final tests to determine the level of participants;
- Establish methods for data analysis and statistical processing.

Research hypothesis

- "The application of an athletic training program significantly optimizes the effort capacity of triathletes. "

Subjects and research site

The present research was conducted with the participation of 3 male athletes, aged 20–36 years (m = 26), from the triathlon sport branch, with more than 4 years of competitive experience, participating in the National Championship (Table 1.1.).

Table 1.1. Research subjects

Subjects	Age (years)	Test	Competitive experience (years)
1	22	triatlon	5
2	20	triatlon	4
3	36	triatlon	12

Organisation of research

In the present research, written informed consent was obtained from the athletes included in the study. Subjects participated voluntarily, without coercion in any way and without penalty; they were informed that they could withdraw from the study at any time and that the results of the assessments would be used in a research paper. Participants' anonymity was respected and data were treated confidentially.

The research was conducted between December 2022 – initial testing and May 2023 – final testing.

The venues where the training programmes have been applied are specific sports bases for running, swimming pools with a distance of 25 metres and cycling circuits for the smooth running of bicycle training.

Table 1.2. Protocolul Bruce – Test Aeroscan

Nr. crt.	Inclination level
1	Level 1 – 10% Inclination at 2.7 km/h
2	Level 2 – 12% Inclination at 4.02 km/h
3	Level 3 – 14% Inclination at 5.47 km/h
4	Level 4 – 16% Inclination at 6.76 km/h
5	Level 5 – 18% Inclination at 8.05 km/h
6	Level 6 – 20% Inclination at 8.85 km/h
7	Level 7 – 22% Inclination at 9.65 km/h
8	Level 8 – 24% Inclination at 10.46 km/h
9	Level 9 – 26% Inclination at 11.26 km/h
10	Level 10 – 28% Inclination at 12.07 km/h

In the following table present the results obtained by the research participants (3 subjects), regarding the assessment of the cardiac function of the respiratory rate, in the initial test (T.I) and in the final test (T.F.), for all the evaluation samples.

Table 1.3. Aeroscan Results – Initial Testing and Final Testing

Paricipants	AEROSCAN I.T. Heart rate	Respiratory rate	F.T. Heart rate	Respiratory rate
1	194.87	54.17	187.20	51.40
2	197.14	57.44	191.14	56.90
3	195.66	56.41	190.79	54.11

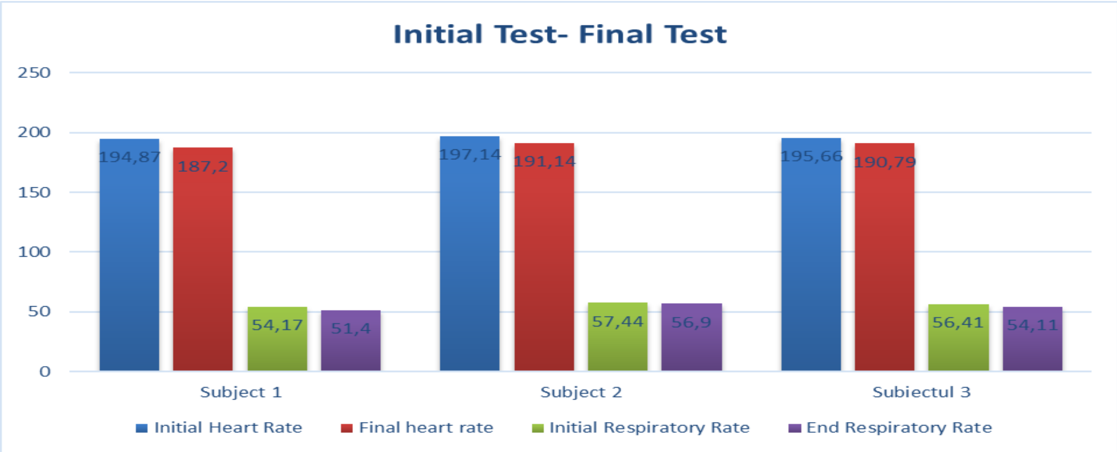

Figure 1. Initial Test – Final Test

Descriptive statistics

The main indicators of descriptive statistics were calculated for the results obtained in the assessment tests taken, both in the initial and final assessments.

Table 1.4. Descriptive statistics – experimental group results – assessment of heart rate and respiratory rate (baseline and end-point testing)

Statistical indicators	Aeroscan		Aeroscan	
	Heart rate	Respiratory rate	Heart rate	Respiratory rate
N	3	3	3	3
Average	195,89	56	189,71	54,13
Standard deviation	0.94	1.36	1.78	2.24
Cv	0,004	0,024	0,009	0,096

We thus present the values of the main statistical indicators: mean (m), standard deviation (S) and coefficient of variability (Cv) for the research group (athletic intervention), for heart rate and respiratory rate coefficients, both (N=3).

Table 1.4. shows the values of the main descriptive statistics indicators for the research group for the evaluation sample (Aeroscan), the initial test and the final test:

In the initial test, regarding heart rate, the participants obtained an average of 195.89 beats per minute, S = 0.94, Cv = 0.004, which indicates that homogeneity is ensured, the participants having close results; regarding respiratory rate coefficient, the average results were 56, S = 1.36, and Cv = 0.024, the results are close to each other.

In the final test, on heart rate, participants averaged 189.71 beats per minute, S = 1.78, Cv = 0.009, indicating that homogeneity is ensured, with participants having close results; on respiratory rate, the mean results were 54.13, S = 2.24, and Cv = 0.096, with similar results at group level.

Interval and variable training can improve exercise capacity: The use of variable-intensity training sessions and intervals of intense effort alternating with periods of active recovery can help increase exercise capacity in triathlon. Interval training allows the body to adapt to the stress caused by high-intensity activities, thus improving endurance and the ability to cope with prolonged competition efforts.

This research examined the training characteristics of high-level triathletes in the 3 months of training leading up to an Olympic distance triathlon. Participants in this study had a training frequency that ranged from 5 to 9 sessions per week. Weekly training duration averaged 6.2 h per week between weeks 1 and 5, with weeks 6 and 10 showing a decrease in training duration. Excluding the athletes' Olympic distance triathlon, week 6 saw a significant reduction in training duration compared to week 1, with athletes averaging just under 3 h of training (Coutts et al., 2007). Compared to athletes training for longer distance triathlons, the average weekly training volume was also lower, as previous research has identified that triathletes participating in Ironman events train an average of 14.1 h per week (Rüst et al., 2013; Rust et al., 2012). The most important goal for coaches and triathletes is to maximize athlete competitiveness and design a well-controlled training program to ensure peak performance is aligned with major triathlon competitions. Traditional training periodization, with the usual division of the training season into hierarchical training, competitive and transition periods, and structural components called macrocycles, mesocycles and microcycles (Matveyev, 1981), provides coaches and athletes with basic guidelines for structuring and planning training. In triathlon, top performances are often associated with periods of intensive training followed by a taper, which involves a sharp reduction in training load for several days before a major competition (Mujika, 2011).

Conclusions

The use of interval and variable intensity training had a positive impact on the triathletes' exercise capacity, adapting the body to intense effort and improving endurance. Participants followed a varied training programme, with between 5 and 9 sessions per week, with a decrease in the weekly training duration as they approached the competition. Structuring training into macrocycles, mesocycles and microcycles, as well as the use of tapering prior to major competitions, was key to maximising top performance, highlighting the differences between Olympic and Ironman distance triathletes in terms of training volume.

Proper scheduling of training sessions, active recovery periods and rest periods can help avoid overtraining and prevent injuries, allowing athletes to improve their performance and maximise their potential in competition.

Finally, by analyzing and interpreting the data obtained from our research, we were able to support with concrete information the hypothesis from which we started, *"The application of a training program with athletic means significantly optimizes the effort capacity of triathletes."* is confirmed.

Authors' Contributions

All authors have equally contributed to this study.

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