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The impact of small sided games football training on the effort capacity of 16-18 year-old juniors

THE SUMMARY OF THE DOCTORAL THESIS

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Introduction

The best football teams in the world are doing their activitie according to modern methodologies, in which training programs with exercises for the development of physical qualities have a fundamental role. The values of the results obtained in the physical training tests at these clubs are superior to the results obtained by teams that do not have a methodological program for performing the training activity. As a result of the researches, important information was obtained, which can support the effective management of physical training in football and the development of effective training methodologies. Optimizing sports performance in football involves the development of technical, tactical, psychological and physical qualities (Laursen & Buchheit, 2019, p. 547; Stolen, Chamari, Castagna, & Wisloff, 2005; Turner & Stewart, 2014). Similar to our research, several studies show that achieving athletic performance requires training in physical qualities such as aerobic endurance (Castagna, Impellizzeri, Chamari, Carlomagno, & Rampinini, 2006; Chamari, 2005; Hill-Haas, Dawson, Impellizzeri, & Coutts, 2011; McMillan, 2005), speed and agility (Little & Williams, 2005; Murphy, Lockie, & Coutts, 2003), or speed endurance, physical quality assessed by performing repeated sprints with breaks between them, but also by the body's resistance to exertion involving rapid muscle contractions over a long period of time (Baroga, 1984, p. 65; Little & Williams, 2007a).

There are training concepts whose main objectives are the development of technical-tactical qualities to the detriment of physical ones. Football is a sport where the physical factor influences the players' answers regarding the technical execution, the tactical decision or the desire to win. Approaching the concept of training in an integrated way, so that the planning and periodization of training to harmonize all training factors, creates the premises for the formation of well-trained player models from all points of view, not just technical or tactical. Scientific research on the football phenomenon can provide new data on how to program training content. Specialists in football research have stated: “football is not a science, but science can help improve performance” (Bangsbo, 2008b, p. 6; Stolen et al., 2005, p. 502).

In recent years there have been debates about the methodology of conducting sports training in football, from training with analytical exercises, where physical training is the main factor, to those structured from open, global exercises, based on the integrated method that includes all training factors (Clemente, Martins, & Mendes, 2014).

PART I

Chapter 1. Football training for children and juniors

1.1. Particularities of training at the age of 16-18

This stage of player training is characterized by a strong motivation of athletes for play and performance. Athletes gain new experiences, being able to achieve remarkable performances at the junior level and close to making the step to senior competitions. In the preparation process, special attention is paid to the training of all motor qualities, being a stage of superior development at the physiological level. The study by Mendez-Villanueva et al. (2011), in the U 18 age group, provide data confirming that this stage is conducive to improving football-specific qualities, such as top speed, sprinting or speed endurance.

It is recommended that coaches use during this period exercises for muscle development, strength, in order to develop anaerobic capacity (Shahidi, Mahmoudlu, Najad Panah Kandi, & Lotfi, 2012).

Aerobic endurance reaches its maximum development potential around the age of 18, which allows the development of skills specific to the sport practiced at the performance level (Ionescu & Demian, 2007).

1.2. Aerobic training

The psychophysical possibilities of the body to withstand fatigue during exertion, the ability to recover after exertion, as well as the total resilience of the body or certain parts of the body to fatigue, are some of the most important characteristics of endurance (Weineck, 2005, p. 15). The same author delimits aerobic capacity as the body's ability to withstand the appearance of specific indicators of fatigue and long-term effort (Weineck, 2005, p. 72).

For footballers, aerobic endurance is an important physical quality (Weineck, 2005, p. 16). Thus, the developed aerobic capacity of athletes has positive effects on improving the general physical condition, optimizing the body's recovery processes, reducing technical errors caused by fatigue, reducing the risk of injury, increasing mental endurance (Weineck, 2005, pp. 21-22) . The energy produced in aerobic mode characterizes the actions specific to football, performed at low intensity (walking, running at a low pace), but also the breaks used after exercises performed at high intensity (Balsom, Lindholm, Nilsson, & Ekblom, 1999). The aerobic system influences the ability to recover quickly after high-intensity exercise, helps to increase resistance to sustained exertion, and is also a decisive factor in the development of resistance to lactate accumulation above the limit that offers the possibility to exert effort (Reilly, Cabri, & Araújo, 2005).

The use of specific exercises can optimize the transport of oxygen in the body. Choosing training topics, then structuring means with medium or low intensity, but longer deployment time, are specific operations to improve aerobic capacity (Clemente et al., 2014).

1.3. Anaerobic training

Of the total production of energy consumed during a football game, anaerobic energy is a lower percentage compared to aerobic, but of major importance. Exercises in training or actions in high-intensity football matches, such as speed running, sprints, changes of direction, jumps, accelerations, decelerations, require the production of anaerobic energy, the development of these skills being the main objectives in football-specific training (Balsom et al., 1999; Reilly, 2007, pp. 83-84; Stolen et al., 2005, p. 502).

According to Bangsbo (1994), during an elite football game, the total duration of the anaerobic effort, consisting of high intensity actions, totals about 7 minutes, “this type of effort includes about 19 sprints with an average duration for 2 seconds ”(p. 7). Mohr, Krustrup, & Bangsbo (2003) obtained data showing the number of sprints, accelerations and decelerations performed by elite players compared to lower level players, the values of the results obtained highlighting the important role of anaerobic capacity in achieving performance in football, and even the individualization of this type of training.

Anaerobic efforts, alactacids and lactacids, are characterized by a high intensity, in which the body's oxygen requirement exceeds the oxygen supply provided by the cardio-respiratory system, continuing the activity longer, without decreasing the intensity, generating depletion of energy substrate in the muscles, the accumulation of lactic acid above normal limits and the impossibility of continuing the effort (Bota, 2000, pp. 49-56). Oxygen debt is paid after the end of the effort (Bota, 2000, p. 52). The energy needed for anaerobic efforts comes from the three substances: ATP, CP, glycogen, which decompose without the intervention of oxygen (Bota, 2000, pp. 42-43; Marinescu, 1998, p. 43).

Chapter 2. Small sided football games

2.1. The method of small sided games in football training

In recent years there have been debates about the methodology of conducting sports training in football, from training that includes analytical exercises where physical training is the main factor, to those structured from open, global exercises based on the integrated method that includes small sided football games (Clemente, Martins, & Mendes, 2014).

There are certain conceptual similarities between integrated and traditional analytical training, the main difference being to approach all training factors and the use of the ball, to the integrated type, in contrast to the separate treatment of training factors to the traditional type (Mendez-Villanueva & Delgado-Bordonau, 2012). The use of the analytical method has as a consequence the development, in particular, of a physical quality, according to the training factor approached in the training program. The low level of specificity is one of the limitations of using this method, which generally deals with the part of physical or tactical training (Clemente et al., 2014).

In high performance sports, the effects of exercise are enhanced when training stimuli are similar to the requirements of sports competitions (Turner & Stewart, 2014). Small sided football games were designed precisely to train in an integrated way the development of technical-tactical skills and physical qualities of athletes, in conditions analogous to the game of football, being more motivating among athletes to develop the specific endurance of football players (Balsom et al., 1999, p. 29; Gabbet & Mulvey, 2008; Hill-Hass, Coutts, Rowssel, & Dawson, 2008; Hill-Hass et al., 2011; Rampinini et al., 2007a; Weineck, 2005, p. 90).

The complexity of the football game is currently addressed in the training sessions, by setting specific objectives, in order to reduce the direct coach-player interaction and to involve the athlete as much as possible in decision making, keeping the characteristics and principles specific to the game and theme addressed (Capranica et al., 2001; Gabbett & Mulvey, 2008; Hill-Hass et al., 2008, 2009, 2009a; Jones & Drust, 2007; Rampinini et al., 2007a).

Studies show that small sided games are more effective in developing the ability of the cardiovascular system to adapt to specific football efforts, compared to traditional training exercises, which involve the type of effort based on intermittent running (Dellal et al., 2008; Impellizzeri et al., 2006). Aerobic metabolism is the main support of medium or low intensity efforts in the game of football, it is often interspersed with anaerobic effort, as a result of high intensity sprints, changes of direction, accelerations and decelerations (Bradley et al., 2009; Dellal et al., 2011a,b; Reilly, 2007).

2.1.1. Factors that influence the intensity of effort in training with small sided football games

The integrated approach of training factors, through the use of small sided games, but also the influences they can have in optimizing sports performance, have led in recent years to increase their popularity in both training practice and scientific research, even if there are difficulties in the correct and efficient programming and planning of such trainings (Dellal et al., 2011b; Dellal et al., 2011c; Hill-Hass et al., 2009a; Iaia, Rampinini, & Bangsbo, 2009; Owen et al., 2004).

In the structuring of small sided football games, the justified change of certain variables such as the themes and objectives of the lesson, the size of the pitch, the pedagogical density of the coach, the effort/break ratio during the exercises, the number of touches of the ball, the number of players, the size and position of the gates, has been shown to generate important transformations on the physical, physiological and technical-tactical level (Aguiar, Gonçalves, Botelho, Lemmink, & Sampaio, 2015; Casamichana & Castellano, 2010; Castagna et al., 2009; Clemente et al., 2014; Dellal et al., 2011b; Dellal et al., 2011c; Gonçalves, Marcelino, Torres-Ronda, Torrents, & Sampaio, 2016; Hill-Hass et al., 2008; 2009; 2009a; Impellizzeri et al., 2006; Owen , Wong, Paul, & Dellal, 2014; Rampinini et al., 2007a; Tessitore et al., 2006). The design of training activities with small sided games must be standardized, taking into account the objectives of training, instruction and performance (Hill-Hass, Coutts, Dawson, & Rowsell, 2010; Reilly et al., 2005).

2.1.2. Periodization of training sessions with small sided football games

Periodization of small sided games in training programs optimizes players' physical performance (Dellal, Varliette, Owen, Chirico, & Pialoux, 2012; Hill-Haas, Rowsell, Coutts, & Dawson, 2008; Owen, Newton, Shovlin, & Malone, 2020). The planning of the training program and the periodization of the proposed activities, in a correct and efficient way, depend on the coaches' knowledge on the physical and physiological responses of the athletes, provoked by training stimuli, through exercises such as football games on the field (Clemente et al., 2014).

Studies have shown that a correct periodization of small sided games in the training program, generates superior physical performance, compared to following a training program with traditional exercises (Hammami, Gabbett, Slimani, & Bouhlel, 2017; Moran et al., 2019).

Chapter 3. Physical effort in the game of football

3.1. Physical effort

Teodorescu (2009) identifies the training effort as “the process of consciously overcoming, by the athlete, the training demands for physical improvement, for reaching a higher technical and tactical level, as well as for accentuating the psychic and intellectual factors, the results of which produce, deliberately, changes in performance capacity and adaptation of the organs and functional systems involved ”(p. 48).

Drăgan (1989, p. 110) defines physical effort as "the ability of the active muscle system to release by anaerobic glycolysis or oxidative phosphorylation the energy needed to produce a mechanical work as high as possible and maintain it as long as possible" (p. 110) .

For the psychic and morphofunctional development of any individual, a conscious process of overcoming the external tasks and requirements to which the body is subjected, an approach that is achieved through effort (Dragnea & Bota, 1999, p. 184).

In footballers, the efficiency of the training process is the main objective and not the physical effort in a state of fatigue (Cometti, 2007, p. 13).

3.2. The energy sources of football effort

At the level of the body there are continuous transformations, both anabolic and catabolic, the living substances being processed into simple compounds such as water, carbon dioxide and ammonia, the phenomenon being replenished by the contribution of substances from the external environment (Demeter et al., 1979, pp. 206).

All the changes and reactions between the body and the external environment, which involve this permanent exchange of matter and energy, take place through an extensive process, called metabolism (Ulmeanu, Demeter, & Obrașcu, 1969, p. 97).

The intensity from training and game has as a result the increasing of the metabolic rate. Energy production can be obtained from different substrates from both aerobic and anaerobic sources (Reilly, 2007, p. 10; Weineck, 2016, p. 127). This energy is obtained from food, mainly based on the three organic substances, carbohydrates, lipids, proteins, resulting in the energy needed for motor activities (Ferretti, 2012, p. 33; Wilmore & Costill, 2002, p. 119).

Movement is possible as a result of the processes of transforming chemical energy from food into mechanical energy (Ferretti, 2012, p. 33). Theoretical concepts, specific to physiology, which reflect these transformations, are represented by energy metabolism (Demeter et al., 1979, p. 206; Ferretti, 2012, p. 33). Demeter et al. (1979, p. 206) states that the reactions of synthesis and decomposition of substances necessary for energy production are concomitant, because energy is released as a result of chemical transformations that take place through intermediate metabolism.

Acquiring specific knowledge on energy metabolism, streamlines the training activity, thus, being better understood the mechanisms of effort, fatigue and recovery as well as the delimitation of athletes' performances according to different variables (Ferretti, 2012, p. 33).

3.3. Effort capacity

Maintaining for a long time the mechanical work done, by harmonizing the motor functions with the vegetative ones, as a result of the energy produced at active muscular level, by oxidative phosphorylation or anaerobic glycolysis, represents the effort capacity of the organism (Bota, 2000, p. 80; Drăgan, 1989, p. 110). The functional capacity of the body to adapt to the effort to which it is subjected in training is fundamental for increasing the effort capacity, a component part of the performance capacity (Bota, 2000, p. 80; Platonov, 2015, p. 184).

Physical capacity improves as a result of the systematic practice of physical exercises that especially promote the development of motor skills and results in improved body function and adaptation to higher demands, a process that takes place heterochronically at all energy levels (Drăgan, 1989, pp. 110-111; Marinescu, 1998, p. 36; Platonov, 2015, p. 98).

We differentiate the anaerobic capacity from the aerobic one depending on the degraded energy substrate and the place of biochemical reactions, at the intracytoplasmic level the anaerobic ones, and the intramitochondrial ones the aerobic ones (Bota, 2000, p. 81).

3.3.1. Evaluation of effort capacity

The efficiency of a training program requires the planning and periodization of evaluation tests, taking into account the technological and scientific progress of modern football (Impellizzeri, Rampinini, & Marcora, 2005; Weineck, 2016, pp. 69-70). The objectivity of evaluating the effects of a training program is a mandatory condition for testing the effort capacity of footballers, in order to quantify the performance of athletes being necessary to collect initial data, but also to perform tests related to training periods (Balsom et al., 1999; Weineck, 2016 , p. 70).

Among the issues discussed in research and medicine is the evaluation of effort capacity. Bota & Dragnea (1999) state that “scientific progress and factual material gathered in recent decades have made it possible to obtain important clarifications on the design, parameters suitable for measurement and methods of investigation” (p. 202).

It is characteristic of the football game to intercalate the high intensity effort with the low or medium intensity one, the anaerobic alactacid and lactacid efforts alternating with the recovery moments, specific to aerobic energogenesis (Drăgan, 1994, p. 415; Swenson & Drust, 2005). Flexibility, agility, strength, aerobic power and anaerobic power are physical qualities specific to football players and the physical and physiological requirements of a football game (Ekblom,

1986; Reilly & Doran, 2001). The game model, individual and collective tactical principles, the dynamics of the players on the field depending on the position occupied, influence their physical and physiological performance during a football match and implicitly the development of the above mentioned qualities (Bangsbo, 1994; Ekblom, 1986; Reilly , 2003). Objective evaluation of these physical qualities involves the selection of standardized and validated exercise tests that identify and strictly measure the motor quality proposed to be quantified (Weineck, 1998, p. 110).

3.3.2. Specific tests for football effort

Planning and conducting the training program on short, medium and long term in an efficient way, is conditioned by the use of tests in structuring training plans (Weineck, 1998, p. 110). A correct and efficient training process is based on data containing the physical and physiological performance of the players, elements that offer the possibility to forecast and plan the training program in the short, medium and long term, but also to provide real feedback and motivation for any player (Bangsbo, 1994; Weineck, 1998, p. 110).

The use of tests to assess the capacity of effort, facilitates the obtaining of information in order to effectively direct and schedule the preparation process. The level of physical training of football players can be quantified by testing the capacity of effort, thus having the possibility to structure a customized program to correct possible deficiencies of athletes (Reilly, 2007, pp. 153-154).

In order to objectify the exercise test used, but also to scientifically establish the physical possibilities of athletes, specialists propose the constant registration of HR to ensure that the physiological responses of athletes, obtained as a result of the effort to which they were subjected, are associated with the effort zones planned to be measured (Weineck, 1998, p. 126).

PART II

Chapter 4. Preliminary research on the effects of the use of small sided games in football training on the effort capacity of juniors aged 16-18

4.1. Introduction

The need to know and improve the level of effort capacity of football players by participating in a training program with small sided games, is an important premise in the proposed approach to conducting this research. The planning of training programs and the harmonization of the content of the selected means with the proposed physical development objectives, are essential landmarks in order to carry out this research.

Purpose

The purpose of this research was to check the tests and equipment to be used in experimental research and the intervention program. We also set out to analize the effects of a 5-month small sided games football training program on the effort capacity of 16-18-year-olds.

Objectives

1. Optimize the effort capacity of athletes participating in small sided games football training.
2. Conducting the intervention program with the scientific support to monitor training intensity by measuring heart rate using modern technology.
3. The use and verification of the functioning of modern technology in the research carried out.

Hypothesis

By applying for 5 months a training intervention program that includes small sided football games, we can influence the effort capacity of 16-18-year junior players.

4.2. Subjects and methods

The sample included in the study consisted of a group of 34 athletes from Cetate Sport`s High School from Deva, all football players, divided into two groups - experiment group and control group. Thus, each group was made up of 17 students all participating in competitions at the same level, in the Junior County Championships in the category of 16—18 years.

The research methods used

During the course of the research, we used the following methods: the bibliographic study method and the study of special publications method, the experimental method, the test method, the statistical method, the measurement of the performance of the subjects.

Tests used

Description and administration of the tests

Yo Yo Intermittent Test Level 1 (YYIRTL1)

The two types of Yo Yo test assess athletes' ability to repeatedly make maximum effort (Bangsbo, Iaia, & Krustrup, 2008a; Bangsbo, 2008b, pp. 103-106; Krustrup et al., 2003). For our research, we selected YYIRTL1, a validated field test, designed specifically for football players, with the main objective of assessing the physical effort capacity in aerobic and anaerobic zones (Bangsbo et al., 2008a; Bangsbo, 2008b, pp. 103-106; Castagna, Impellizeri, Chamari, Carlagno, & Ramini, 2006; Gumusdag, Unlu, Cicek, Kartal, & Evli, 2013; Krustrup et al., 2003). Subjects conducted the Yo Yo intermittent level 1 field test at the beginning of each assessment period, for HRmax measurement, for the purpose of delimiting the effort zones for each athlete, and for the assessment of aerobic and anaerobic capacity, relative to the variables measured in this test.

By using the Hosand GT.a technology, we evaluated aerobic capacity by measuring retention time in aerobic effort zones, and anaerobic capacity by measuring retention time in anaerobic zones according to HR values, physiological indicators reported by the technology used. The YYIRTL1 field test provides the ability to analyze a wide range of parameters that give data on the physical capacity of athletes.

Test 7x34.2 Bangsbo - speed endurance evaluation

Before performing this test, subjects shall perform a standardized warm-up of 5 minutes of dynamic stress, 5 minutes of running exercises and 3 minutes of intermittent short and medium distance runs in order to prepare the body for effort, at the optimum parameters to start the test. All assessments were performed on the same surface, synthetic grass field. The control group performed each test immediately after the experiment group.

Subjects are positioned at the stand position 50 cm before the start line marked with the first photocells gate, and sprint for a distance of 34.2 meters after the first 10 meters driven by changing the alternating left-right direction by 10 meters, then sprint to the finish line that is marked with the second photocells gate. Subjects are directed to continue for 25 seconds with a easy recovery run to the start line. The coach provides verbal tips to direct the athletes, who perform the ‘ready’ command per second 23 and the start-to-second command 25 (Bangsbo,

2008b, pp. 89-92). The test continues until 7 repetitions of 34.2 meters are performed. Performance is monitored using the Witty Gate Microgate 2 photocells system, the following parameters are recorded: best time (BT), average of 7 measured distance runs (AVT), fatigue index (FI) (Bangsbo, 2008b, p. 90).

Pro Agility 5-10-5 test applied to evaluate speed and agility

The Pro Agility test also known as the 5-10-5 freighter was for the first time structured and utiliazed using the protocol of Harman, Garhammer, & Pandorf (2000). This test is part of the test battery used by the US national Football leagues and Hockey. The characteristics of this test fit it into the category of speed and change of direction tests and less into the category of agility tests (Sayers, 2015).

Use of Hosand GT.a and Witty Gate Microgate 2 technology

In order to meet the specific requirements of scientific research, but also for the validity and objectivity of the approach and the results obtained, we have used modern technology, through the Hosand GT.a. and Witty Gate Microgate 2 systems.

Organization and conduct of preliminary research

The two groups of 17 subjects have completed a training program from 8.07.2019 to 22.12.2019. According to the annual plan, the training program contained the preparatory period (8.07—1.09), the competition period (2.09—24.11) and the transition period (25.11—22.12).

Both groups performed 4 weekly trainings with a game on Saturday during the competition period. For the experiment group, an intervention program was introduced which included 3 weekly training sessions whose main content were small sided football games.

During this period, the control group followed a training program with classic exercises, structured to practice technical-tactical elements or to develop effort capacity.

Both groups were subjected to three scientifically validated effort field tests (YYIRTL1, 7x34.2 Bangsbo, Pro Agility 5-10-5) at each start or end of the training period.

In both groups, the planning of short, medium and long term training was performed respecting both the specific laws of training periods and the specific development particularities of the subjects at this age.

The intervention program

Throughout the training, all subjects participated in 4 trainings per week, Monday, Tuesday, Wednesday and Friday, with an average duration of 90 minutes. Each training microcycle included 3 weekly workouts, Monday, Wednesday and Friday, whose main content

were small sided football games. Thus, the intervention program included a total of 54 training sessions, 75% of the total number of training sessions, whose themes were carried out through small sided football games, between 8.07.2019 and 29.11.2019.

In order to improve the training and observance of the training principles used in the periodisation of the training in football, we have inserted into every weekly microcycle small sided football games on Monday, Wednesday and Friday, adapting the exercise content to the training time volume and intensity. In the weeks of evaluation, we did not use small sided games in the weekly microcycle.

Small sided games have been selected, rationalized and standardized to cover all effort zones, aerobics, anaerobics and mix. In the standardization of small sided football games, we have established the same structuring rules, depending on the following variables: the theme determined according to the phases of the game, the size of the pitch, the number of players, the number of touches, the gates, the size and position of the gates, effort/pause ratio, number of repeats, presence or absence of goalkeepers, inferior and numerical superiority.

4.3 Results

Results obtained at YYIRTL1, EG and CG

The t-test for independant samples and Mann Whitney U show that at T1 the difference between the means (Graph 1) of the two groups at all measured parameters is not statistically significant (Table 1), with the groups being homogeneous.

Graph 1. Comparison of means, EG/CG, T1, YYIRTL1, preliminary research

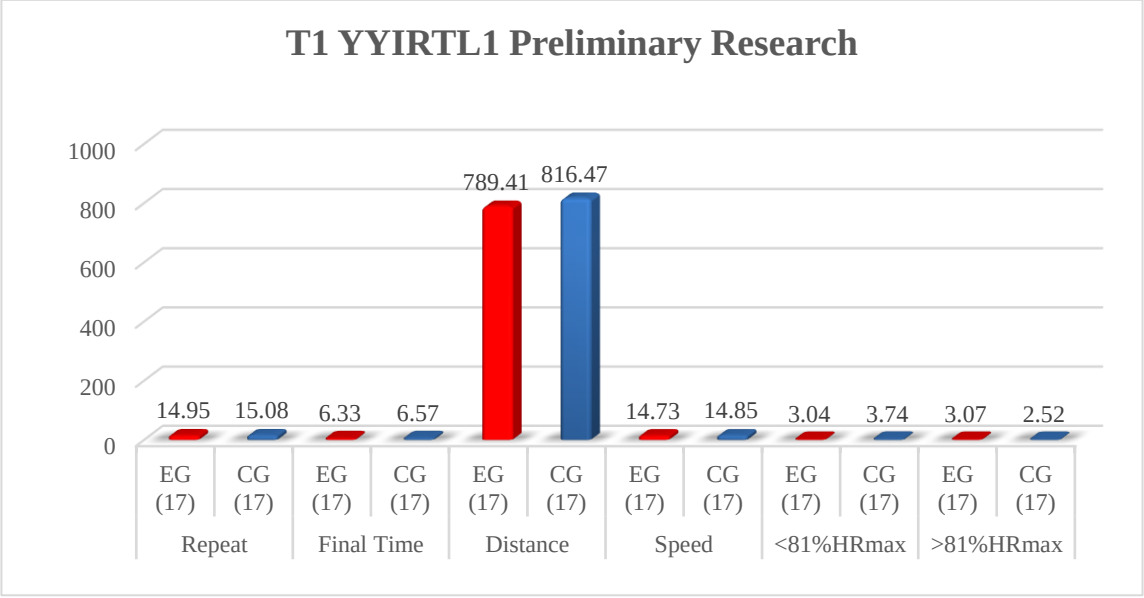

Table 1. Descriptive analysis, comparison of means and effect size, YYIRTL1 test, by group at T1 (N = 34)

Variable	Group	Mean	AS	ES	Test statistics t/U*	df.	Sig.	Hedges g
Repeat	EG (17)	14.95	.44	.1075	-.690	32	.49	.25
	CG (17)	15.08	.59	.1433				
Final Time	EG (17)	6.33	1.07	.25955	-.539	32	.59	,18
	CG (17)	6.57	1.56	.37923				
Distance	EG (17)	789.41	139.66	33.87	-0.480	32	.63	,16
	CG (17)	816.47	185.50	44.99				
Speed	EG (17)	14.73	.25	.06	119.50*	32	.33	,40
	CG (17)	14.85	.34	.08				
OnZoneAe<81%HRmax	EG (17)	3.04	.67	.16	95.50*	32	.09	,59
	CG (17)	3.74	1.53	.37				
OnZoneAn>81%HRmax	EG (17)	3.07	1.05	.25	-1.416	32	.16	,48
	CG (17)	2.52	1.18	.28				

After the completion of the intervention program, the measurements, T3 (Graph 2), for the test carried out were repeated, the results being also statistical analyzed (Table 2). The difference between the scores means of the two groups was significant for the variables: repeat (t = 1.587, df = 32, two-tailed p =.001, g = 1.20), final time (t = 3.704, df = 32, two-tailed p =.001, g = 1.24), distance (t = 3.586, df = 32, two-tailed p = .001, g = 1.20), speed (U = 107.50, N_1 = 17, N_2 = 17, two-tailed p =.003, g = 1.14) and holding time in zone An>81%HRmax (t = -3.01, df = 32, two-tailed p =.005, g = 1.01); the Mann Whitney U test shows that there are no significant static differences between the mean scores of the two groups for the parameter indicating hold time in zone Ae<81%HRmax (U = 89.50, N_1 = 17, N_2 = 17, two-tailed p = .058, g = .65).

Graph 2. Comparison of means, EG/CG, T3, YYIRTL1, preliminary research

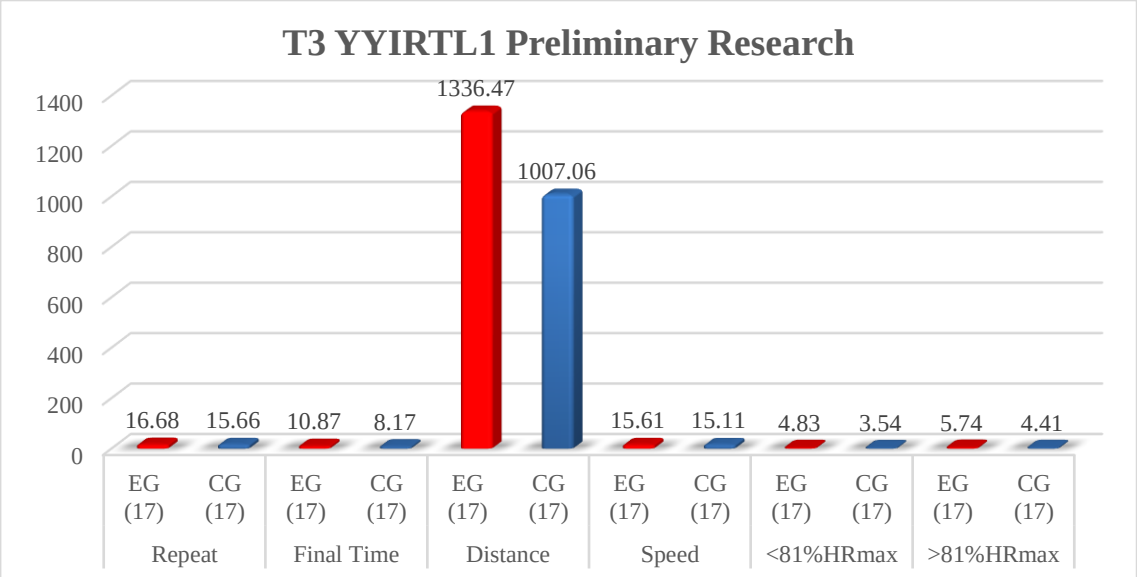

Table 2. Descriptive analysis, comparison of means and effect size, YYIRTL1, by group at T3 (N = 34)

Variable	Group	Mean	AS	ES	Test statistics t/U*	df.	Sig.	Hedges g
Repeat	EG (17)	16.68	.95	.23	3.569	32	.001	1.20
	CG (17)	15.66	.69	.16				
Final Time	EG (17)	10.87	2.34	.56	3.704	32	.001	1.24
	CG (17)	8.17	1.88	.45				
Distance	EG (17)	1336.47	306.28	74.28	3.586	32	.001	1.20
	CG (17)	1007.06	222.81	54.04				
Speed	EG (17)	15.61	.48	.11	63.00*	32	.003	1.14
	CG (17)	15.11	.37	.09				
OnZoneAe<81%HEmax	EG (17)	4.83	2.06	.50	89.50*	32	.058	.65
	CG (17)	3.54	1.83	.44				
OnZoneAn>81%HRmax	EG (17)	5.74	1.30	.31	3.019	32	.005	1.01
	CG (17)	4.41	1.27	.30				

Evaluation of speed endurance, test 7x34.2m Bangsbo, preliminary research

The test t for independant samples shows that the difference between the two groups' means (Graph 3) at the BT and FI parameters is not statistically significant (Table 3), the groups being homogeneous.

Graph 3. Comparison of means, EG/CG, T1, 7x34.2 Bangsbo, preliminary research

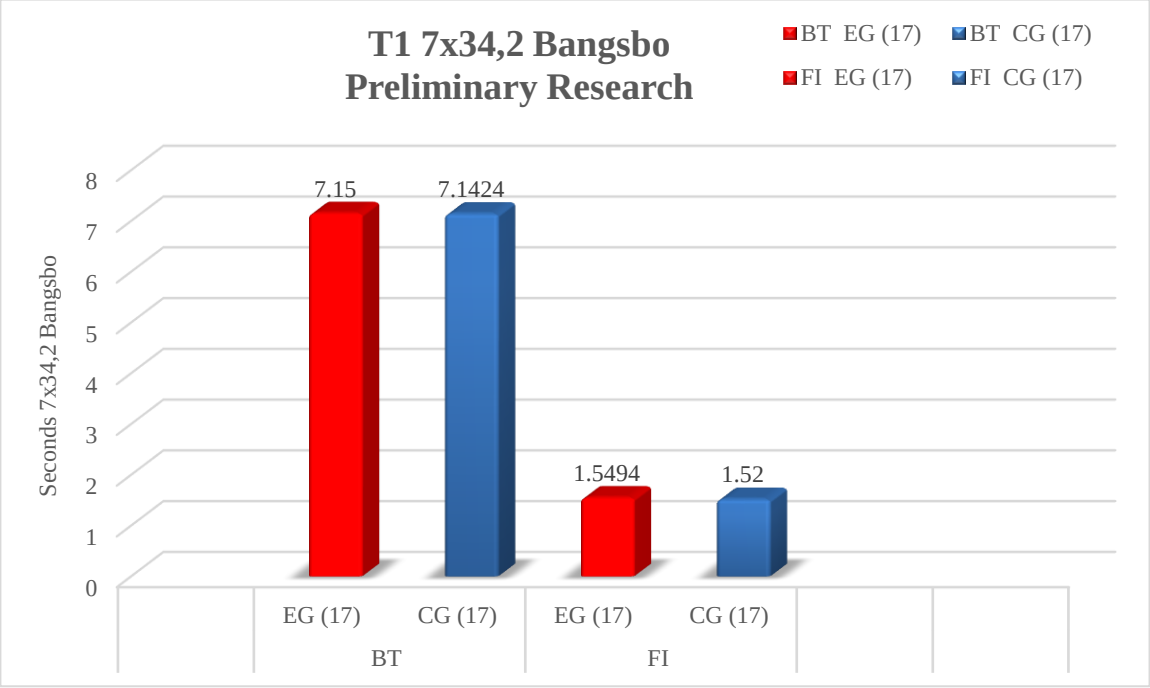

Table 3. Comparison of means and effect size, 7x34.2 — BT and FI — before the application of the intervention program (N = 34)

Variable	Group	Mean	Std. Deviation	t-test for Equality of Means t	df	Sig.	Hedges g
BT	EG (N = 17)	7.1500	.45914	.062	32	.951	.02
	CG (N = 17)	7.1424	.21905				
FI	EG (N = 17)	1.5494	.46837	.221	32	.826	.09
	CG (N = 17)	1.5200	.28476				

To compare the means recorded in the two groups, T1, at the AVT parameter, the Mann-Whitney U test was used, which shows that there is no significant difference between the mean values of the two groups (U = 142.50, N_1 = 17, N_2 = 17, two-tailed p = .945, g = .05), the groups are homogeneous also for this parameter of the 7x34.2 field test.

After the completion of the intervention program, the measurements, T3 (Graph 4), for the test carried out were repeated, the results being also statistical analyzed (Table 4). The difference between the scores means of the two groups was significant for all measured variables, BT (t = -4.192, df = 32, two-tailed p = .000, g = 1.40), AVT (t = -3.373, df = 32, two-tailed p = .002, g = 1.14) and FI (t = -2.147, df = 32, two-tailed p = .039, g = .72).

Graph 4. Comparison of means, EG/CG, T3, 7x34.2 Bangsbo, preliminary research

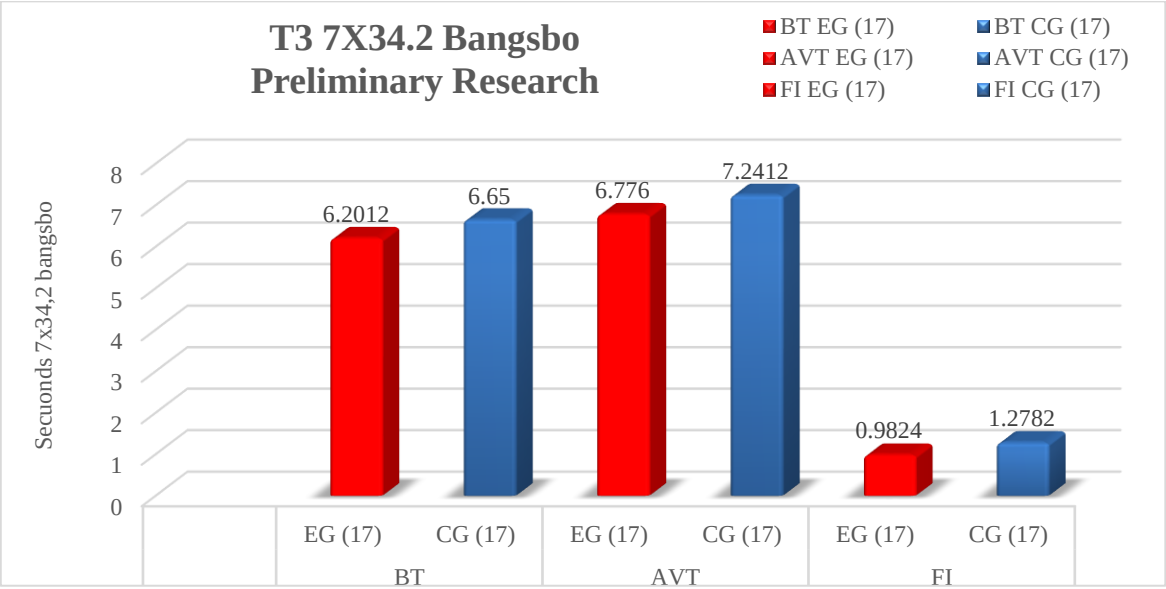

Table 4. Comparison of means and effect size, test 7x34.2, at the end of the intervention program (N = 34)

Variable	Group	Mean	Std. Deviation	t-test for Equality of Means t	df	Sig.	Hedges g
BT	EG (N = 17)	6.2012	.35068	-4.192	32	.000	1.40
	CG (N = 17)	6.6500	.26819				
AVT	EG (N = 17)	6.7776	.29397	-3.373	32	.002	1.14
	CG (N = 17)	7.2412	.48446				
FI	EG (N = 17)	.9824	.30308	-2.147	32	.039	.72
	CG (N = 17)	1.2782	.48067				

Evaluation of speed and agility, Pro Agility test 5-10-5, preliminary research

The test t for independant samples shows that, at T1, the difference between the two groups' means (Graph 5), at the final time parameter, is not statistically significant (t = -2.577, df = 32, two-tailed p = .015, g = .50), the groups being homogeneous (Table 5).

Graph 5. Comparison of means, T1/T3, EG/CG, Pro Agility 5-10-5, preliminary research

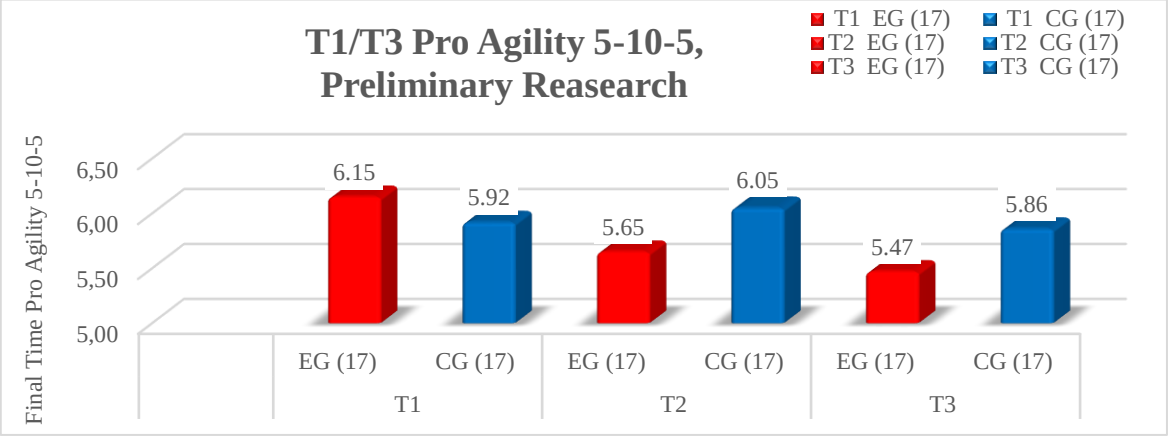

Table 5. Comparison of means and effect size, Pro Agility 5-10-5 – before the aplication of the intervention program (N = 34)

Variable	Group	Mean	Std. Deviation	t-test for Equality of Means t	df	Sig.	Hedges g
T1 PAG Ft	EG (N = 17)	6.15	.43	1.473	32	.151	.50
	CG (N = 17)	5.92	.46				

After the completion of the intervention program, the measurements, T3 (Graph 5), for the test carried out were repeated, the results being also statistical analyzed (Table 6). The difference between the scores means of the two groups was significant to the measured variable, the final time (t = -2.505, df = 32, two-tailed p = .018, g = .84).

Table 6. Comparison of means and effect size, Pro Agility 5-10-5, at the end of the intervention program (N = 34)

Variable	Group	Mean	Std. Deviation	t-test for Equality of Means t	df	Sig.	Hedges g
T3 PAG Ft	EG (N = 17)	5.47	.43	-2.505	32	.018	.84
	CG (N = 17)	5.86	.48				

4.4. Discussions

The analysis of the results obtained after the evaluations shows that significant progress has been made in the experiment group compared to the control group.

The results obtained by the two groups in the initial evaluation of the YYIRTL1 show no significant differences between the two groups in any of the measured parameters. Unlike T1 and T2, the results obtained in T3 at the YYIRTL1 show significant static differences in all measured

parameters in favor of the experiment group, except for the parameter indicating the aerobic hold time<81%HRmax.

Improving the intervention program or increasing the duration of the intervention can contribute to achieving statistically significant results also to the parameter indicating the hold time in the aerobic zone<81%HRmax.

The results obtained by the two groups in the initial evaluations, ProAgility 5-10-5, show no significant differences between groups. The time obtained by the two groups at the interim and final evaluations of this test, shows significant statistical differences in favor of the experiment group. This demonstrates that trainings with small sided football games improves speed and agility.

In our research, we have demonstrated that the long-term application of a small sided games football training program, where we have changed variables such as the size of the field or the number of players, in order to train the targeted effort zone, improves speed and agility. These physical qualities were quantified by Pro Agility 5-10-5, the difference between the average final time scores recorded by athletes in the group of experiment at the two measured moments (T1/T3), showing statistical significance and a high effect size ($t = 14.405$, $df = 16$, $p = .001$, $g = 1.54$).

As regards the 7x34.2 Bangsbo field test, the results obtained by the two groups at T1 show that there are no significant differences between the two groups in any of the measured parameters. After a period of 6 weeks of training with small sided football games for the experiment group and traditional exercises for the control group, nor at T2 significant statistical differences were recorded in any of the quantified parameters at the 7x34.2 field test.

Unlike T1 and T2, the results obtained in T3 for the same field test show significant differences across all parameters in favor of EG. After 13 weeks of training from T2 and 19 weeks from T1, the results at T3 show significant differences between the performance of the two groups at all measured parameters. It is thus demonstrated that appling a correctly standardized training program with small sided football games over a longer period of time improves speed resistance measured by the 7x34.2 Bangsbo field test.

The only area where we did not get significant differences between the two groups was at the aerobic hold minutes parameter<81%HRmax. Even if there were differences in favor of the experimental group, they did not show any statistical significance.

4.5. Conclusions

- By checking the equipment, the Hosand Gt.a system and WityGate Microgate2, in preliminary research, we found their reliability in monitoring and measuring the physical and physiological reactions of athletes.

- Selected field tests, which cover all the effort zones, but also the data obtained from their application, have confirmed to us the effectiveness of the training program with small sided football games.
- The results obtained with the parameter that emphasizes the aerobic effort capacity of athletes (hold time in aerobic zone<81%HRmax) indicate the need to improve or direct the training program applied in the preliminary research.
- After the completion of the intervention program, the difference between the scores means of the two groups was statistically significant, and the effect size large, showing that small sided football training can be more effective in developing the athletes' effort capacity compared to the training containing classic exercises.
- The hypothesis of the preliminary research is confirmed being created the prerequisites for implementing experimental research.

PART III

Chapter 5. Experimental research on developing effort capacity at 16—18 year junior through training with small sided football games

5.1 Introduction

The use of small sided games in football training was not a sufficiently addressed theme, according to our knowledge, in the literature from our country. For these reasons, there is also little information on the effects of applying small sided football games, and little data on using specific tests to assess their effectiveness in optimizing physical training for athletes of 16—18 years.

Purpose

The aim of the research was to optimize the physical performance of 16—18 year-old football athletes through a training program with small sided football games. By comparing the physical and physiological effects, especially on players who use small sided games in training against players who do their training through traditional methods, we sought to increase the body's level of adaptation to the specific effort of football game.

Objectives

1. Standardization of short, medium and long term training programs.
2. Monitoring training intensity using modern HR measurement technology.
3. Continuous analysis of the data obtained by the two groups and the re-standardization of the training program with small sided football games, depending on the progress of the athletes.
4. Improvement of the physical performance of athletes in the experimental group in all proposed effort zones.

Hypothesis

In this research we started from the assumption that the participation of subjects from the experiment group in a training program with small sided football games for 1 year will result in improving physical performance in the area of the aerobically, anaerobically and mixed effort. The use of small sided football games in the training program will produce effects in optimizing the physical performance of the athletes in the experiment group compared to those in the control group who perform training with classic exercises.

5.2. Subjects and methods

The sample included in the research consisted of a group of 40 athletes, all football players, divided into two groups, the experiment group and the control group. Thus, each group was made up of 20 athletes, all of them being in the age category 16—18.

All the subjects participating in the research were medically evaluated at the county sports medicine cabinet. None of the subjects has shown particular pathologies of the muscular or neuromuscular type. During the course of the research, the medical protocol on outdoor sports activities was followed.

The research methods used

In the experimental research we used the following methods: the bibliographic study method and of special publications, the experimental method, the test method, the statistical method, the method of measuring the performance of the subjects.

Organization and conduct of experimental research

Experimental research was planned over a calendar year, its contents being in a bicyclu-type annual plan. The two groups of 20 subjects have completed a training program from 6.07.2020 to 20.06.2021. The annual plan was made up of two macrocycles, each carried out over 24 weeks.

The microcycles included 4 weekly trainings and a bilateral game at the weekend. Due to the situation generated by Sars Cov, official competitions being stopped for the competition season 2020-2021, we planned bilateral friendly games at the end of weekly microcycles to model the training program according to the specific content of each training stage.

For the experiment group, 3 of the 4 weekly trainings included small sided football games between the initial and final testings. The control group has followed during that period a training program with classical exercises.

During the research, in order to evaluate the physical performance of the athletes, but also to effectively control and direct the training program, the subjects were tested by 3 scientifically validated effort field tests at each start or end of the training period. The control tests were planned in compliance with the rest periods necessary for the restoration of energy substances consumed as a result of the athletes effort. For both groups, the YYIRTL1 field test was applied at each time, at the beginning of the week of evaluation, with the aim of measuring HRmax and delimiting the typical effort zones for each athlete, but also to assess the aerobic and anaerobic possibilities, according to the variables quantified by this field test.

We used the Hosand GT.a system to monitor exercise intensity used in the experiment group training program by measuring HR values. Both the Hosand GT.a telemetry system and the electronic timing system, WityGate Microgate 2 photocells have been used for all tests and measurements performed.

The intervention program

The training microcycles followed by the subjects in the experiment group were structured from 4 weekly trainings and a bilateral or friendly game at the weekend.

The trainings had a duration between 60 and 110 minutes, with small sided football games scheduled in the microcycle on Monday, Wednesday and Friday. The weekly microcycle also included technical-tactical training on Tuesday with an intensity of 50-60% of HRmax. Both groups had theoretical lessons included in the weekly program on Thursday.

The intervention program included a total of 107 training with small sided football games, out of a total of 179 training sessions conducted during the course of the research.

Having analyzed the data obtained from preliminary research, where no significant statistical differences have been obtained between the two groups, under the parameter indicating the aerobic possibilities of athletes, in experimental research in addition to the longer period of deployment, we have added standardized small sided football games to influence the improvement of the capacity and aerobic power of athletes in the experiment group.

Training planing and content periodisation were carried out respecting the legacies of sports theory and sports physiology. Unlike preliminary research, at experimental research, during the training period of the preparatory phase, we included in the training lessons 2 small sided football games with the aim of developing aerobic power on Monday and only performed 2 games to improve aerobic capacity. We also introduced 1 small sided game to develop aerobic capacity on Friday. Changes have also been made in the planning of competitive exercises compared to preliminary research, adding 1 game for developing aerobic capacity on Monday, Wednesday and Friday.

Statistical analysis

Analysis and interpretation of results were carried out through the SPSS program, version 23.0, with the materiality threshold $p < 0.05$ applied. The Shapiro Wilk test was used to analyze the normality of the data distribution. For comparison of the results obtained between the two groups we used the parametric t test for independant samples when the data were normally distributed, and the nonparametric test Mann Whitney U, if there was no normal distribution of the data. In order to compare the results obtained by each group between the tests, we used the parametric t test for paired samples, and the Wilcoxon nonparametric test when there was no normal distribution of data. The results have been reported as averages and standard deviations. The size of the effect (Cohen, 1988) was also calculated.

5.3. Results

Results obtained at YYIRTL1, EG/CG

The t-test for independant samples and Mann Whitney U indicate that at T1 the difference between the two groups means for all measured parameters (Graph 6) is not statistically significant (Table 7), the groups being homogeneous.

Graph 6. Comparison of means, EG/CG, T1, YYIRTL1, experimental research

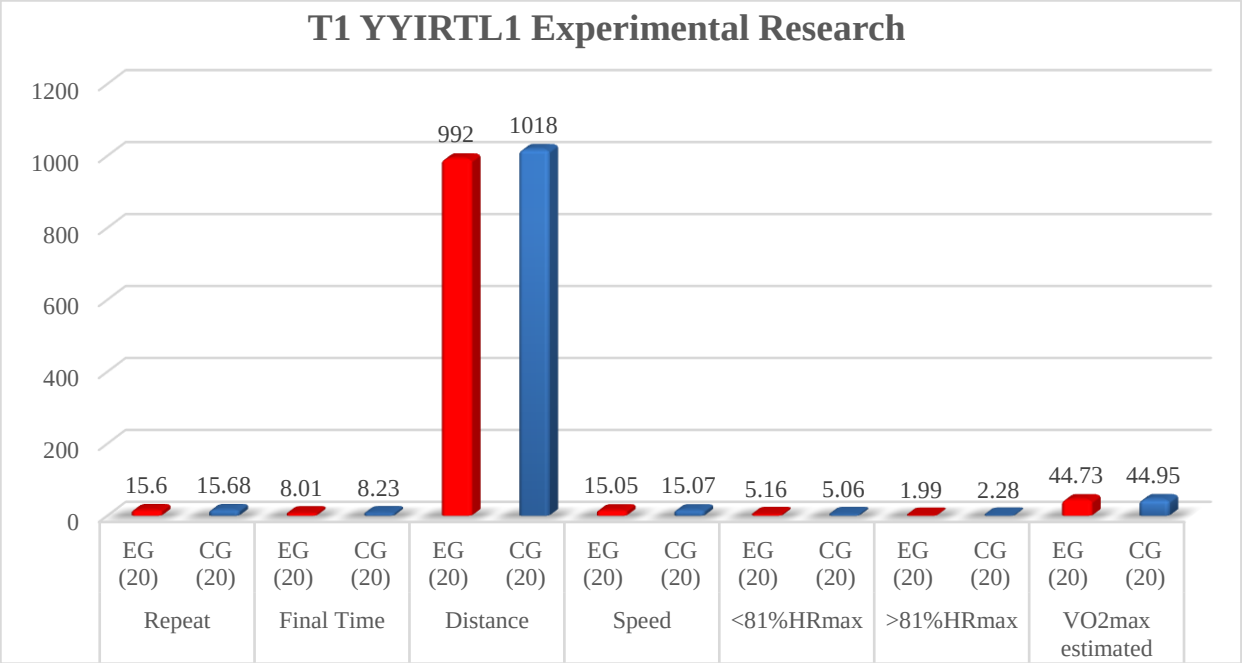

Table 7. Descriptive analysis, comparison of means and effect size, YYIRTL1, by group at T1 (N = 40)

Variable	Group	Mean	AS	ES	Test statistics t/U*	df.	Sig.	Cohen d
Repeat	EG (20)	15.60	.31	.07	143.5*	38	.121	.28
	CG (20)	15.68	.59	.05				
Final Time	EG (20)	8.01	.83	.18	152.00*	38	.190	.29
	CG (20)	8.23	.64	.14				
Distance	EG (20)	992	108.26	24.21	145.00*	38	.131	.26
	CG (20)	1018	83.57	18.68				
Speed	EG (20)	15.05	.15	.03	190.00*	38	.637	.12
	CG (20)	15.07	.18	.04				
OnZoneAe<81%HRmax	EG (20)	5.16	.72	.16	.450	38	.655	.13
	CG (20)	5.06	.79	.17				
OnZoneAn>81%HRmax	EG (20)	1.99	.61	.13	130.50*	38	.060	.56
	CG (20)	2.28	.39	.08				
VO_2max estimated	EG (20)	44.73	.90	.20	145.00*	38	.131	.26
	CG (20)	44.95	.69	.15				

After the completion of the intervention program, for the first part of the research, the measurements, T3 (Graph 7), for the field test performed, were repeated and the results were also statistically analyzed (Table 8). The difference between the scores means of the two groups was significant for all measured variables: repeat ($U = 4.000$, $N_1 = 20$, $N_2 = 20$, two-tailed $p = .000$, $d = 2.96$), final time ($U = 4.000$, $N_1 = 20$, $N_2 = 20$, two-tailed $p = .000$, $d = 3.32$), distance ($U = 4.000$, $N_1 = 20$, $N_2 = 20$, two-tailed $p = .000$, $d = 3.35$), speed ($U = 72.00$, $N_1 = 20$, $N_2 = 20$, two-

tailed p = .000053, d = 1.63), hold time in zone Ae<81%HRmax (U = 82.50, N_1 = 20, N_2 = 20, two-tailed p = .001, d = 1.21), hold time in zone An>81%HRmax (t = 5.625, df = 38, two-tailed p = .000002, d = 1.78) and the estimated VO_2max (t = 1.,730, df = 38, two-tailed p = 0.000, d = 3.74).

Graph 7. Comparison of means, EG/CG, T3, YYIRTL1, experimental research

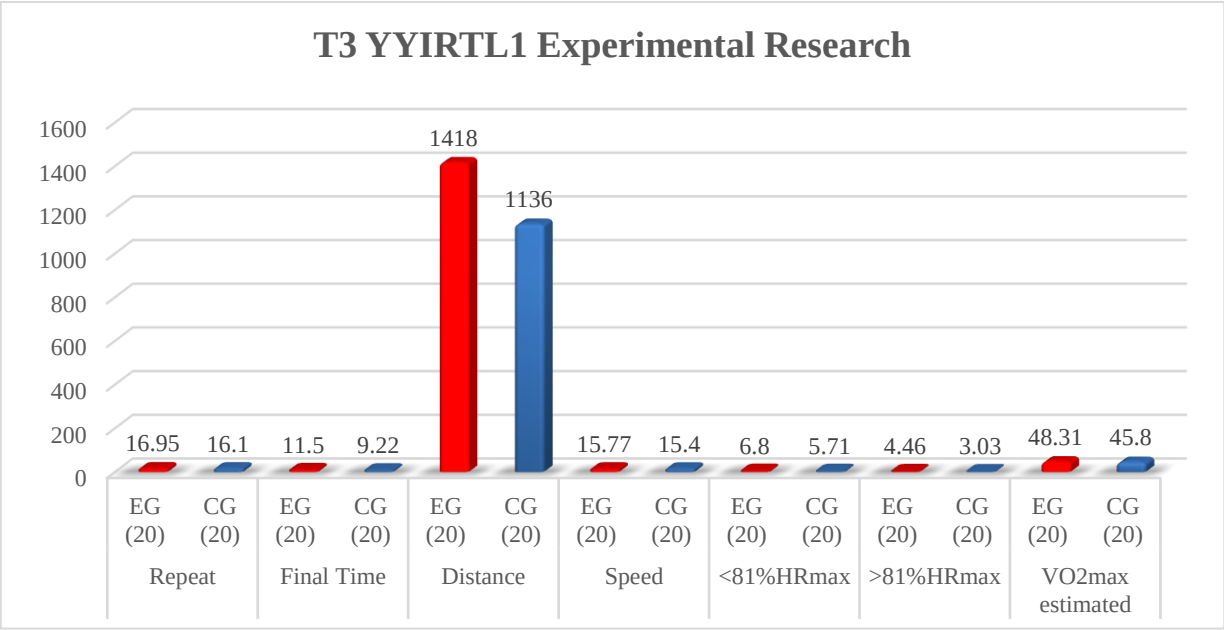

Table 8. Descriptive analysis, comparison of means and effect size, YYIRTL1, by group at T3 (N = 40)

Variable	Group	Mean	AS	ES	Test statistics t/U*	df.	Sig.	Cohen d
Repeat	EG (20)	16.95	.32	.07	4.00*	38	.000	2.96
	CG (20)	16.10	.25	.05				
Final Time	EG (20)	11.50	.72	.16	4.00*	38	.000	3.32
	CG (20)	9.22	.65	.14				
Distance	EG (20)	1418	93.11	20.82	4.00*	38	.000	3.35
	CG (20)	1136	73.87	16.51				
Speed	EG (20)	15.77	.25	.05	72.00*	38	.000	1.63
	CG (20)	15.40	.20	.04				
OnZoneAe<81%HRmax	EG (20)	6.80	.87	.19	82.50*	38	.001	1.21
	CG (20)	5.71	.92	.20				
OnZoneAn>81%HRmax	EG (20)	4.46	.80	.18	5.625	38	.000	1.78
	CG (20)	3.03	.80	.17				
VO_2max estimated	EG (20)	48.31	.78	.17	11.730	38	.000	3.74
	CG (20)	45.80	.54	.12				

At the beginning of the preparation period in the second part of the research, athletes have been re-evaluated, T4 (Graph 8), the difference between the two groups' means shows significant statistical differences (Table 9), only at the parameter indicating the hold time in zone Ae<81%HRmax (U = 77.00, N_1 = 20, N_2 = 20, two-tailed p = .001, d = 1.33). For all other measured parameters, the recorded results do not show any significant differences between the average scores of the two groups.

Graph 8. Comparison of means, EG/CG, T4, YYIRTL1, experimental research

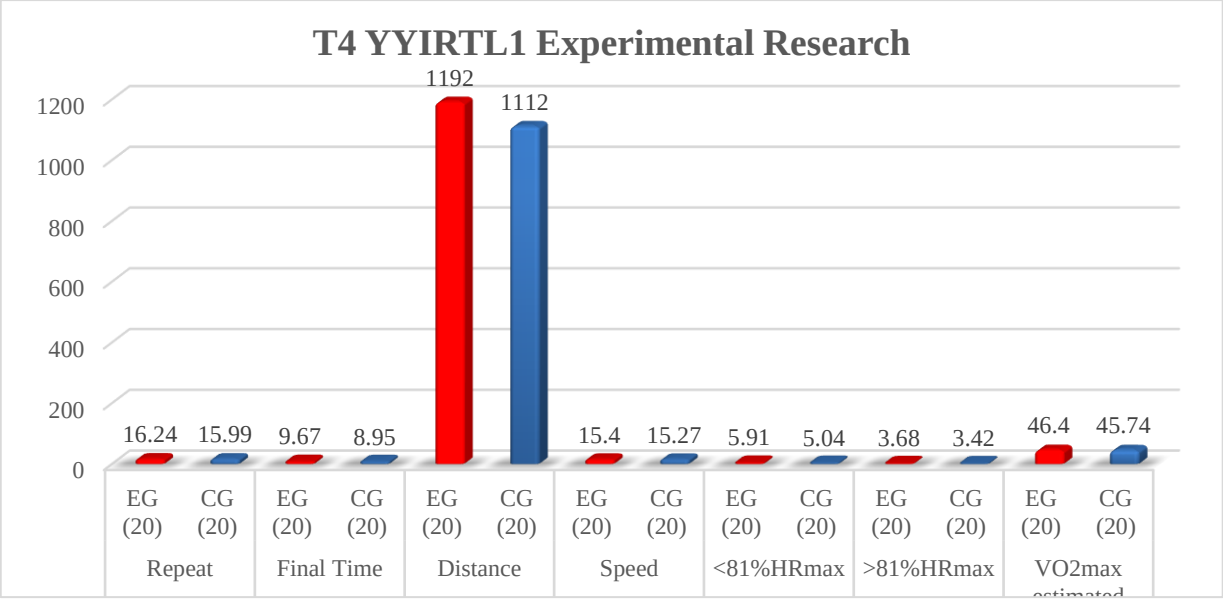

Table 9. Descriptive analysis, comparison of means and effect size, YYIRTL1, by group at T4 (N = 40)

Variable	Group	Mean	AS	ES	Test statistics t/U*	df.	Sig.	Cohen d
Repeat	EG (20)	16.24	.32	.07	133.50*	38	.068	.73
	CG (20)	15.99	.36	.08				
Final Time	EG (20)	9.67	.92	.20	133.50*	38	.068	.75
	CG (20)	8.95	.98	.22				
Distance	EG (20)	1192	107.48	24.03	133.50*	38	.068	.72
	CG (20)	1112	114.32	25.56				
Speed	EG (20)	15.40	.20	.04	150.00*	38	.096	.57
	CG (20)	15.27	.25	.05				
OnZoneAe<81%HRmax	EG (20)	5.91	.73	.16	77.00*	38	.001	1.33
	CG (20)	5.04	.56	.12				
OnZoneAn>81%HRmax	EG (20)	3.68	.68	.15	153.50*	38	.208	.42
	CG (20)	3.42	.54	.12				
VO_2max estimated	EG (20)	46.40	.89	.19	133.50*	38	.068	.73
	CG (20)	45.74	.95	.21				

After the completion of the intervention program, at the end of the research, the measurements, T6 (Graph 9), for the field test performed, were made and the results were also statistically analyzed (Table 10). As shown in the t-test for independant samples and Mann Whitney U test, the difference between the scores means for the two groups was significant for all measured variables: repeat ($t = 9.771$, $df = 38$, two-tailed $p = .000$, $d = 3.08$), final time ($U = 7.500$, $N_1 = 20$, $N_2 = 20$, two-tailed $p = .000$, $d = 3.23$), distance ($t = 10.214$, $df = 38$, two-tailed $p = .000$, $d = 3.23$), speed ($U = 40.00$, $N_1 = 20$, $N_2 = 20$, two-tailed $p = .000003$, $d = 2.20$), hold time in zone Ae<81%HRmax ($U = 32.50$, $N_1 = 20$, $N_2 = 20$, two-tailed $p = .000006$, $d = 1.78$), hold time in zone An>81%HRmax ($t = 7.395$, $df = 38$, two-tailed $p = .000$, $d = 2.34$), VO_2max estimated ($t = 10.130$, $df = 38$, two-tailed $p = .000$, $d = 3.21$).

Graph 9. Comparison of means, EG/CG, T6, YYIRTL1, experimental research

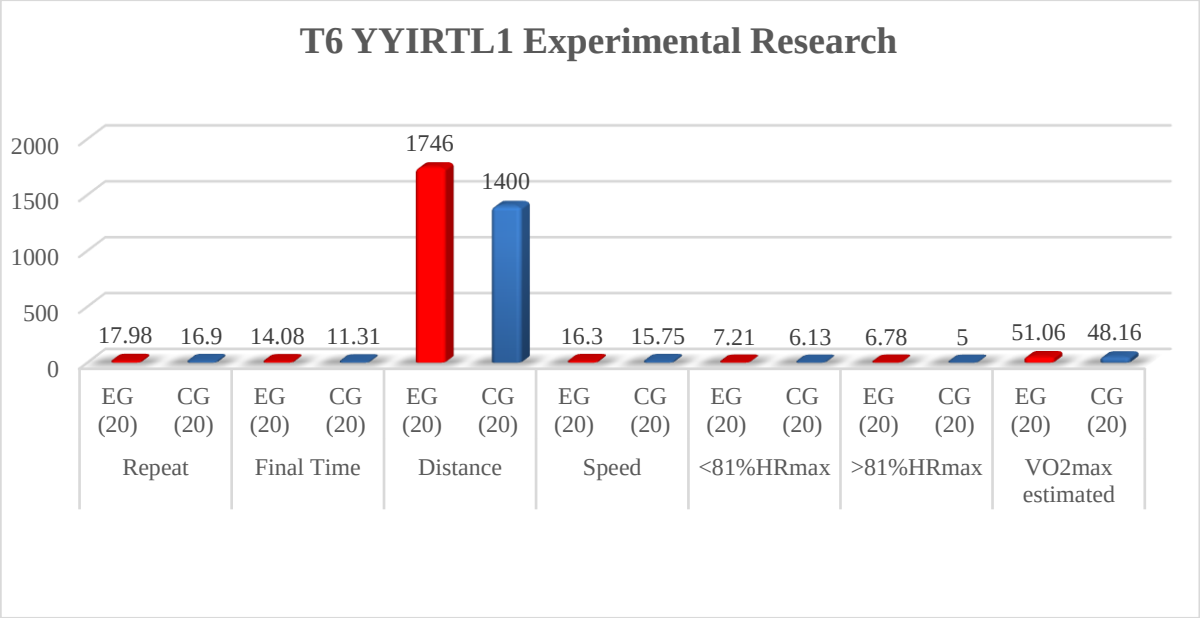

Table 10. Descriptive analysis, comparison of means and effect size, YYIRTL1, by group at the end of the research, T6 (N = 40)

Variable	Group	Mean	AS	ES	Test statistics t/U*	df.	Sig.	Cohen d
Repeat	EG (20)	17.98	.37	.08	9.771	38	.000	3.08
	CG (20)	16.90	.33	.07				
Final Time	EG (20)	14.08	.95	.21	7.500*	38	.000	3.23
	CG (20)	11.31	.75	.16				
Distance	EG (20)	1746	114.81	25.67	9.771	38	.000	3.23
	CG (20)	1400	98.83	22.10				
Speed	EG (20)	16.30	.25	.05	40.00*	38	.000	2.20
	CG (20)	15.75	.25	.05				
OnZoneAe<81%HRmax	EG (20)	7.21	.52	.11	32.50*	38	.000	1.78
	CG (20)	6.13	.68	.15				
OnZoneAn>81%HRmax	EG (20)	6.78	.79	.17	7.395	38	.000	2.34
	CG (20)	5.00	.73	.16				
VO_2max estimated	EG (20)	51.06	.96	.21	10.130	38	.000	3.21
	CG (20)	48.16	.84	.18				

For the analysis of the effect for intervention programs on subjects in the two groups, the means recorded by the subjects between the six study moments were compared using tests according to the data distribution.

In the experiment group, for the distance variable (Graph 10), the Wilcoxon test (Table 11) shows that there are statistically significant differences between the tests at all measured moments: T1/T2 (Z = -3.354, two-tailed p = .001, d = 1.67), T2/T3 (Z = -3.931, two-tailed p = .000085, d = 2.81), T1/T3 (Z = -3.926, two-tailed p = .000086, d = 2.81), T4/T5 (Z = -3.854, two-tailed p = .000116, d = 4.19), T5/T6 (Z = -3.931, two-tailed p = .000085, d = 3.22), T4/T6 (Z = -3.926, two-tailed p = .000086, d = 4.97), T1/T6 (Z = -3.929, two-tailed p = .000085, d = 6.75).

Graph 10. Comparison of means, EG, YYIRTL1, distance variable, experimental research

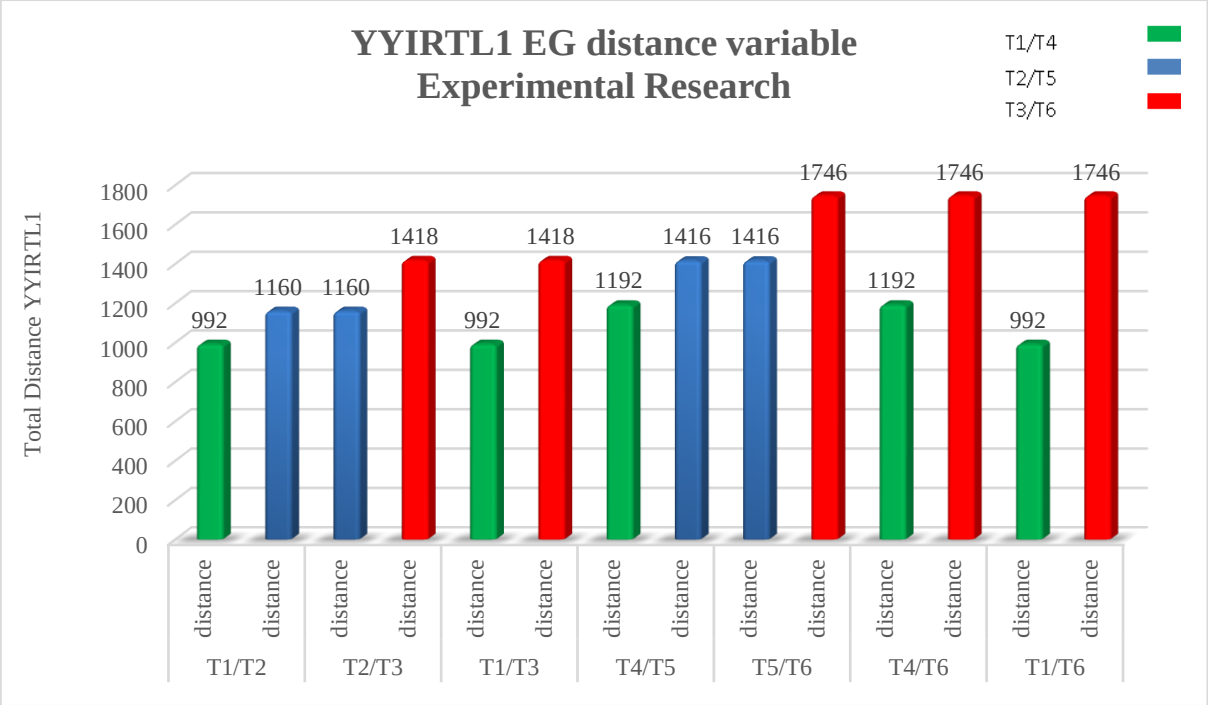

Table 11. Comparison of means and effect size, YYIRTL1, distance variable, experimental group (N = 20)

		Paired Samples Statistics[a]		Test Statistics[b,c]		
Pair	Variable	Mean	Std. Deviation	Z	Sig. 2-tailed	Cohen d
Pair 1	T1 distance	992	108.269	-3.354[b]	.001	1.67
	T2 distance	1160	89.912			
Pair 2	T2 distance	1160	89.912	-3.931[b]	.000	2.81
	T3 distance	1418	93.110			
Pair 3	T1 distance	992	108.269	-3.926[b]	.000	4.19
	T3 distance	1418	93.110			
Pair 4	T4 distance	1192	107.488	-3.854[b]	.000	5.93
	T5 distance	1416	81.460			
Pair 5	T5 distance	1416	81.460	-3.931[b]	.000	3.22
	T6 distance	1746	114.818			
Pair 6	T4 distance	1192	107.488	-3.926[b]	.000	4.97
	T6 distance	1746	114.818			
Pair 7	T1 distance	992	108.269	-3.929[b]	.000	6.75
	T6 distance	1746	114.818			

Note: a. EG; b.Wilcoxon Signed Ranks Test; c. Based on positive ranks

For the holding time variable Ae<81%HRmax (Graph 11), the Wilcoxon test and t test for paired samples indicate that there are statistically significant differences between all measured moments (Table 12): T1/T2 (t = -2.711, df = 19, two-tailed p = .014, d = .92), T2/T3 (t = -5.378, df = 19, two-tailed p = .000034, d = 1.19), T1/T3 (t = -6.222, df = 19, two-tailed p = .000006, d = 2.03), T4/T5 (Z = -2.377, two-tailed p = .017, d = .77), T5/T6 (Z = -3.402, two-tailed p = .001, d = 1.21), T4/T6 (t = -7.324, df = 19, two-tailed p = .000, d = 1.99), T1/T6 (t = -11.074, df = 19, two-tailed p = .000, d = 3.18).

Graph 11. Comparison of means, EG, YYIRTL1, aerobic zone variable<81%HRmax, experimental research

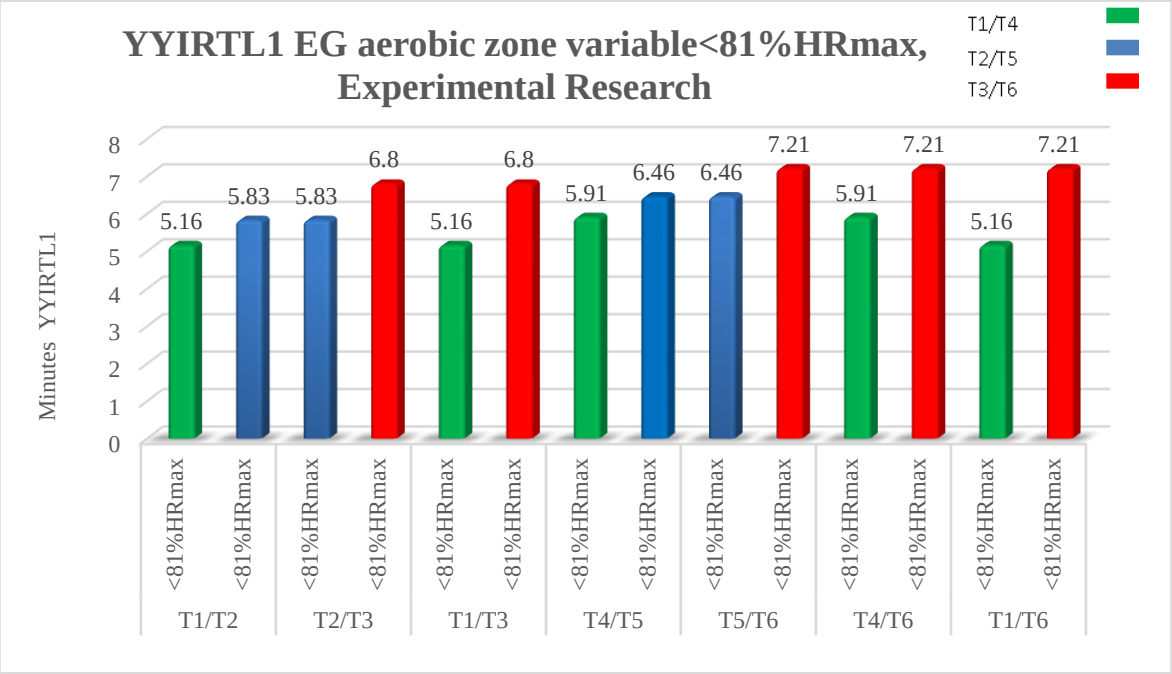

Table 12. Comparison of means and effect size, YYIRTL1, variable on zone Ae<81%HRmax, experimental group (N = 20)

		Paired Samples Statistics		Paired Samples Test[a,b]			
Pair	Variable	Mean	Std. Deviation	t[a]/Z[b]	df	Sig. 2-tailed	Cohen d
Pair 1	T1 OnzoneAe<81%HRmax T2 OnzoneAe<81%HRmax	5.1685 5.8315	.72575 .73958	-2.711[a]	19	.014	.92
Pair 2	T2 OnzoneAe<81%HRmax T3 OnzoneAe<81%HRmax	5.8315 6.8055	.73958 .87143	-5.378[a]	19	.000	1.19
Pair 3	T1 OnzoneAe<81%HRmax T3 OnzoneAe<81%HRmax	5.1685 6.8055	.72575 .87143	-6.222[a]	19	.000	2.03
Pair 4	T4 OnzoneAe<81%HRmax T5 OnzoneAe<81%HRmax	5.91 6.46	.73 .68	-2.377[b]	19	.017	.77
Pair 5	T5 OnzoneAe<81%HRmax T6OnzoneAe<81%HRmax	6.46 7.21	.68 .52	-3.402[b]	19	.001	1.21
Pair 6	T4 OnzoneAe<81%HRmax T6 OnzoneAe<81%HRmax	5.9185 7.2175	.73359 .52894	-7.324[a]	19	.000	1.99
Pair 7	T1 OnzoneAe<81%HRmax T6 OnzoneAe<81%HRmax	5.1685 7.2175	.72575 .52894	-11.074[a]	19	.000	3.18

Note: a.t-test; b.Wilcoxon Signed Ranks Test.

The t-test for paired samples (Table 13) shows that for the variable indicating the holding time in zone An>81%HRmax (Graph 12), there are significant statistical differences between the following moments: T2/T3 (t = -13.632, df = 19, two-tailed p = .000, d = 2.89), T1/T3 (t = -13.667, df = 19, two-tailed p = .000, d = 3.41), T4/T5 (t = -7.337, df = 19, two-tailed p = .000, d = 2.12), T5/T6 (t = -11.694, df = 19, two-tailed p = .000, d = 2.42), T4/T6 (t = -16.418, df = 19, two-tailed p = .000, d = 4.18), T1/T6 (t = -19.581, df = 19, two-tailed p = .000, d = 6.67); the same test shows that the results recorded between moments T1/T2 do not present significantly differences (t = -1.415, df = 19, two-tailed p = .173, d = .47).

Graph 12. Comparison of means, EG, YYIRTL1, anaerobic zone variable>81%HRmax, experimental research

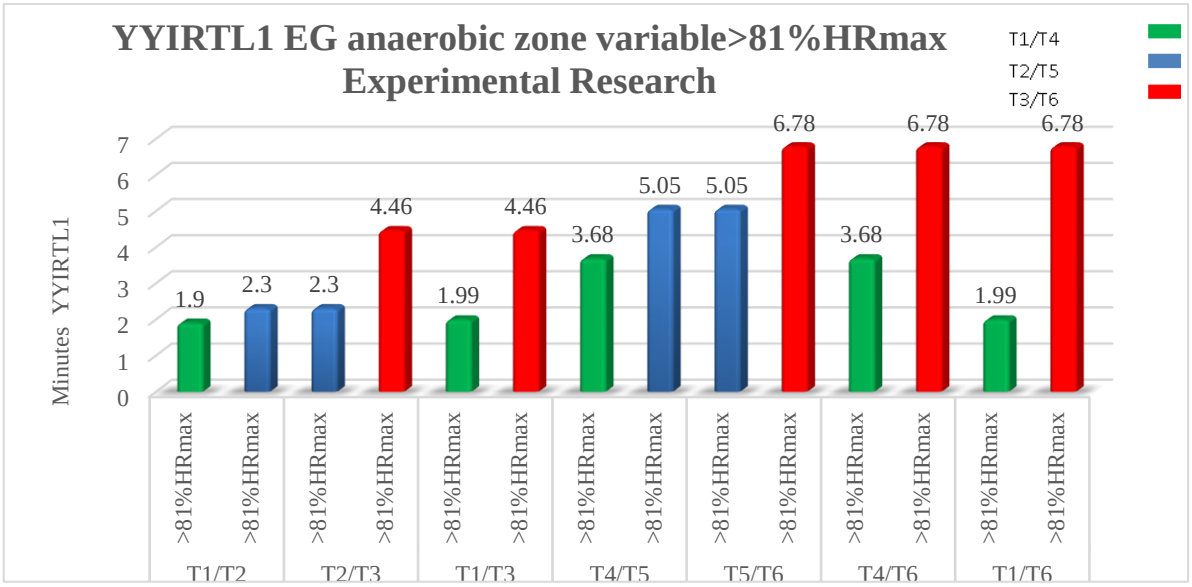

Table 13. Comparison of means and effect size, YYIRTL1, variable on zona An>81%HRmax, experimental group (N = 20)

		Paired Samples Statistics[a]		Paired Samples Test[b]			
Pair	Variable	Mean	Std. Deviation	t	df	Sig. 2-tailed	Cohen d
Pair 1	T1 OnzonaAn>81%HRmax	1.9960	.61680	-1.415	19	.173	.47
	T2 OnzonaAn>81%HRmax	2.3025	.68546				
Pair 2	T2 OnzonaAn>81%HRmax	2.3025	.68546	-13.632	19	.000	2.89
	T3 OnzonaAn>81%HRmax	4.4635	.80651				
Pair 3	T1 OnzonaAn>81%HRmax	1.9960	.61680	-13.667	19	.000	3.41
	T3 OnzonaAn>81%HRmax	4.4635	.80651				
Pair 4	T4 OnzonaAn>81%HRmax	3.6885	.68558	-7.337	19	.000	2.12
	T5 OnzonaAn>81%HRmax	5.0540	.60945				
Pair 5	T5 OnzonaAn>81%HRmax	5.0540	.60945	-11.694	19	.000	2.42
	T6 OnzonaAn>81%HRmax	6.7815	.79108				
Pair 6	T4 OnzonaAn>81%HRmax	3.6885	.68558	-16.418	19	.000	4.18
	T6 OnzonaAn>81%HRmax	6.7815	.79108				
Pair 7	T1 OnzonaAn>81%HRmax	1.9960	.61680	-19.581	19	.000	6.67
	T6 OnzonaAn>81%HRmax	6.7815	.79108				

At the control group for the distance variable (Graph 13), the Wilcoxon test (Table 14) shows that there are no statistically significant differences between the measured moments T2/T3 (Z = -.983, two-tailed p = .326, d = .36); for all other results recorded in this field test, the Wilcoxon and t test for paired samples show that there are statistically significant differences between all measured moments (Table 14): T1/T2 (Z = -3.211, two-tailed p = .001, d = 1.19), T1/T3 (Z = -3.250, two-tailed p = .001, d = 1.49), T4/T5 (t = -3.229, df = 19, two-tailed p = .004, d = .96), T5/T6 (t = -5.491, df = 19, two-tailed p = .000027, d = 1.93), T4/T6 (t = -8.034, df = 19, two-tailed p = .000, d = 2.68), T1/T6 (Z = -3.925, two-tailed p = .000087, d = 4.14).

Graph 13. Comparison of means, CG, YYIRTL1, distance variable, experimental research

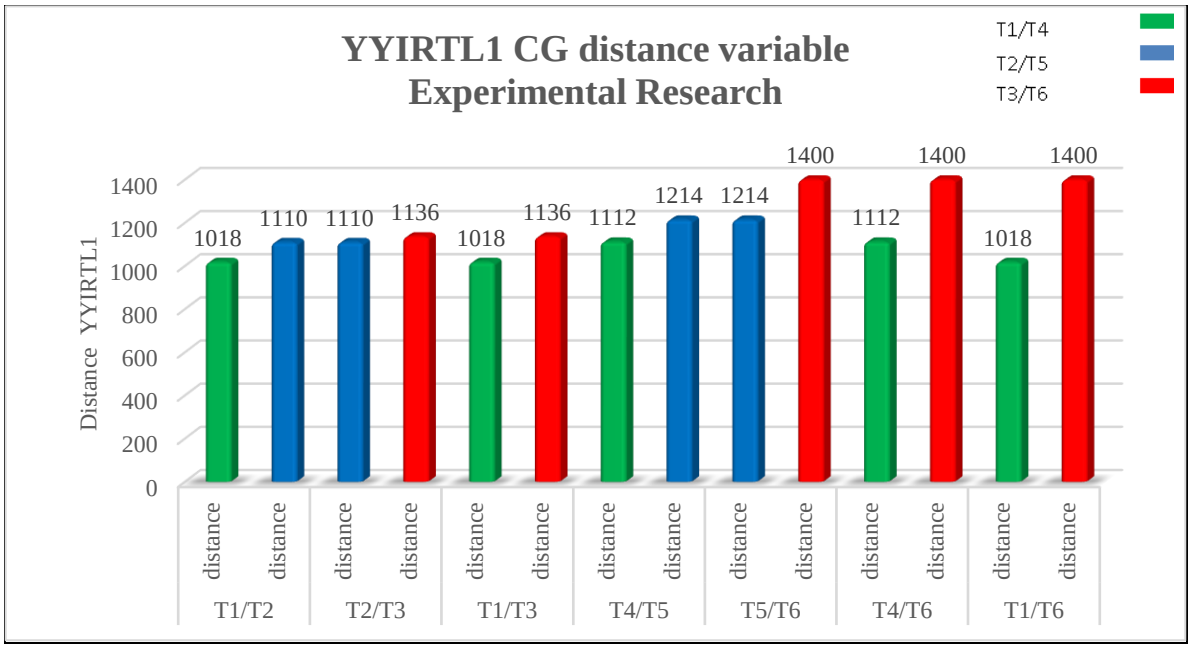

Table 14. Comparison of means and effect size, YYIRTL1, distance variable, control group (N = 20)

		Paired Samples Statistics[a]		Paired Samples Test[a,b]			
Pair	Variable	Mean	Std. Deviation	t[a]/Z[b]	df	Sig. 2-tailed	Cohen d
Pair 1	T1 distance T2 distance	1018 1110	83.578 67.278	-3.211[b]	19	.001	1.19
Pair 2	T2 distance T3 distance	1110 1136	67.278 73.870	-.983[b]	19	.326	.36
Pair 3	T1 distance T3 distance	1018 1136	83.578 73.870	-3.250[b]	19	.001	1.49
Pair 4	T4 distance T5 distance	1112 1214	114.322 92.929	-3.229[a]	19	.004	.96
Pair 5	T5 distance T6 distance	1214 1400	92.929 98.835	-5.491[a]	19	.000	1.93
Pair 6	T4 distance T6 distance	1112 1400	114.322 98.835	-8.034[a]	19	.000	2.68
Pair 7	T1 distance T6 distance	1018 1400	83.578 98.835	-3.925[b]	19	.000	4.14

Note: a.t-test; b.Wilcoxon Signed Ranks Test.

For the holding time variable Ae<81%HRmax (Graph 14), the Wilcoxon test (Table 15) shows that there are significant statistical differences between the following measured moments: T1/T3 (Z = -2.221, two-tailed p = .026, d =.75), T4/T5 (Z = -2.261, two-tailed p = .024, d = .76), T5/T6 (Z = -2.875, two-tailed p = .004, d = 1.08), T4/T6 (Z = -3.510, two-tailed p = .000448, d = 1.73), T1/T6 (Z = -3.118, two-tailed p = .002, d = 1.44); the t-test for paired samples and Wilcoxon test show that there are no significant statistical differences (Table 15) for the results recorded between T1/T2 (t = -1.103, df = 19, two-tailed p = .284, d = .28) and T2/T3 (Z = -1.456, two-tailed p = .145, d = .45).

Graph 14. Comparison of means, CG, YYIRTL1, aerobic zone variable<81%HRmax, experimental research

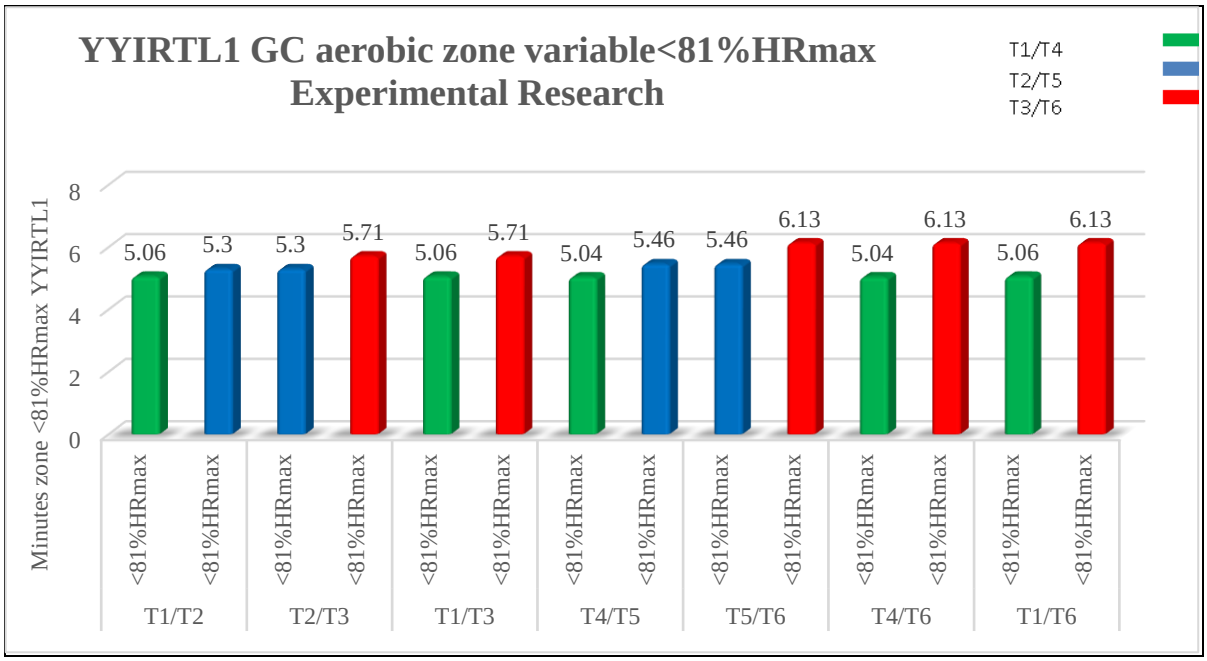

Table 15. Comparison of means and effect size, YYIRTL1, aerobic zone variable Ae<81%HRmax, control group (N = 20)

		Paired Samples Statistics		Paired Samples Test[a,b]			
Pair	Variable	Mean	Std. Deviation	t[a]/Z[b]	df	Sig. 2-tailed	Cohen d
Pair 1	T1 OnZoneAe<81%HRmax	5.0605	.79083	-1.103[a]	19	.284	.28
	T2 OnZoneAe<81%HRmax	5.3080	.90445				
Pair 2	T2 OnzoneAe<81%HRmax	5.3080	.90445	-1.456[b]	19	.145	.45
	T3 OnzoneAe<81%HRmax	5.7110	.92811				
Pair 3	T1 OnzoneAe<81%HRmax	5.0605	.79083	-2.221[b]	19	.026	.75
	T3 OnzoneAe<81%HRmax	5.7110	.92811				
Pair 4	T4 OnzoneAe<81%HRmax	5.0440	.56286	-2.261[b]	19	.024	.76
	T5 OnzoneAe<81%HRmax	5.4675	.53046				
Pair 5	T5 OnzoneAe<81%HRmax	5.4675	.53046	-3.875[b]	19	.004	1.08
	T6 OnzoneAe<81%HRmax	6.1365	.68477				
Pair 6	T4 OnzoneAe<81%HRmax	5.0440	.56286	-3.510[b]	19	.000	1.73
	T6 OnzoneAe<81%HRmax	6.1365	.68477				
Pair 7	T1 OnzoneAe<81%HRmax	5.0605	.79083	-3.118[b]	19	.002	1.44
	T6 OnzoneAe<81%HRmax	6.1365	.68477				

Note: a.t-test; b.Wilcoxon Signed Ranks Test.

The Wilcoxon test and t-test for paired samples shows that for the holding time variable in anaerobic zone An>81%HRmax (Graph 15) there are significant statistical differences between the moments (Table 16): T2/T3 (t = -3.118, df = 19, two-tailed p = .006, d = 1.06), T1/T3 (Z = -2.949, two-tailed p = .003, d = 1.08), T4/T5 (Z = -3.059, two-tailed p = .002, d = 1.23), T5/T6 (Z = -2.576, two-tailed p = .010, d = 1.23), T4/T6 (Z = -3.920, two-tailed p = .000089, d = 2.67), T1/T6 (Z = -3,920, two-tailed p = .000089, d = 4.29); Wilcoxon test shows that there are no statistically significant differences between the control group results between moments T1/T2 (Z = -0.709, two-tailed p = .478, d = .09).

Graph 15. Comparison of means, CG, YYIRTL1, anaerobic zone variable An>81%HRmax, experimental research

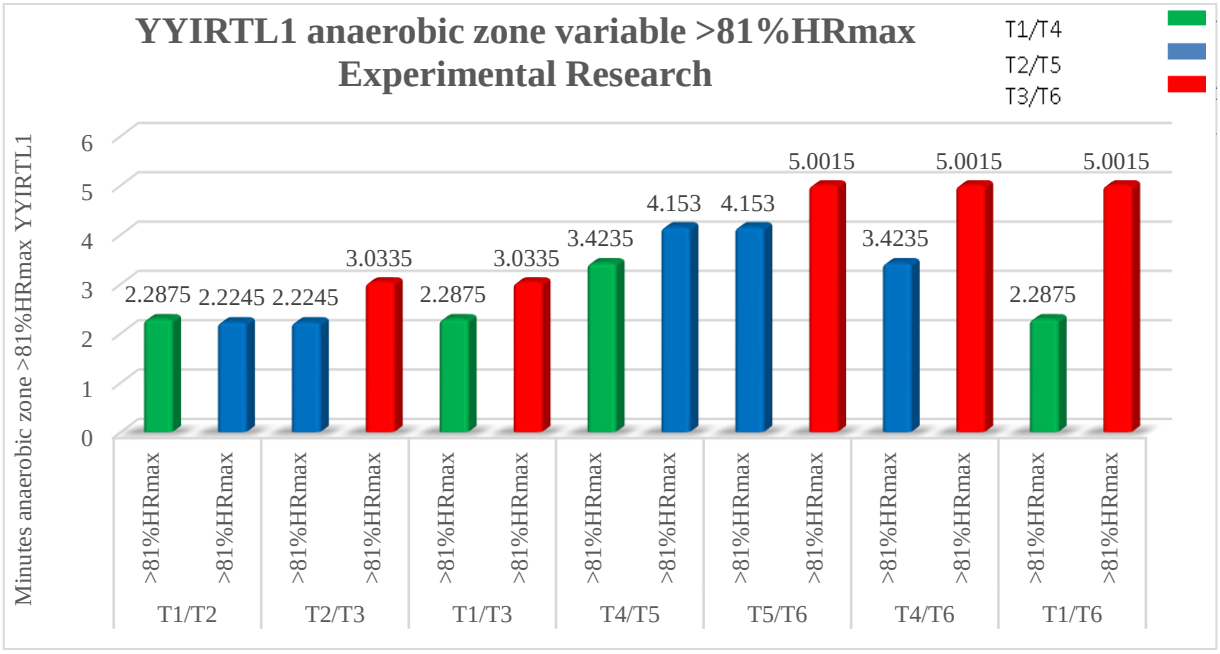

Table 16. Comparison of means and effect size, YYIRTL1, variable on zone An>81%HRmax, control group (N = 20)

Pair	Variable	Paired Samples Statistics Mean	Std. Deviation	Paired Samples Test[a,b] t[a]/Z[b]	df	Sig. 2-tailed	Cohen d
Pair 1	T1 OnzoneAn>81%HRmax	2.2875	.39543	-.709[b]	19	.478	.09
	T2 OnzoneAn>81%HRmax	2.2245	.71240				
Pair 2	T2 OnZoneAn>81%HRmax	2.2245	.71240	-3.118[a]	19	.006	1.06
	T3 OnZoneAn>81%HRmax	3.0335	.80126				
Pair 3	T1 OnzoneAn>81%HRmax	2.2875	.39543	-2.949[b]	19	.003	1.08
	T3 OnzoneAn>81%HRmax	3.0335	.80126				
Pair 4	T4 OnzoneAn>81%HRmax	3.4235	.54950	-3.059[b]	19	.002	1.23
	T5 OnzoneAn>81%HRmax	4.1530	.63911				
Pair 5	T5 OnzoneAn>81%HRmax	4.1530	.63911	-2.576[b]	19	.010	1.23
	T6 OnzoneAn>81%HRmax	5.0015	.73010				
Pair 6	T4 OnzoneAn>81%HRmax	3.4235	.54950	-3.920[b]	19	.000	2.67
	T6 OnzoneAn>81%HRmax	5.0015	.73010				
Pair 7	T1 OnzoneAn>81%HRmax	2.2875	.39543	-3.920[b]	19	.000	4.29
	T6 OnzoneAn>81%HRmax	5.0015	.73010				

Note: a.t-test; b.Wilcoxon Signed Ranks Test.

Evaluation of speed resistance, field test 7x34.2m Bangsbo

The t-tests for independant samples and Mann Whitney U (Table 17) show that, at T1 (Graph 16), the difference between the mean scores of the two groups at BT parameter (t = -.098, df = 38, two-tailed p = .922, d = .02), FI (t = .151, df = 38, two-tailed p = .881, d = .21) and AVT (U = 182.50, N_1 = 20, N_2 = 20, two-tailed p = .63, d = .02) are not statistically significant, the groups being homogeneous.

Graph 16. Comparison of means, EG/CG, T1, 7x34.2 Bangsbo, experimental research

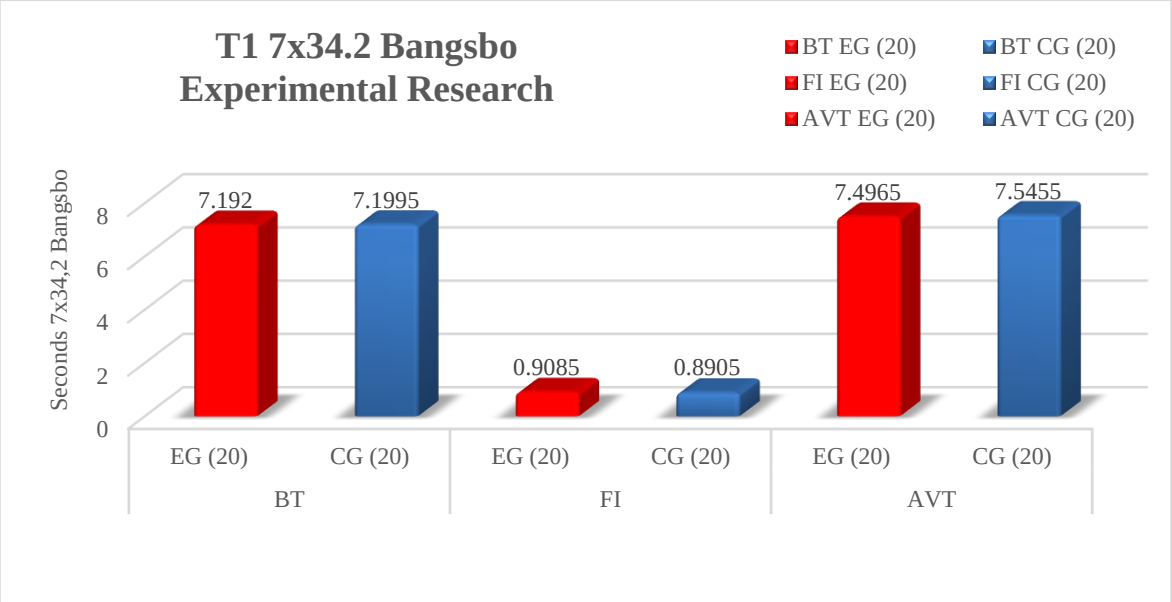

Table 17. Descriptive analysis, comparison of means and effect size, 7x34.2 field test, by group at T1 (N = 40)

Variable	Group	Mean	AS	ES	Test statistics t/U*	df.	Sig.	Cohen d
BT	EG (20)	7.1920	.18775	.04198	-.098	38	.922	.02
	CG (20)	7.1995	.28581	.06391				
FI	EG (20)	.9085	.37720	.08434	.151	38	.881	.21
	CG (20)	.8905	.37884	.08471				
AVT	EG (20)	7.4965	.11663	.02608	182.50*	38	.636	.02
	CG (20)	7.5455	.31550	.07055				

After the completion of the intervention program for the first macrocycle of the research, the measurements, T3 (Graph 17), for the field test performed were repeated and the results were also statistically analyzed (Table 18). The difference between the scores means of the two groups was significant for all measured variables, BT (t = -5.629, df = 38, two-tailed p = .000002, d = 1.87), FI (U = 111.50, N_1 = 20, N_2 = 20, two-tailed p = .017, d = .80) and AVT (t = -9.387, df = 38, two-tailed p = .000, d = 3.04).

Graph 17. Comparison of means, EG/CG, T3, 7x34.2 Bangsbo, experimental research

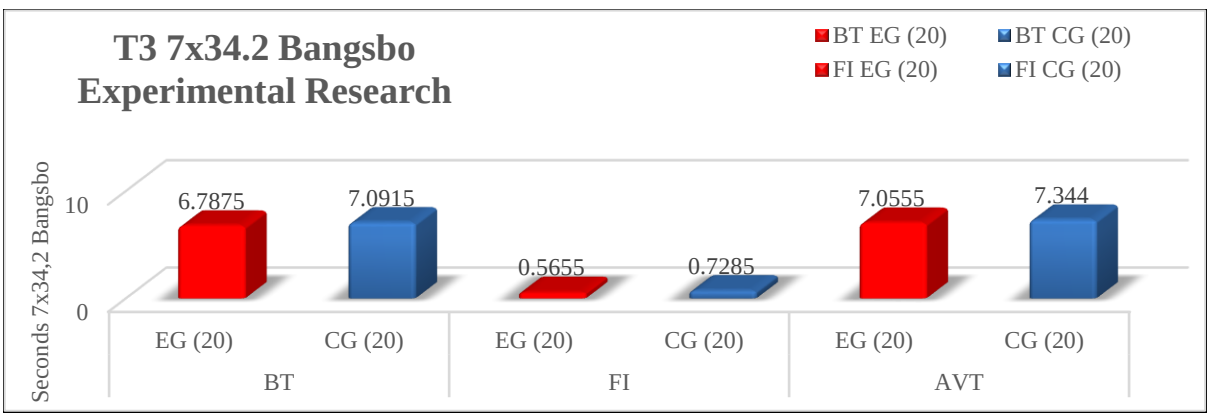

Table 18. Descriptive analysis, comparison of means and effect size, 7x34.2 field test, by group at T3 (N = 40)

Variable	Group	Mean	AS	ES	Test statistics			
					t/U*	df.	Sig.	Cohen d
BT	EG (20)	6.7875	.12290	.02748	-5.629	38	.000	1.87
	CG (20)	7.0915	.20790	.04649				
FI	EG (20)	.5655	.13359	.02987	111.50*	38	.017	0.80
	CG (20)	.7285	.25407	.05681				
AVT	EG (20)	7.0555	.09070	.02028	-9.387	38	.000	3.04
	CG (20)	7.344	.12290	.02748				

At the time of the initial test, T4 (Graph 18), corresponding to the beginning of the preparatory period in the second part of the research, there were no significant statistical differences (Table 19) between the two groups at any of the measured parameters, BT (t = -1.093, df = 38, two-tailed p = .281, d = .35), FI (U = 186.00, N_1 = 20, N_2 = 20, two-tailed p = .705, d = .22) and AVT (t = .804, df = 38, two-tailed p = .426, d = .25), the groups being homogeneous.

Graph18. Comparison of means, EG/CG, T4, 7x34.2 Bangsbo, experimental research

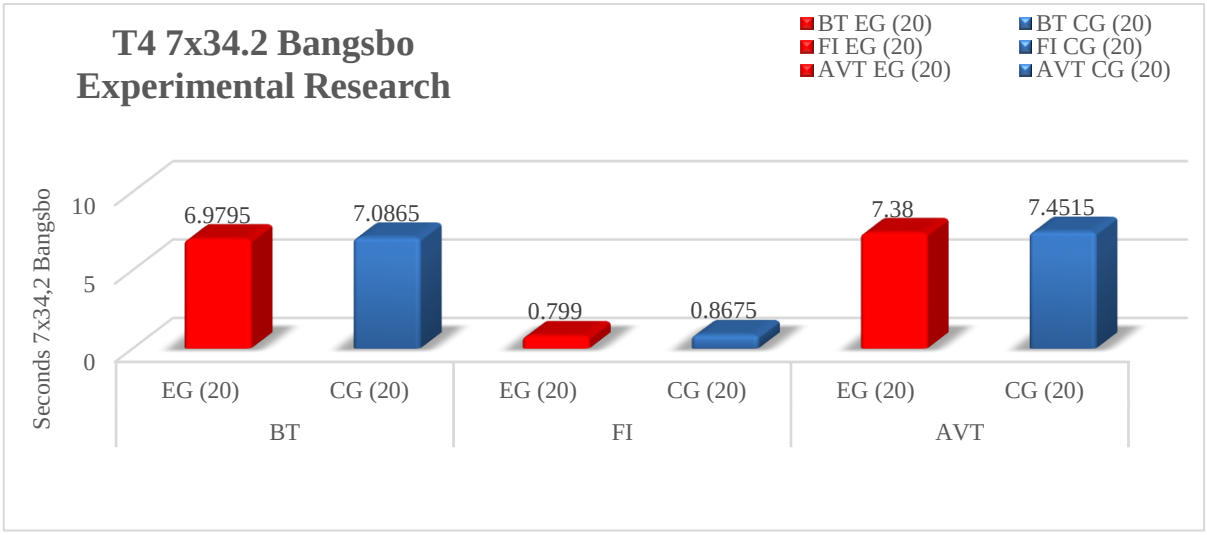

Table 19. Descriptive analysis, comparison of means and effect size, 7x34.2 field test, by group at T4 (N = 40)

Variable	Group	Mean	AS	ES	Test statistics			
					t/U*	df.	Sig.	Cohen d
BT	EG (20)	6.9795	.19234	.04301	-1.093	38	.281	.35
	CG (20)	7.0865	.39330	.08795				
FI	EG (20)	.7990	.31232	.06984	186.00*	38	.705	.22
	CG (20)	.8675	.30378	.06793				
AVT	EG (20)	7.3800	.22541	.05040	-.804	38	.426	.25
	CG (20)	7.4515	.32751	.07323				

At the end of the research, the final measurements, T6 (Graph 19), were made for the field test performed, the results being also analyzed statistically (Table 20). The difference between the scores means of the two groups was significant for all measured variables, BT (U = 62.50, N_1 =

20, N_2 = 20, two-tailed p = .000, d = 1.29), FI (U = 110.00, N_1 = 20, N_2 = 20, two-tailed p = .015, d = .92) and AVT (t = -6.997, df = 38, two-tailed p = .000, d = 2.26).

Graph 19. Comparison of means, EG/CG, T6, 7x34.2 Bangsbo, experimental research

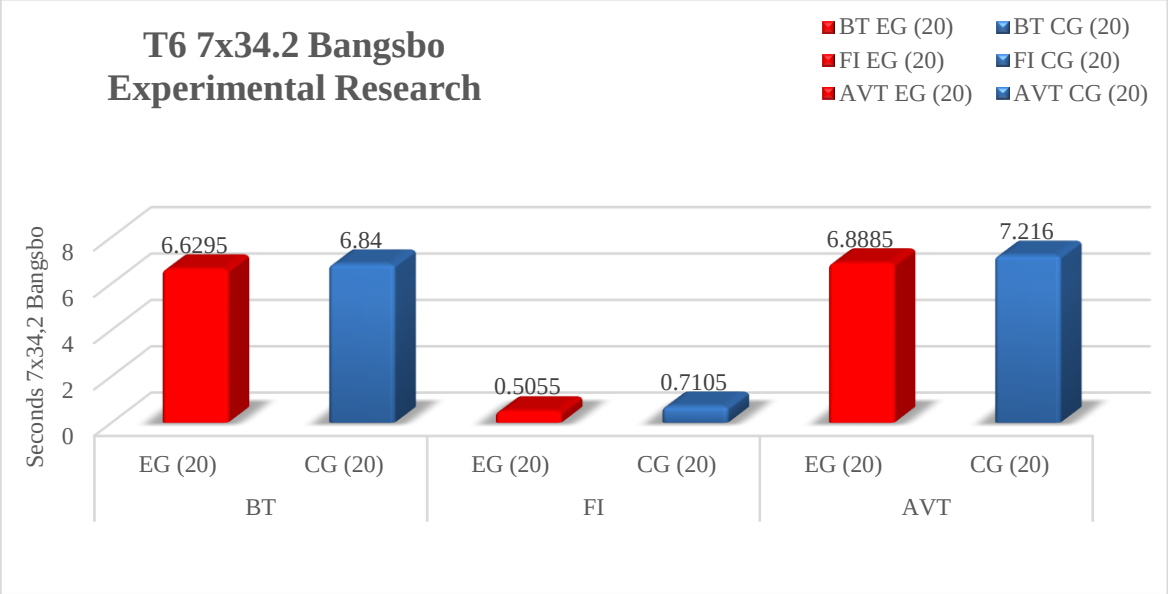

Table 20. Descriptive analysis, comparison of means and effect size, field test 7x34.2, by group, at T6 (N = 40)

Variable	Group	Mean	AS	ES	Test statistics t/U*	df.	Sig.	Cohen d
BT	EG (20)	6.6295	.17307	.03870	62.50*	38	.000	1.29
	CG (20)	6.8400	.17953	.04014				
FI	EG (20)	.5055	.14831	.03316	110.00*	38	.015	.92
	CG (20)	.7105	.29280	.06547				
AVT	EG (20)	6.8885	.10307	.02305	-6.997	38	.000	2.26
	CG (20)	7.2160	.18219	.04074				

Evaluation of speed and agility, Pro Agility field test 5-10-5

T-tests for independant samples and Mann Whitney U show that between the results of the two groups (Graph 20) there are not statistically significant differences (Table 21) at moments: T1 (t = -.768, df = 38, two-tailed p = .447, d = .20), T2 (t = -1.791, df = 38, two-tailed p = .081, d = .53), T4 (t = -1.616, df = 38, two-tailed p = 0.114, d = .54); in contrast, the differences between the mean scores of the two groups in this field test are statistically significant at moments: T3 (U = 88.50, N_1 = 20, N_2 = 20, two-tailed p = .003, d = .99), T5 (U = 92.00, N_1 = 20, N_2 = 20, two-tailed p = .003, d = .78) and T6 (t = -2.358, df = 38, two-tailed p = .024, d = .73).

Graph 20. Comparison of means, EG/CG, Pro Agility 5-10-5, experimental research

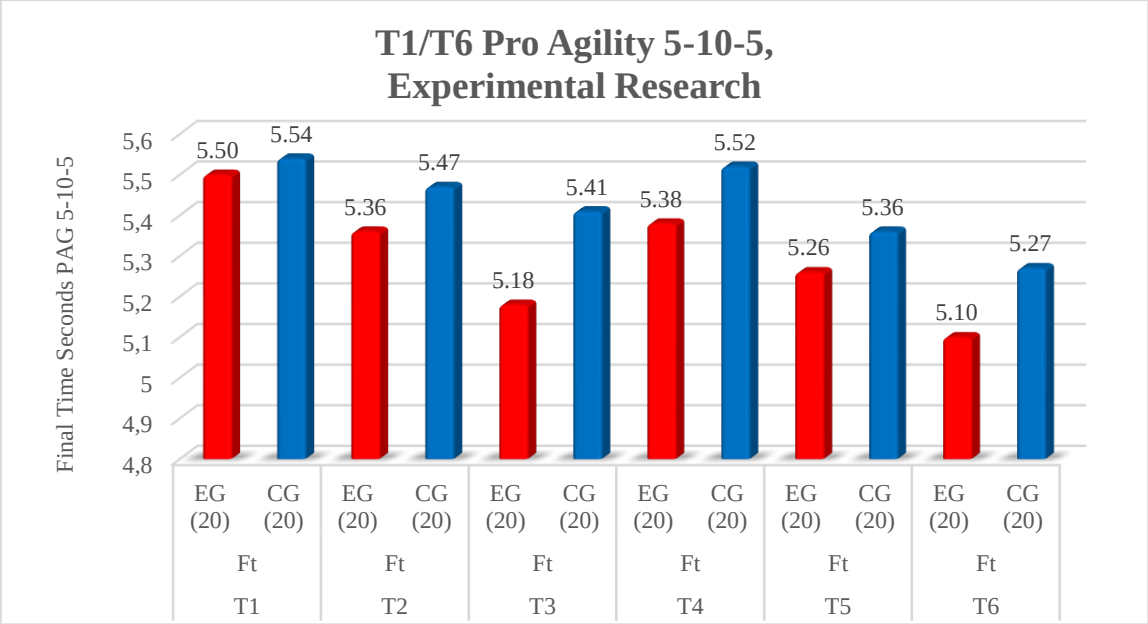

Table 21. Descriptive analysis, comparison of means and effect size, Pro Agility 5-10-5 field test by group at T1/T6 (N = 40)

Time	Variable	Group	Mean	AS	ES	Test statistics t/U*	df.	Sig.	Cohen d
T1	Ft	EG (20)	5.5010	.24645	.05511	-.768	38	.447	.20
		CG (20)	5.5495	.13801	.03086				
T2	Ft	EG (20)	5.3615	.16265	.03637	-1.791	38	.081	.53
		CG (20)	5.4795	.24560	.05492				
T3	Ft	EG (20)	5.1845	.15275	.03416	88.500*	38	.003	.99
		CG (20)	5.4155	.29795	.06662				
T4	Ft	EG (20)	5.3875	.18781	.04200	-1.616	38	.114	.51
		CG (20)	5.5290	.34371	.07686				
T5	Ft	EG (20)	5.2635	.10975	.02454	92.000*	38	.003	.78
		CG (20)	5.3660	.15682	.03507				
T6	Ft	EG (20)	5.1015	.17409	.03893	-2.358	38	.024	.73
		CG (20)	5.2795	.28916	.06466				

Note: Ft – final time, EG – experiment group, CG – control group

For the analysis of the effect of intervention programs on subjects in the two groups, the results recorded by the subjects between the six study moments were compared using the t-test for pairerd samples and Wilcoxon test. Thus, for the experiment group (Graph 21) the t-test for paired samples shows that the differences are statistically significant for the variable Ft (Table 22), between all measured moments: T1/T2 (t = 2.930, df = 19, p = .009, d = .66), T2/T3 (t = 3.664, df = 19, p = .002, d = 1.15), T1/T3 (t = 6.235, df = 19, p = .000005, d = .76), T4/T5 (t = 2.735, df = 19, p = .013, d = .76), T5/T6 (t = 3.649, df = 19, p = .002, d = 1.08), T4/T6 (t = 4.967, df = 38, p = .000086, d = 1.59), T1/T6 (t = 6.641, df = 19, p = .000002, d = 1.87).

Graph 21. Comparison of means, EG, Pro Agility 5-10-5, experimental research

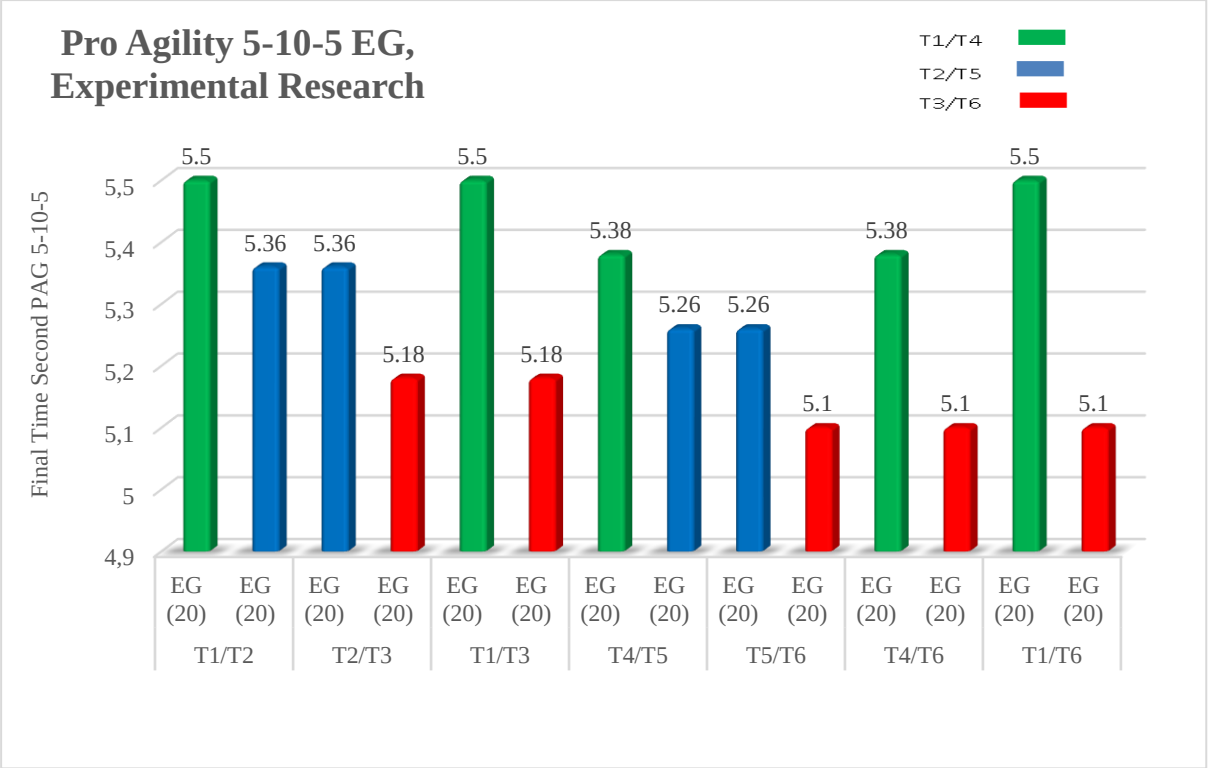

Table 22. Comparison of means and effect size, Pro Agility field test 5-10-5, variable Ft, experimental group, T1/T6 (N = 20)

		Paired Samples Statistics[a]			Paired Samples Test[b]		
Pair	Variable	Mean	Std. Deviation	t	df	Sig. 2-tailed	Cohen d
Pair 1	T1 PAG Ft T2 PAG Ft	5.5010 5.3615	.24645 .16265	2.930	19	.009	.66
Pair 2	T2 PAG Ft T3 PAG Ft	5.3615 5.1845	.16265 .15275	3.664	19	.002	1.15
Pair 3	T1 PAG Ft T3 PAG Ft	5.5010 5.1845	.24645 .15275	6.235	19	.000	1.52
Pair 4	T4 PAG Ft T5 PAG Ft	5.3875 5.2635	.18781 .10975	2.735	19	.013	.76
Pair 5	T5 PAG Ft T6 PAG Ft	5.2635 5.1015	.10975 .17409	3.649	19	.002	1.08
Pair 6	T4 PAG Ft T6 PAG Ft	5.3875 5.1015	.18781 .17409	4.967	19	.000	1.59
Pair 7	T1 PAG Ft T6 PAG Ft	5.5010 5.1015	.24645 .17409	6.641	19	.000	1.87

When comparing the control group means (Graph 22), the t-test for paired samples and Wilcoxon test show significant statistical differences for the variable Ft (Table 23) between moments: T4/T6 (t = 3.166, df = 19, two-tailed p = .005, d = .79) and T1/T6 (t = 3.919, df = 19, two-tailed p = .001, d = 1.11); the same tests show that there are no statistically significant differences for CG results between moments: T1/T2 (t = 1.298, df = 19, two-tailed p = .210, d = ,33), T2/T3 (Z = -1.288, two-tailed p = .198, d = .29), T1/T3 (Z = -1.954, two-tailed p = .051, d = .51), T4/T5 (Z = -1.792, two-tailed p = .073, d = .54), T5/T6 (Z = -1.158, two-tailed p = .247, d = .37).

Graph 22. Comparison of means, CG, Pro Agility 5-10-5, experimental research

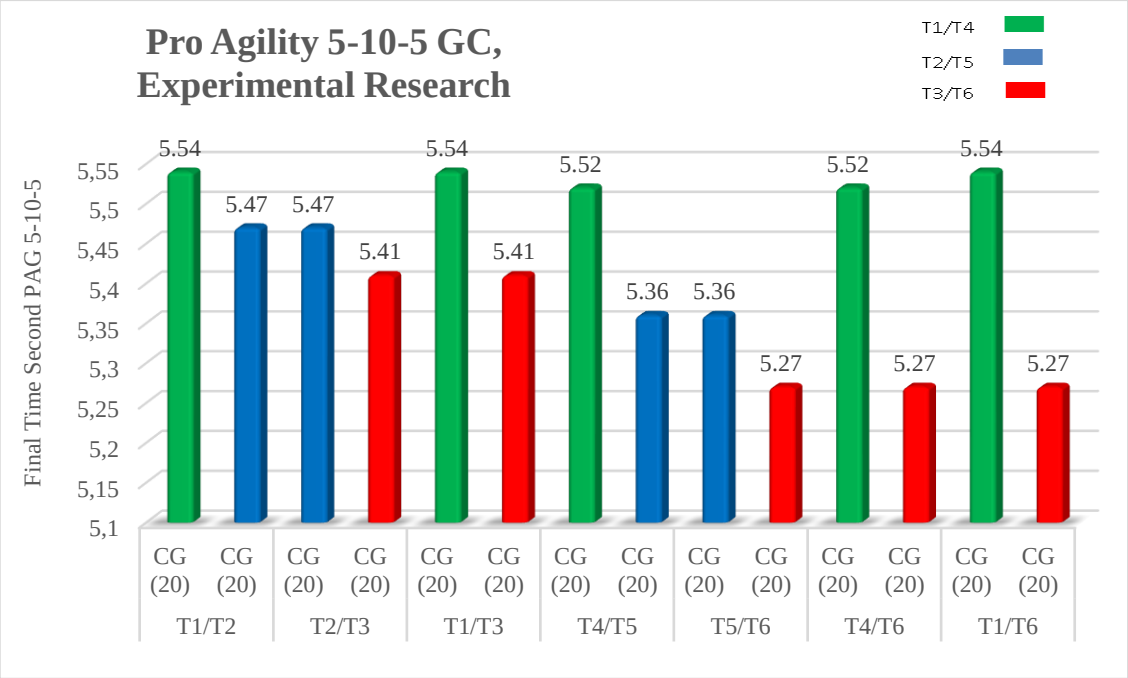

Table 23. Comparison of means and effect size, Pro Agility field test 5-10-5, variable Ft, control group (N = 20)

		Paired Samples Statistics		Paired Samples Test[a,b]			
Pair	Variable	Mean	Std. Deviation	t[a]/Z[b]	df	Sig. 2-tailed	Cohen d
Pair 1	T1 PAG Ft	5.5495	.13801	1.298[a]	19	.210	.33
	T2 PAG Ft	5.4795	.24560				
Pair 2	T2 PAG Ft	5.4795	.24560	-1.288[b]	19	.198	.22
	T3 PAG Ft	5.4155	.29795				
Pair 3	T1 PAG Ft	5.5495	.13801	-1.954[b]	19	.051	.51
	T3 PAG Ft	5.4155	.29795				
Pair 4	T4 PAG Ft	5.5290	.34371	-1.792[b]	19	.073	.54
	T5 PAG Ft	5.3660	.15682				
Pair 5	T5 PAG Ft	5.3660	.15682	-1.158[b]	19	.247	.37
	T6 PAG Ft	5.2795	.28916				
Pair 6	T4 PAG Ft	5.5290	.34371	3.166[a]	19	.005	.79
	T6 PAG Ft	5.2795	.28916				
Pair 7	T1 PAG Ft	5.5495	.13801	3.919[a]	19	.001	1.11
	T6 PAG Ft	5.2795	.28916				

Notă: a.t-test; b.Wilcoxon Signed Ranks Test, Ft – final time, PAG – Pro Agility Test

5.4 Discussions

Bangsbo, Iaia, & Krustrup (2008a), shows that the distance athletes run in YYIRTL1 is directly proportional to their aerobic possibilities. Another study shows that YYIRTL1 is an objective and effective assessment test to determine the specific resistance of footballers, by age or field position (Markovic & Mikulic, 2011).

The analysis of the data from the YYIRTL1 field trial evaluations shows that significant progress has been made in the experiment group compared to the control group. Significant progress was also observed between initial and final testing at experimental group, with the intervention program with small sided football games generating the proposed effects.

The results of the two groups do not show significant statistically differences for any of the parameters measured by the YYIRTL1 field test, the groups being homogeneous at the moment T1.

In contrast to T1, the results recorded in T3, the YYIRTL1, show statistically significant differences between the two groups at all measured parameters. Compared with the results obtained by CG at T3, performance of EG shows that participating in a 21-week training program with small sided football games develops aerobic effort capacity in 16—18 year athletes.

For T4, the results obtained by the two groups differ statistically significantly only at one parameter, which indicates the holding minutes in zone Ae<81%HRmax. Even if the T4 was performed after a short holiday period, the values obtained at this parameter show that the training program applied to EG athletes has resulted in significant changes in capacity and aerobic power compared to the training schedule followed by the athletes in the CG.

The final evaluation at YYIRTL1, T6, confirmed that a small sided football games training program develops the effort capacity of athletes compared to the use of classic training methods. All parameters measured by the YYIRTL1 field test, show significant statistical differences of athletes from EG compared to the results obtained in the same test by CG athletes. If no significant statistical differences between the two groups have been obtained in preliminary research, at the parameter indicating the holding time in the aerobic zone<81%HRmax, in the case of experimental research, it is demonstrated that better standardization of the intervention program improves the performance of athletes for this variable, indicating aerobic capacity. The size of the effect for all analyzes performed in this test, T6, is high, indicating that the intervention program can be successfully implemented in a training methodology aiming in developing effort capacity.

The differences between the T4/T6 and T1/T6, of athletes from EG, represent statistical significance for all the parameters measured by the YYIRTL1 field test. By comparing the data obtained in the second row, but also looking at the high statistical significance between T1 and T6 moments, we demonstrate that participating in a standardized training program with small sided football games over a longer period of time, improves the physical potential of athletes.

The results obtained by CG in the YYIRTL1 field test show significant statistical differences between moments T1 and T3, after 21 weeks of training. These results obtained by CG athletes at YYIRTL1 show that, after a longer period of time, also the training that included classical exercices, develop the physical potential of athletes.

In the 7x34.2 m Bangsbo field test the results obtained in T1 do not differ significantly between the two groups in any of the measured parameters BT, AVT and FI. After 8 weeks of trainings specific to the preparatory period and 13 weeks of trainings typical to the competition period, EG's performance at T3, 7x34.2 m Bangsbo, shows significant statistical differences

compared to the results achieved by CG, which followed classical exercise training during this period. As well as at T1, the results obtained in T4 do not show any significant statistical differences between the two groups on any of the measured parameters. After a similar period of preparation as in macrocycle 1, EG's results in T6, 7x34.2m Bangsbo, show significant statistical differences compared to the results achieved by athletes in the CG.

The results obtained at 7x34.2m Bangsbo field test, which shows significant differences also between both groups and between repeated measurements for EG, show that a small sided games football training program develops speed endurance.

The conduct of repeated sprints (<10s) with breaks (<60s) results in changes in both anaerobically metabolism, the consumption and recovery of ATP and CP reserves, as well as the consumption and recovery of ATP through oxidative phosphorylation (Girard et al., 2011). Making repeated sprints involves repeating 5-6 speed runs at maximum intensity, lasting 3-10 seconds, interlaced with incomplete recovery breaks of less than 30 seconds (Arjol & Gonzalo, 2012; Clivetti, 2014, p. 91). Getting a good average of total sprints time while maintaining the same breaks, but also low fatigue index values, shows a high level of the common physical quality of team sports, speed endurance (Girard et al., 2011).

The results obtained from the Pro Agility 5-10-5 field test do not show any significant statistical differences between the two groups either at T1 or at T2. After 21 weeks from T1 and 13 weeks from T2, the results obtained by the two groups at T3 show significant statistical differences in favor of athletes from EG. It is demonstrated that after 21 weeks of small sided games football training, athletes' speed and agility performance as measured by the Pro Agility 5-10-5 field test is significantly better than the results of athletes who have been trained with classic exercises.

The results obtained at T4 in the second part of the research show no significant differences between the two groups. The results obtained by the two groups at T6 show significant differences, with the final time at Pro Agility 5-10-5 being much better for the athletes from EG. This demonstrates that application of a small sided games football training program develops speed and agility.

The results of the EG'athletes at T1, the Pro Agility 5-10-5, show no significant statistical differences compared to T2, but we see significant differences between T2 and T3, after 13 weeks of small sided games football training. Similar to the training period between T1 and T2, EG's Pro Agility 5-10-5 results do not show any significant statistical differences between T4 and T5. The performance achieved at the same test by EG'athletes, at T6, shows significant statistical differences compared to the T4 or T1, which shows that the applied intervention program has been effective.

Compared to EG's results where we have seen significant statistical differences between moments evaluated, after 13 weeks of training, CG' results, at Pro Agility 5-10-5, are not statistically significantly different between moments T1,T2,T3,T4,T5. The first significant statistical differences are observed between moments T4/T6 and T1/T6. These results show that traditional trainings can also improve the speed and agility of athletes, but after a longer period of training.

The method of small sided football games in training is common in both amateur and professional football training programs, as well as its effectiveness in developing technical-tactical skills being used successfully to improve physical capabilities (Hil-Haas, Dawson, Impellizzeri, & Coutts, 2011). However, in order to achieve better physical performance, it is indicated to standardize and rationalize small sided games with rigor, taking into account the rules used in training, in relation to factors influencing the intensity of the effort specific to football (Billat, 2002, pp. 41-42; Hil-Hass et al., 2011).

5.5 Conclusions

- A 12-month small sided games football training program can improve the physical performance of 16—18-year athletes.
- Compared to the preliminary research, the longer period of deployment, but also the improvement of the content of the intervention program, have significantly increased the aerobic performance for the athletes in the experimental group.
- The constant re-standardization of the exercises used in the intervention program, simultaneously with the adaptation of the athletes' organism to the effort stimuli, has positively influenced the physical potential of the athletes.
- The development of a small sided game content model in training, through physiological measurements of sportsmen, can make the way of directing the training process more efficient.
- Performing repeated measurements through specific field tests that covered both the areas of aerobically and anaerobically effort gave us the possibility to control and direct the training program.
- The physiological profile of athletes according to the effort zones can be determined by monitoring the intensity of the training effort.
- The results obtained confirm the assumption that the use of small sided games in football training is an effective method for the physical training of athletes.

- After a long period of preparation both methods produce improvements in athletes' effort capacity, but the effects of small sided football games training are superior than traditional practice training.
- The hypothesis of experimental research is confirmed.

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