

NATIONAL SPORTS ACADEMY "VASIL LEVSKI"

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**AN EXPERIMENTAL MODEL FOR DEVELOPING SPEED
ABILITIES IN 17-18-YEAR-OLD FOOTBALL PLAYERS**

ABSTRACT

of a dissertation for the award
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The dissertation was discussed at the internal defense and proposed for official defense by the Department of Football and Tennis at 'Vasil Levski' National Sports.

The work contains 229 pages, illustrated with 24 tables and 43 figures. The bibliography (sources of reference) includes 196 literary and documentary sources, of which 92 in Cyrillic and 104 in Latin.

The public defense of the dissertation thesis for the award of the educational and scientific degree of "Doctor" will take place on 11.02.2025 at 14:00 in Franz Beckenbauer Hall of 'Vasil Levski' National Sports Academy (Studentski grad, Sofia) at a meeting of a specialized scientific jury. The materials for the defense of the dissertation are available in the library of 'Vasil Levski' National Sports Academy.

INTRODUCTION

Football is one of the most popular and loved sports worldwide. It requires a combination of technical skill, tactical training, physical strength and mental toughness. However, one key motor quality that sets successful players apart from the rest is their speed.

Despite its importance, speed development is often overlooked in traditional football training programs, resulting in a lack of focus on specific training activities to improve athletes' speed abilities.

The present study aims to investigate effective strategies to improve agility and speed in 17-18-year-old football players. Through an in-depth literature review, we will discuss various factors that influence the development of speed capabilities, including physiological and psychological ones. Alongside this, we will examine existing training programs and methodologies used in the sport, and their impact on improving speed in young football players. We will elaborate some practical recommendations for coaches and athletes who want to positively impact the development of speed capabilities in adolescent players. Finally, based on an experimental design whose main goal is to develop and implement an effective model for maximizing speed potential in 17-18 year-old athletes, we will design a project including a combination of conditioning exercises, running techniques and periodization tailored to the age and need of the players.

The main outcome of this research project is the comparison of changes in speed capabilities between the experimental and control groups after a six-month implementation period.

CHAPTER ONE

I. STATE OF THE PROBLEM ACCORDING TO LITERATURE SOURCES

I.1. Specifics of the manifestation of the motor quality speed and theoretical-methodical considerations in its development

From the analysis of a significant number of sources, as well as those from the digital sphere, we have established that many specialists in the field of sports science are working hard on the topic of developing the speed capabilities of football players. And this is actually and undeniably explained by the fact that the improvement of speed abilities of athletes is directly dependent on sports improvement (E. Atanasov, 2013, 2018; L. Dimitrov 2002, 2012, 2023; Yu. Nikolov, 2015; M. Gudev, 2002; K. Aladzhov, 1986; M. Bachvarov, 1992; L. Krastev, 2005; D. Avramov, 2002; A. Shishkov, 2001; K. Rachev, 1971, 1999, etc.).

By its nature, speed is a highly genetically determined motor ability that, according to Milenković (2011), reflects an individual's ability to move from one place to another as quickly as possible. In this regard, many authors believe that even with well-planned and well-conducted training that takes into account the individual abilities of athletes, there is very little chance of developing this ability in its original "pure" form (Milenković, 2011).

On the other hand, football as a game is constantly evolving and teaching at the same time. New trends in football training, precise analysis of the opponent, different types of tactical approaches used by coaches in order to achieve ultimate success appear. Often, looking for details that decided the ultimate success, we get information that speed was decisive or the team won because it played football faster. Exploring speed in football, it is common to come across the statement that "football is getting **faster** and **faster**".

Understanding the concept of "speed" in most cases is related to several factors. Based on our own observations and analyses of the literature sources (P. Chmura, 2016, 2019; L. Dimitrov, 2002, 2012; Yu. Nikolov, 2015; M. Gudev, 2002; K. Alajov, 2013; E. Atanasov, 2013, 2018, etc.) we could define speed as follows:

1. Speed of perception - perceiving, receiving, processing and evaluating information related to the game and its relationships using the senses, i.e. vision, hearing.

2. Anticipation speed - anticipating situations, predicting the actions of the opponent, partner and the development of the game based on knowledge from own experience and the current situation.

3. Speed of decision making - selecting a decision in the shortest time, leading to finding an effective action from many options.

4. Speed of reaction - the shortest possible reaction time in surprising situations related to the actions of the opponent as well as the partner.

5. Speed of movement - performing movements at maximum speed (maximum speed of movement) with and without the ball, often under pressure of time, space and opponent.

6. Speed of action - acting effectively in the game at maximum speed, taking into account the comprehensive capabilities of the game in terms of cognitive, technical-tactical and physical skills.

As these six manifestations of speed capabilities largely cover the requirements of the specificity of the football game and do not claim to be exhaustive, but we derive them according to the specificity of our study. Considering the components described above, we can note that movement speed, i.e. the speed developed by players, is only one of the components. And if the player has potential in speed qualities, it is all the more worth focusing on other areas of speed and develop this player in those areas where there are still reserves.

I.2. Specificity of manifestation of the motor quality of speed in football

Based on the specificity of the manifestations of the motor quality of speed in football, Milenković (2011) divides it into three main lines of manifestation. As the first manifestation, he points out that speed which determines the speed of movement without the ball or as the author defines it - "pure speed", the second manifestation is the speed of movement with the ball, and as the third manifestation he brings out the speed of the first step.

Several factors can affect speed in football players. These factors can be broadly categorised as physiological, psychological and tactical. The physiological factors are strength and power. Muscular strength and power are critical to generating speed. Players with greater muscle strength can usually run faster and longer. This is evidenced by Cross, M. R., et al. (2018), Hill, M. D., et al. (2004), Wilson, R.J., et al. (1997) who suggest that strength, explosive power and muscular endurance are important factors that contribute to high running speed in elite football players. In addition to strength, we should also consider flexibility. Greater flexibility allows for more efficient strides, resulting in increased speed. Along these lines are the results of a study by M. Hutchinson (2000) who found that "ankle and knee flexibility is a critical factor in achieving high running speeds in the game of football" , while reducing the risk of injury.

Another group of factors determining the specificity of the manifestation of the speed and, respectively, the speed abilities of the football player are psychological. Here we should pay attention to motivation and focus. A high level of motivation and concentration can help the players to perform to their physical abilities and potentially improve their speed.

Confidence also makes a huge difference. Confident players often perform better as they tend to make the right decisions and act more efficiently. The ability to deal with stress and anxiety also has an impact.

Tactical preparation is also a factor that determines the manifestation of the abilities under consideration (Young, W & Rogers, N, 2004; Cronin, J., & Mortimer, J., 2007). Certain game management strategies, such as effective use of space or combining with other players, can help increase speed by creating favourable running opportunities (M. Andrzejewski et al., 2010).

I.3. Approaches and methodologies for developing speed in football players

One of the specifics in developing quickness in football, discussed by authors such as Milenković (2011), V. M. Smirnov, V. И. Dubrovsky (2018), Ts. Zhelyazkov (2012), L. Dimitrov (2021), M. Gudev (2002), P. Nyagin (2020), R. Stoyanova (2019), Yu. Nikolov (2015, 2023), E. Atanasov (2013, 2018), is that the improvement of motor quality can be realized indirectly by improving the movement technique and by working on the development of the necessary muscle groups.

The main objective of training aimed at developing speed is to improve the human body's ability to perform high-intensity activities in a short period of time. Although the parameter of the relationship between speed, resistance and duration varies according to the nature of the motor activity, specific adaptation of the neuromuscular system requires consistent and purposeful loading under certain conditions. In order to stimulate the majority of motor units in muscle fibers without completely depleting creatine phosphate stores, exercise should last from 3 to 7 seconds.

The movements should be cyclical, involving moments of rhythmic muscle activation and relaxation. Rest periods should ensure complete recovery of creatine phosphate stores and removal of the lactate that forms. Active rest lasting 45-70 seconds is also key. The recommended number of repetitions in a workout is 15-40, with workouts performed 1-2 times per day. The number of training days of this type in a weekly cycle can vary from 2 to 4 depending on the specific period.

The guiding principle that dictates exercise dosage and intensity is to work at full recovery with the elbow completely removed. This is also the basis for specific systematic goals to impact quickness, which is a fundamental motor quality. Improve absolute speed by focusing on high frequency innervations, low resistance and short execution times. In addition, increase the level of special strength training by incorporating plyometric, sprint and other dynamic-oriented exercises (L. Dimitrov, 2002; Hill, M. D., et al. 2004; Wilson, J. M., et al. 2009; Young, W., & Farrow D., 2013).

CHAPTER TWO

II. AIM, OBJECTIVES, METHODOLOGY AND ORGANIZATION OF THE STUDY

II.1. Aim and objectives of the study

The analysis and interpretation of literature sources, as well as the subsequently derived working hypothesis, led us to derive the aim of the present study, which is to create and approbate an experimental model for training and education of 17-18-year-old football players aimed at increasing their speed capabilities.

In order to realize our goal we set the following research tasks:

1. Study and analysis of the problem from literature sources.
2. Development of a questionnaire aimed at investigating the current state of youth clubs in terms of their activities with adolescent footballers.
3. Selection of a test battery to determine the level of speed ability of 17-18-year-old football players.
4. Development and validation of a six-month experimental training model aimed at developing the speed of 17-18-year-old football players.
5. Define reasoned conclusions and recommendations based on the research conducted and subsequent data analysis and interpretation.

II.2. Subject, object and population of the study

The subject of the present study are the changes in the speed abilities of football athletes aged 17-18 years, as well as the ways of optimization of the training and competition process characteristic for the respective age group.

The object of the study in this dissertation is the influence of the developed six-month experimental training model on the speed abilities of 17-18-year-old football athletes.

The contingent of the study was a total of 29 football players from PFC "Lokomotiv" (Sofia) and Football Development Academy. The players from the Football Development Academy formed the experimental group and those from PFC Lokomotiv (Sofia) formed the control group of the study.

B The study also included 53 licensed football coaches who participated in the survey.

II.3. Research Methodology

The experimental work was carried out with the players from the Football Development Academy, who were preparing for 6 months at the National Training Base in the district. We have been training for 6 months in Boyana. For the same period of time, the control group, composed of players of PFC Lokomotiv (Sofia), trained according to the training methodology generally accepted in the club. After the end of the experiment, testing was again conducted on the exercises included in the test battery. The control tests of the experimental work were conducted on the artificial field of the NSA Vasil Levski in March 2023 and 6 months later, in September 2023. Two consecutive days were required to conduct the tests. On the first day, the control group was the testing contingent and on the second day, the experimental group.

II.4. Organisation of the study

In the process of experimental research in the period from the end of 2021 to August 2024, in terms of the implemented exploratory, organizational and research work, the following stages can be distinguished:

Stage I - from November 2021 to May 2022, where the priority was the implementation of the following activities:

- Familiarization, study and analysis of literature sources concerning general and specialized problems on the subject of the dissertation.
 - Prior targeted pedagogical observation and experimentation of certain tools in the training process.
 - Selection of tests to control and assess the speed abilities of the subjects.
 - Formulation of the objective and development of the working hypothesis of the study.
 - Selection of experimental and control group.
-
- Development of an experimental training model aimed at developing the motor quality of speed and respectively improving the speed capabilities of athletes, relative to the specific age group.

II stage - from June 2022 to February 2023, with the following activities:

- Conduct initial player testing.
 - Conducting a survey with football coaches on the speed abilities of players in the SSC and the percentage of speed work in the training process.

Stage III - from March 2023 to October 2023, in which the following activities were carried out:

- Organization and conducting of the pedagogical experiment.

- Conducting retesting of the participating football players after 6 months.
- Inputting the data from the first and second testing in tabular form.

Stage IV - November 2023 to August 2024, characterised by the following activities:

- Mathematical and statistical processing, analysis, conclusions and summary of the research data.
- Final shaping, structuring and writing of the dissertation.

II.5. Methods

For the realization of the set goal and accomplishment of the tasks we used the following scientific methods:

- 1. Research, analysis, conclusions and synthesis from literature.**
- 2. A survey regarding the place in the training cycle for developing speed.**
- 3. Pedagogical observation and analysis of the motor-cognitive activity of football players aged 17-18 years**
- 4. Sports Pedagogical Experiment**
- 5. Sports Pedagogical Testing**

A test battery of 18 tests was developed based on the aim and objectives concerning the experimental model to develop the speed abilities of 17-18-year-old football players.

Table 1. Test battery

№	Name of the test	Sign	Measuring unit	Direction of Increase
1.	Height in standing position	Physical development	cm	+
2.	Body weight	Physical development	kg	+
3.	Somatotype	Physical development	%	
4.	Analysis of anthropometric features and indicators of body build	Physical development	kg/cm	
5.	Long jump with two legs from location	Dynamic strength	cm	+
6.	High jump from one foot	Explosive force	cm	+
7.	High jump from two feet	Explosive force	cm	+
8.	30 m sprint from walking without a ball	Speed	sec	-
9.	30 m sprint from jogging without a ball	Speed	sec	-
10.	30 m sprint from walking with a ball	Speed	sec	-
11.	30 m sprint from jogging with a ball	Speed	sec	-
12.	20 m sprint with change of direction every 5 m at 45° from walking without a ball	Speed	sec	-
13.	20 m sprint with change of direction every 5 m at 45° from jogging without a ball	Speed	sec	-
14.	20 m sprint with change of direction every 5 m at 45° from walking with a ball	Speed	sec	-
15.	20 m sprint with change of direction every 5 m at 45° from jogging with a ball	Speed	sec	-
16.	Complex speed without a ball	Speed	sec	-
17.	Complex speed with a ball	Speed	sec	-
18.	Cognitive speed	Speed/ psychomotor	Number/ errors	+

II.6. Experimental model

The model we created includes 24 sessions integrated during the competition and preparation period in the training cycle of the experimental group. The majority of them are as individual exercises, while the rest are as complete training sessions. The emphasis in the last two training sessions was on the tests included in the test battery. In one the exercises were performed without a ball and in the other with a ball. When we resorted to the use of isolated means, these were followed by drills with the following focus:

1. High-intensity interval training.
2. Training for speed-strength endurance.
3. Workouts to increase anaerobic capacity.

The complete training sessions aimed to improve and improvement of:

1. The mental abilities of the players.
2. Individual sprinting technique.
3. Individual football technique.

Based on the positive results achieved after the application of the model in the training program of the experimental group, we have grounds to claim that the applied means and methods had a beneficial impact on both the speed abilities of the players and their overall performance. The applied exercises help to improve the muscular explosiveness and the speed of the nervous system and, consequently, to activate the muscle fibres more quickly and, consequently, to produce force more quickly.

The aim of the experimental model is to provide specific situations contributing to the improvement of the relationship between motor habit and motor qualities, in particular football technique - speed - explosiveness, after the application of isolated influences in a game setting.

Experimental model highlights:

- explosive power and explosiveness;
- focus on the first step and reducing the contraction;
- sprinting technique and change of direction technique;
- starting reaction and acceleration;
- ball control and coordination.

Focus	Training				Focus & objective of the training
<i>Explosive force lower limbs</i>	<i>1</i>				<i>Anaerobic capacity</i>
Plyometrics and focus on the first step	Number of repetitions	Number of participants	Number of series	Duration	
	10	20	2	15 min	

Implementation:



5 players on the goal line. 4 lines. Starting position - on knees. On signal from coach, bounce up and sprint to penalty area line - 11 metres. Reducing the counter-step and maximizing a big and powerful first step. Enough rest time between repetitions.

Focus	Training				Focus & objective of the training
Explosive force	2				Aerobic power
lower limbs					
Explosiveness and changing technique of direction	Number of repetitions	Number of participants	Number of series	Duration	
	10 per leg	20	2	15 min	



Implementation:

Starting squat position on one leg, knee of the other leg almost resting on the grass. Hands are in a swinging position. Explosive and abrupt upward knee extension, pivoting body on toes of supporting leg and landing at 45 degrees to starting position. One series inward rotation, other series out. 5 groups of 4 players. Each working individually under the supervision of a coach.

Focus	Training				Focus & objective of the training
<i>Agility /Speed capacity/</i>	3				<i>Aerobic power</i>
Explosiveness and changing technique of direction	Number of repetitions	Number of participants	Number of series	Duration	
	5 per leg	20	2	25 min	



Implementation:

5 groups of 4 players.

2 hats 1 m apart. Starting position - on one leg, the other bent at the knee at hip level, hands on the waist.

3 bounces from hat to hat. On the last one turn the body 90 degrees, with the supporting leg stepping on toes that point in the direction to be sprinted.

Emphasis on the first step.

Maximum sprint of 30 metres.

The second set is sprinted to the other side. Ample rest time between repetitions.

Focus	Training				Focus & objective of the training
Speed abilities	4				Aerobic power
Explosiveness, changing technique of direction and first step	Number of repetitions	Number of participants	Number of series	Duration	
	10 per leg	20	1	20 min	

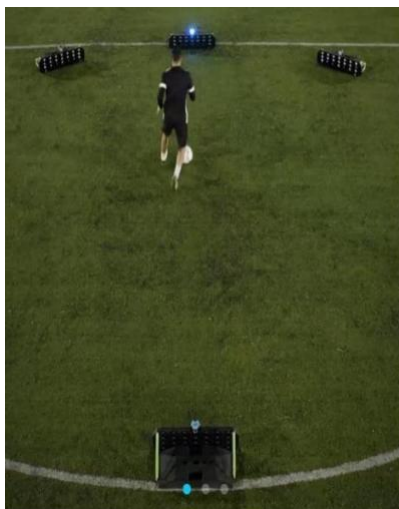
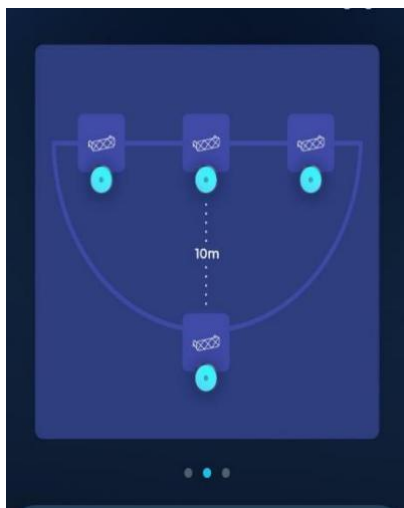


Implementation:

5 groups of 4 players.
2 caps by 5 meters from each other. Starting position - the player has stepped with both legs of ground. At a signal from coach, they set off quickly back without counter-step, to the second cap. There they step with the supporting toes and then sprint forward with as large as possible and powerful step.

Maximum sprint 30 meters.
Enough time for relaxation between repetitions.

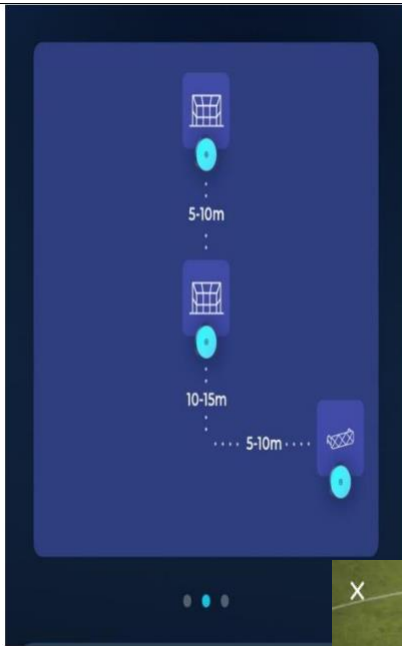
Focus	Training				Focus & objective of the training
Cognitive Speed, technique with ball	5				BTI
Scan, flipping with a ball, pass	Number of repetitions	Number of participants	Number of series	Duration	
	2x30 sec	20	2	30 min	



Implementation:

1 small goal at 10 metres from three benches. Player with ball. The player aims at the goal or a bench where the BlazePod lamp lights up. Scan, reaction, ball control, accuracy.

Focus	Training				Focus & objective of the training
Cognitive Speed, technique with ball	6				BTI
Scan, mastering, ground shooting or by air	Number of repetitions	Number of participants	Number of series	Duration	
	2x30 sec	20	2	30 min	



Implementation:

2 goals at 5-10 m from each other. A player with a ball at 10-15 m from the first goal. A bench to the side at a distance of 5-10 m.

Coach with balls.

Controlling the ball from the coach, playing with the bench and shooting at the goal where the BlazePod lights up.

CHAPTER THREE

III. ANALYSIS OF RESULTS

III.1. Analysis of the results of the survey among coaches

The results of the survey we distributed to coaches reflect a variety of perspectives on the dissertation topic. The analysis and interpretation of its data served us as reference points in clarifying the individual details of the developed methodology for developing the speed capabilities of adolescent football players. In the survey, conducted using the online tool Google Forms, 53 Bulgarian coaches volunteered, whose opinion we analyze next. All fifty-three respondents are UEFA licence holders.

Although many good practices have been established in terms of developing speed, a significant question is whether and to what extent the youth schools of the clubs in the country are working on developing speed. Therefore, we took the liberty to ask the question "Is speed development being worked on in youth clubs?". We visualize the respondents' answers in Figure 1.

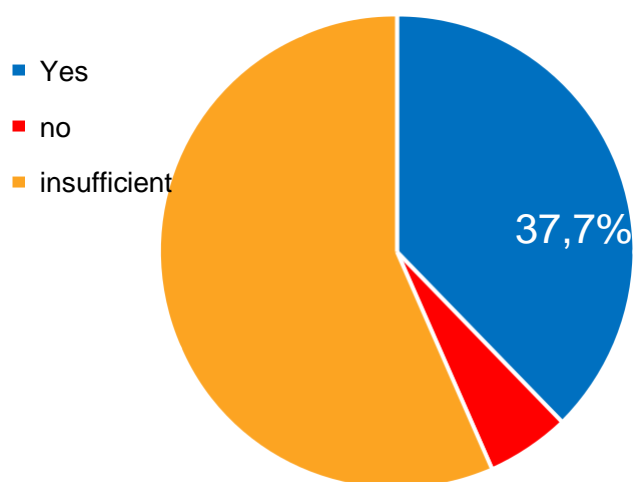


Figure 1. *Distribution of responses to the question "Is there any work being done to develop speed in the CJS?"*

Summarizing the opinion of the surveyed Bulgarian coaches in the field of football, we can say that not enough is being done in the youth schools to develop the speed abilities of the players. We confirm this statement with the data presented in Figure 1, where we see that 56.6% support this thesis, and 37.7% are of the opposite opinion, namely that enough attention is paid to the development of speed in the training process. This difference of almost 20% convinces us of the necessity of developing a specialized model to positively influence the capabilities of football players as far as the considered motor quality is concerned.

Considering this and the theoretical and methodological formulations we identified based on multiple literature sources, we asked a question to determine the views of Bulgarian coaches on the nature and type of this first step before sprinting. Here, we gave the respondents the opportunity to choose between three possible answers that we encountered most frequently in the scientific literature, namely - large, small or not relevant. The data from the responses of

respondents on the first step in sprinting are shown in Figure 2.

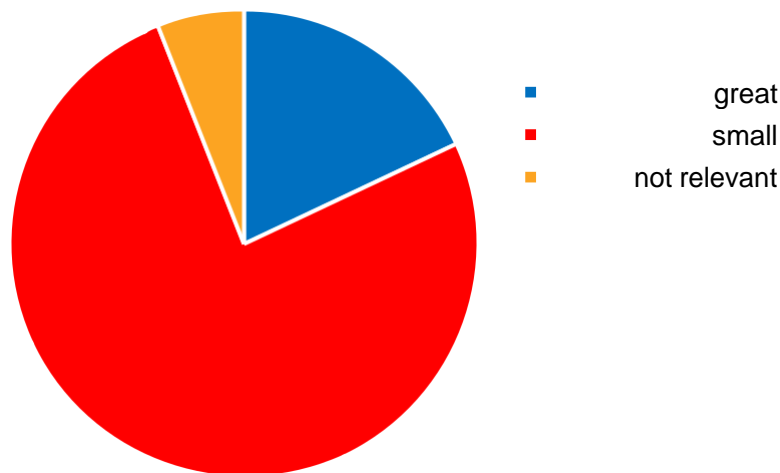


Figure 2. *Distribution of responses to the question "What should be the first step in sprinting?"*

Quite a high percentage of specialists (76%) believe that the first step should be small, and only 18% defend the thesis of a large first step, while 6% are of the opinion that the first step in sprinting is not important. In the dissertation we have developed, we will try to defend our working hypothesis based on the statistical data and relevant analyses after the first testing before the implementation of the experimental model and the second study after the implementation of the project, that the first step in football should be large and powerful.

In the following Figure 3 we reflect the attitude of Bulgarian coaches towards the reduction of the contraction in the speed work in the CJS.

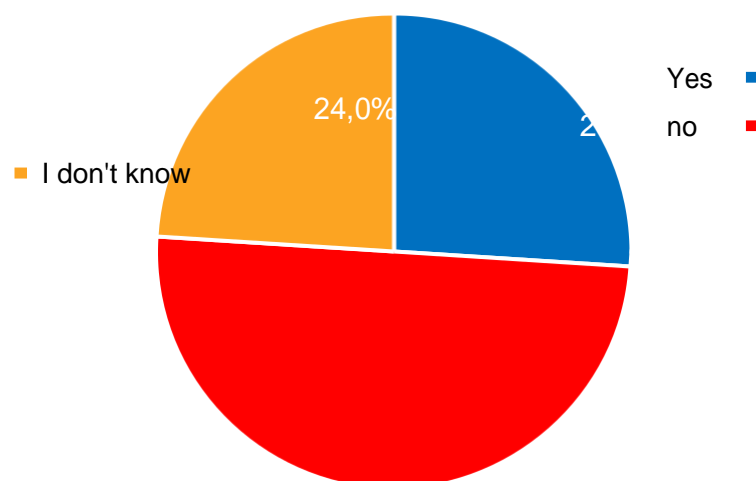


Figure 3. *Distribution of responses to the question "Is the CJS working to reduce the contraction?"*

50% of the responses indicate a lack of targeted work on contraceptive elimination. Approximately equal % support the thesis of sufficient attention to this case, 26%, and 24% who are not at all familiar with the problem. For us, 50% is not sufficient regarding targeted work to reduce the step in question. This gap is due to insufficient theoretical and methodological training in half of the coaches surveyed and, accordingly, insufficient awareness regarding the development of motor qualities and overall physical training in adolescent football players. The lack of information regarding the contraction and its parasitic influence on speed capabilities in adolescents also supported our idea of creating a specialized project for developing speed in 17-18-year-old football players. And one of its main mainstays is the improvement of this very first step in starting, which is also largely related to multiple cognitive influences and consequently changes in athletes' stereotypes.

III.2. Analysis of anthropometric traits and body build indices of the persons included in the experimental work

Body build is considered as a set of two components: active body mass and amount of adipose tissue. In sport, the determination of body build and anthropometric traits is an important part of the overall competitive modelling process. Anthropometric characteristics correlate with sport-specific performance, as there is mutual conditioning between the shape, size of the human body and motor performance qualities.

On this basis before the start of the experimental work

We performed an anthropometric study included in the experimental work of adolescent football players. These data also largely served us as a starting point for the development of the methodology for developing speed, which we should approbate in real training conditions.

In Table 2 we see the data from the analysis of variance.

Table 2. *Data from the analysis of variance of individual anthropometric indicators*

	n	Min	Max	\bar{X}	S	V%
Age	49	15,4	18,1	17,1	,7	4,1
Weight (kg)	49	50,0	85,3	68,1	8,8	12,9
Height (sm)	49	160,0	192,0	176,6	6,7	3,8
Protein (kg)	49	8,8	15,3	11,8	1,4	12,2
Minerals (kg)	49	2,9	5,3	4,1	,5	12,7
Fat mass (kg)	49	3,6	19,5	8,6	3,1	36,3
Fat mass %	49	6,0	23,7	12,4	3,4	27,5
FFM (kg)	49	44,3	76,2	59,5	7,1	12,0
SMM (kg)	49	24,7	43,8	33,7	4,3	12,8
BMI (kg/m) ²	49	18,3	26,8	21,8	2,0	9,3
BMR (kcal)	49	1326,0	2016,0	1655,3	154,2	9,3
Growth (score)	49	59,0	135,0	98,8	14,1	14,3

Table 2 gives us information on the homogeneity of the parameters studied. At a coefficient of variation up to 12% the parameter under study is defined as homogeneous, from 10 to 30% a relatively homogeneous sample, above 30% the sample is not homogeneous. We can see that only the parameter adiposity measured in kilograms comes out above a relatively homogeneous sample. This result is due to the fact that we found three athletes with overweight BMI and adipose tissue values among the subjects.

Somatotype is a quantitative assessment that determines the shape of the human body. The somatotype is a three-digit score containing the respective components of endomorphy, mesomorphy and ectomorphy, the latter always being written in the order indicated. The first digit defines the endomorphic component. Refers to the relative fullness or leanness in the individual physique. Low values indicate poor fat development. The second digit characterizes mesomorphy and refers to musculoskeletal development. Low values tell us about poorly developed musculature и light skeleton. The third figure refers to the ectomorphic component. It gives an idea of the relative elongation of the segments of the human body (Toteva, M., 1992).

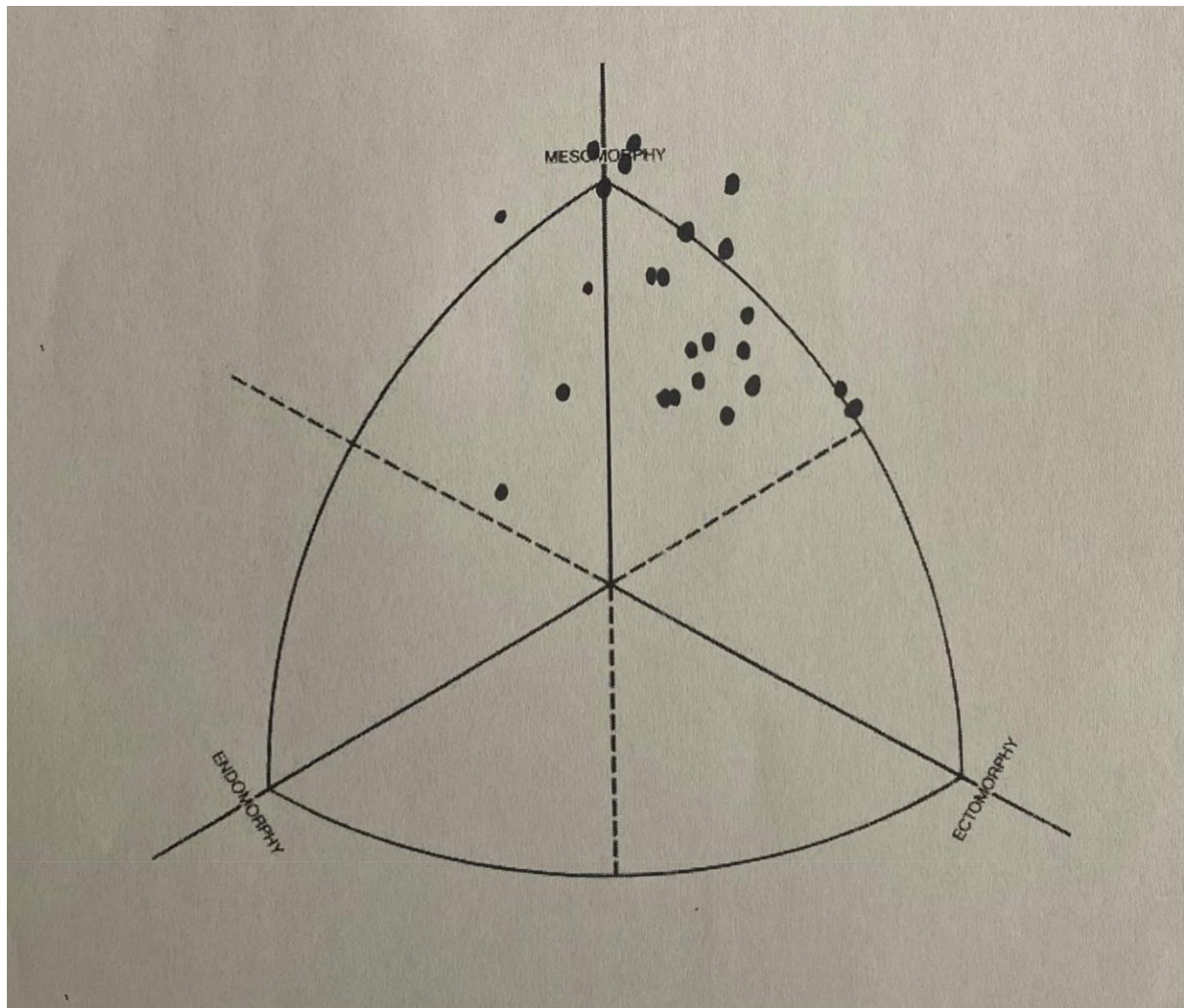


Figure 1. *Somatic map of football players at the age of 17 years*

In Figure 4, we see that four players move significantly away from the point cloud formed by the other players. We made a reference to the playing position they occupy, and we were informed that these four cases refer to the four goalkeepers. They were diagnosed as endomorph-mesomorph. The majority of the examined football players at the age of 17 years were diagnosed as ectomorph-mesomorph category. According to the literature, this type of somatotype is characterized by the highest work capacity. In the figure we notice six other athletes who fall exactly on the highest part of the somatocard and were awarded with a balanced mesomorphic somatotype, characterized by a more developed muscle tissue.

When checking the positions occupied by these players, we found that four of them occupy the position of defender and two are forwards.

The generalizations we can make from the somatotype diagnosis are as follows. In goalkeepers, the most common somatotype is endomorph-mesomorph. In contrast, the ectomorph-mesomorph somatotype comes to the fore in attackers and defenders. Less frequently we encountered a somatotype of the type: balanced mesomorphic somatotype, mesomorphic-ectomorph. We expect the strongest performance on fitness tests at age 17 because this is where the ectomorph-mesomorph category is formed, which is said to be the most able-bodied somatotype.

III.3. Analysis of variance analysis data of the conducted sport-pedagogical tests

The results of the analysis of variance of the data from the conducted tests provide us with information that will support the analysis of the condition and the changes that occurred in the experimental and control groups before and after the approbation of the training methodology developed by us, aimed at influencing changes in the state of the motor quality speed, which in a purely practical aspect is manifested by changes in the speed abilities of the subjects.

Table 3. *Data from the analysis of variance in the first testing of the experimental group*

Indicators	n	R	Min	Max	\bar{X}	S	V%	As	Ex
High jump from standing on two legs	16	23,50	34,70	58,20	43,76	7,01	16,02	-1,27	-0,44
High jump from one leg	16	17,30	24,40	41,70	34,21	4,50	13,15	1,04	0,50
Long jump with two legs from the spot	16	67,00	196,00	263,00	230,75	18,03	7,81	-0,06	0,36
30-meter sprint from walking without a ball	16	0,54	3,93	4,47	4,18	0,14	3,56	-0,32	-0,03
30-meter sprint from jogging without a ball	16	,064	3,74	4,38	4,06	0,17	4,21	0,07	-0,37
30-meter sprint from walking with a ball	16	1,02	4,25	5,27	4,52	0,26	5,90	0,06	0,05
30-meter sprint from jogging with a ball	16	0,77	3,93	4,70	4,33	0,23	5,35	1,661	3,04
20-meter sprint with change of direction every 5m at 45° from walking without a ball	16	0,80	4,16	4,96	4,68	0,23	5,08	-1,01	0,27
20-meter sprint with change of direction every 5m at 45° from jogging without a ball	16	0,75	4,03	4,78	4,46	0,26	5,90	-0,53	-1,17
20-meter sprint with change of direction every 5m at 45° from walking with a ball	16	1,52	4,46	5,98	5,22	0,39	7,62	0,24	-0,16
20-meter sprint with change of direction every 5m at 45° from jogging with a ball	16	1,61	4,38	5,99	5,12	0,46	8,99	0,30	-0,44
Cognitive speed	16	13,00	29,00	42,00	37,75	3,66	9,69	-0,92	0,31
Complex speed without a ball	16	2,11	8,34	10,45	9,57	0,54	5,73	-0,52	0,41
Cognitive speed with a ball	16	3,04	10,78	13,82	12,16	0,80	6,61	0,11	-0,05

The data presented in Table 3 are from the initial testing of the subjects in the experimental group. As indicated above, the values of the coefficient of variation of interest to us are

(V%). Its values in individual tests varied between 3.56 and 16.02%. These values indicate high levels of homogeneity in 12 of the 14 tests performed. The exceptions are the data from the two-leg jump and one-leg jump tests. The values of the indicator in these two tests can be interpreted as carrying information about the presence of multiple individual differences in the state of the boys' ability to jump to height. In full force this applies to the test "Jump to height from two legs", where we notice a high value of the coefficient of asymmetry (As), which value has a negative sign. This means that most of the individual achievements of the subjects are lower than the value of the average or are concentrated around the minimum achievement of 23.50 cm, represented by the

в Table 3. This implies a significant margin in terms of the considered motor ability of the studied football players.

In terms of the type and shape of the distributions, with few exceptions, we can define them as normal based on the values of the asymmetry (As) and skewness (Ex) indices presented in Table 3, which in most cases are lower than the critical $As_{cr.} = 0.711$ and $Ex_{cr.} = 0,907$. These results allow us to subsequently apply Stewart's parametric t-criterion for dependent and independent samples to test the impact of the methodology we developed and validated, and Pearson's simple linear correlation coefficient to determine the direction and shape of the relationships between individual motor abilities.

Table 4. Data from the analysis of variance in the second testing of the experimental group

Indicators	n	R	Min	Max	\bar{X}	S	V%	As	Ex
High jump from two legs	13	12,50	39,50	52,00	45,80	4,20	9,18	-0,09	-1,03
High jump from one leg	13	20,30	26,80	47,10	35,46	5,78	16,31	0,38	-0,08
Long jump with two feet from the spot	13	49,00	201,00	250,00	228,92	13,88	6,06	-0,43	0,14
30 m sprint from walking without a ball	13	,77	4,02	4,79	4,32	0,23	5,38	0,68	-0,15
30 m sprint from jogging without a ball	13	,43	3,91	4,34	4,10	0,13	3,33	0,26	-0,54
30 m sprint from walking with a ball	13	,66	4,12	4,78	4,49	0,19	4,40	-0,17	-,54
30 m sprint from jogging with a ball	13	,57	3,94	4,51	4,29	0,16	3,91	-0,82	-0,00
20 m sprint with a change of direction every 5 m at 45° from walking without a ball	13	1,00	4,07	5,07	4,75	0,26	5,63	-1,35	2,59
20 m sprint with a change of direction every 5 m at 45° from jogging without a ball	13	,61	4,24	4,85	4,51	0,20	4,54	0,18	-1,34
20 m sprint with a change of direction every 5 m at 45° from walking with a ball	13	1,67	4,83	6,50	5,56	0,46	8,41	0,34	-0,18
20 m sprint with a change of direction every 5 m at 45° from jogging with a ball	13	1,18	5,01	6,19	5,62	0,35	6,25	-0,39	-0,65
Cognitive speed	13	19,00	26,00	45,00	36,92	6,07	16,44	-0,55	-0,92
Complex speed without a ball	13	1,57	8,24	9,82	9,13	0,41	4,57	-0,49	-,45

Complex speed with a ball	13	1,89	10,34	12,23	11,16	0,50	4,55	0,32	0,60
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The data in Table 4 illustrate the performance of the second testing of the experimental group players. Again, the values of the coefficient of variation (V%) are the subject of discussion. The values of this coefficient in the different tests vary between 3.33 and 16.44%. The high levels of homogeneity were in 12 of the 14 tests performed. Data from the tests "Cognitive speed" and "Jump height from one foot" stand out. The values of the coefficient of variation (V%) in these 2 tests can be interpreted as an expression of the accumulation of personal specificities as far as the ability of the tested players to jump to a height of one leg, as well as to use their mental abilities as quickly as possible under time pressure. Our attention was drawn to the test of "Cognitive speed", where it was noticed that the coefficient of asymmetry (As) had a negative value. This fact could mean that most of the personal performances of each of the tested players are lower than the value of the average. Another conclusion we can draw is that these achievements are clustered around the minimum one of 19.00, apparently

В Table 4. Therefore, the individual manifestations in the examined persons in terms of the considered ability have improved as a consequence of the applied means and methods, which should be verified through the subsequent analyses and interpretation of the statistical processing data.

As for the type and shape of the distribution, we can characterize them as normal based on the values of the asymmetry (As) and skewness (Ex) indicators shown in Table 4. In 100% of the cases they are lower than the critical As $k_p = 0.711$ and Ex $k_p = 0.907$. This gives us reason to assume a positive influence of the applied training loads on all athletes.

Thanks to these results, we will be able to incorporate the parametric Stewart t-criteria for dependent and independent samples in order to test the impact of the methodology we have developed and implemented. Along with this, Pearson's simple linear correlation coefficient will be applied to determine the direction and shape of the dependencies between individual motor abilities.

III.4. Analysis of the data from the comparative analysis of the sports pedagogical testing

The processing of the data from the tests conducted before and after the experimental work using the statistical criteria for hypothesis testing will enable us to establish the influences and effectiveness of the methodology developed and approved by us in real training conditions. The values of the individual statistical indicators will be commented on individually for each of our selected

14 test.

Table 5: Results of the comparative analysis of the performance on the 30 m sprint test of walking without a ball

Indicators	n	First testing		Second testing		Increase			
		\bar{X}	S	\bar{X}	S	d	d %	t	P(t)
EG	16	4,18	0,15	4,05	0,13	-0,13	3,11	8,548	100
KG	13	4,33	0,23	4,40	0,19	0,07	1,62	-1,894	97,7
d		-0,15		-0,35					
t		-2,04		0,59					
P(t)		94,8		100					
Cohen's d		0,772		2,150					

The results of the 30 m sprint test from walking without a ball are noted in Table 5 and Figure 5. Analyzing the performance of the players in the experimental group, there is an increase in the mean performance of the players compared to the lower final mean performance of the players in the control group. Prior to implementation

of the experimental model for the development of speed capabilities, the representatives of the experimental group achieved an average of 4.18 s, and in the second study reached 4.05 s, which is an absolute increase of 0.13 s and a relative increase of $d\% = 3.11\%$. We could define the difference as significant, referring to the probability guarantee value $P(t) = 100\%$.

However, the changes in the control group players are quite different. For them, the initial 4.33 sec deteriorated to 4.40 sec during the second testing. This 1.62% decrease in team average performance is statistically significant and justified by the guarantee probability of $P(t) = 97.7\%$ shown in the table above.

We can report and state the existence of positive effects of the experimental model we developed in terms of the ability to sprint from a starting position walking without a ball and adhere to the tools and methods used in this regard.

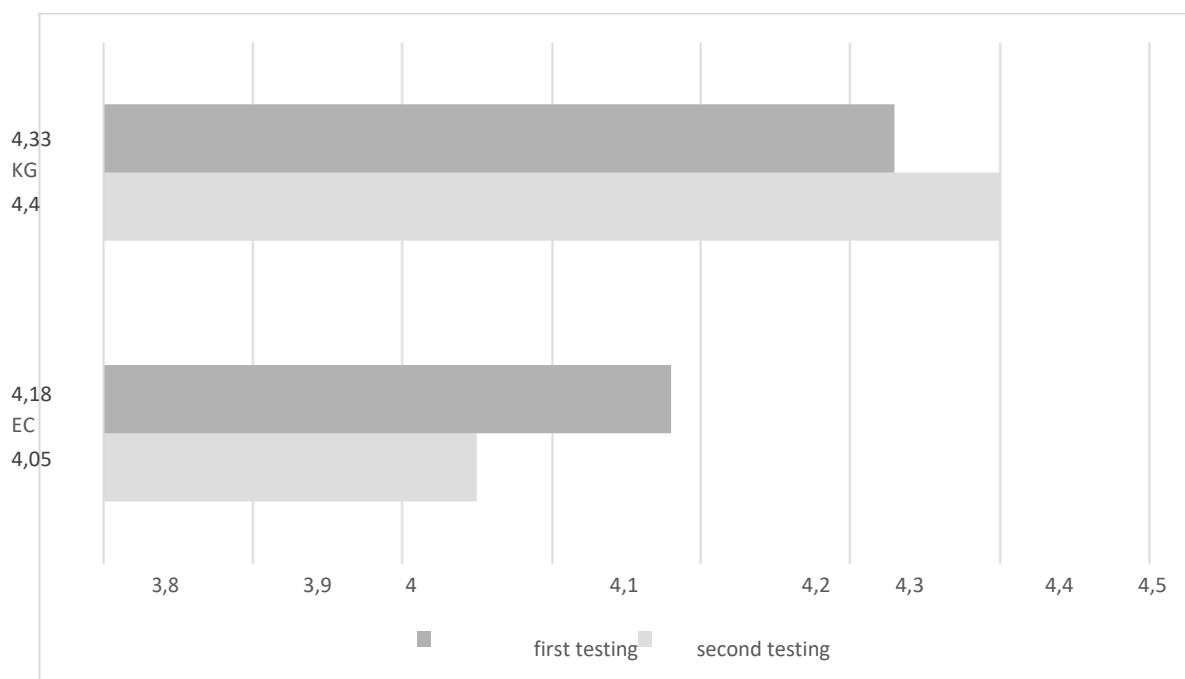


Figure 5: Mean performance on the 30 m sprint test from walking without a ball

Examining and comparing the differences in the performances of the tested groups, we note the better baseline performance of the players of the experimental group reported in Figure 5, namely 4.18 sec vs. 4.33 sec achieved by the players of the control group. We define this difference as insignificant based on the $P(t) = 94.8\%$ probability guarantee value noted in Table 14. After the application of the experimental work to develop the speed capabilities, the reported difference is also in favor of the athletes of the experimental group and is within 0.35 sec, which difference we can attribute to the effects indicated during the training activities, based on the value of $P(t) = 100\%$.

The better performance results of the boys in the experimental group and their improved results in the second study, comparing them with those of the players in the control group, make us optimistic about the experimental methodology applied on this motor ability.

Table 6: Results of the comparative analysis of the performance on the test "Complex ball speed"

Indicators	n	First testing		Second testing		Increase			
		\bar{X}	S	\bar{X}	S	d	d %	t	P(t)
EG	16	12,04	0,64	10,25	0,53	-1,79	14,87	13,295	100
KG	13	11,16	0,51	11,78	0,63	0,62	5,56	-3,358	99,4
d		0,44		-1,53					
t		3,99		-7,13					
P(t)		100		100					
Cohen's d		1,521		2,628					

The processing of the results of the Complex Ball Speed test are noted in Table 6 and Figure 6. Comparing the performance of the players in the experimental group, there is an increase in the average performance of the players compared to the weaker final average

achievement of the control group players. Before the application of the experimental work, the players of the experimental group achieved an average of 12.04 s, and in the second testing they reached 10.25 s, which is an absolute gain of 1.79 s and a relative gain of 14.87%. We could define the difference as significant, referring to the probability guarantee value $P(t) = 100\%$.

The changes in the control group players are different. For them, the baseline 11.16 s deteriorated to 11.78 s during the second trial. This 5.56% deterioration in team mean performance is statistically significant and justified by a probability guarantee of $P(t)$

= 99.4%, shown in Table 6. We can account for the presence of positive impacts of our applied experimental model with respect to complex ball speed. After analyzing the between-group differences, we will know whether the results will deny or confirm this claim.

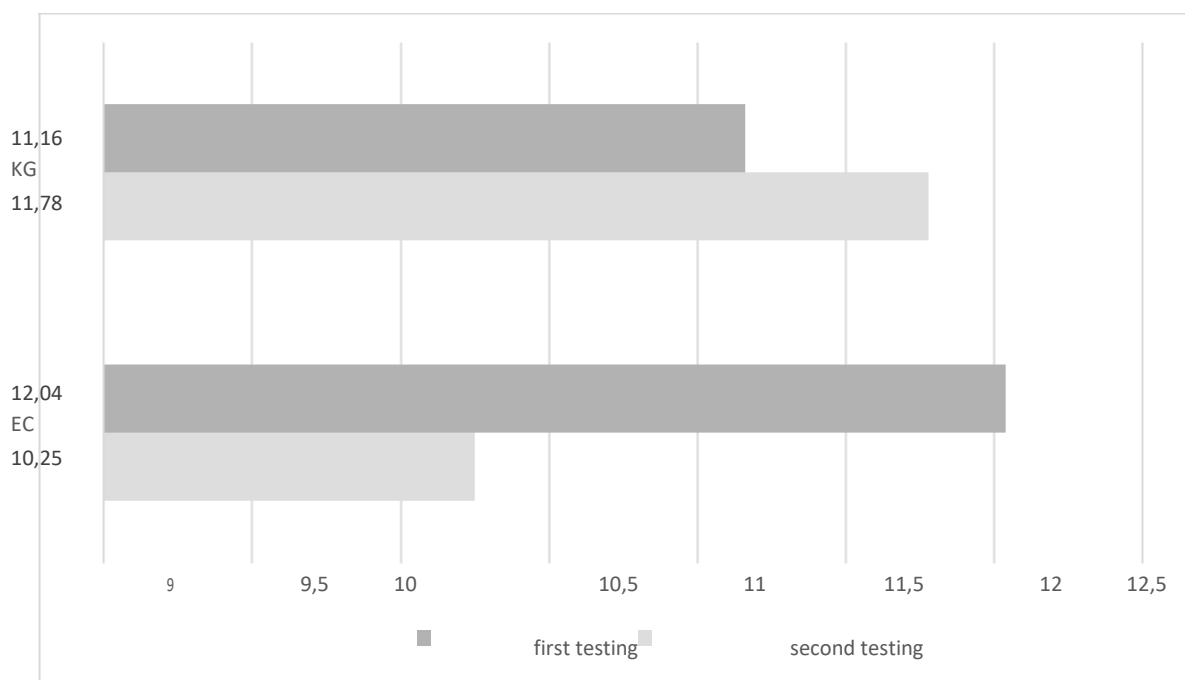


Figure 6: Average performance on the Complex Ball Speed test

Comparing the differences in the performance of the studied groups, we note the better initial performance of the control players

group, evident in Figure 6, namely 11.16 vs. 12.04 sec realized by the athletes of the experimental group. We would define this difference as significant, given a probability guarantee value $P(t)$ of 100%. After applying the experimental work against the speed capabilities, the difference noted is now predominantly for the players in the experimental group and is 1.53 sec. This difference is confirmed by the required confidence level, taking into account the value of $P(t) = 100\%$.

The improved performance of the subjects from the experimental group and the realized mean difference in the testing conducted after the experimental work, compared to the players from the control group, give us reason to define the impact of the model we developed on the motor ability under consideration as significant. Supporting this claim is the value of the Cohen's d statistic, which in the second testing was 2.628 and entitles us to attribute these changes in differences to the groups studied.

III.5. Analysis of the data from the correlation analysis of the sports pedagogical testing

The results of the correlation analysis will allow us to reveal the direction and magnitude of the relationships between the different exercises, as well as the changes that occur between them as a consequence of the methodological validation.

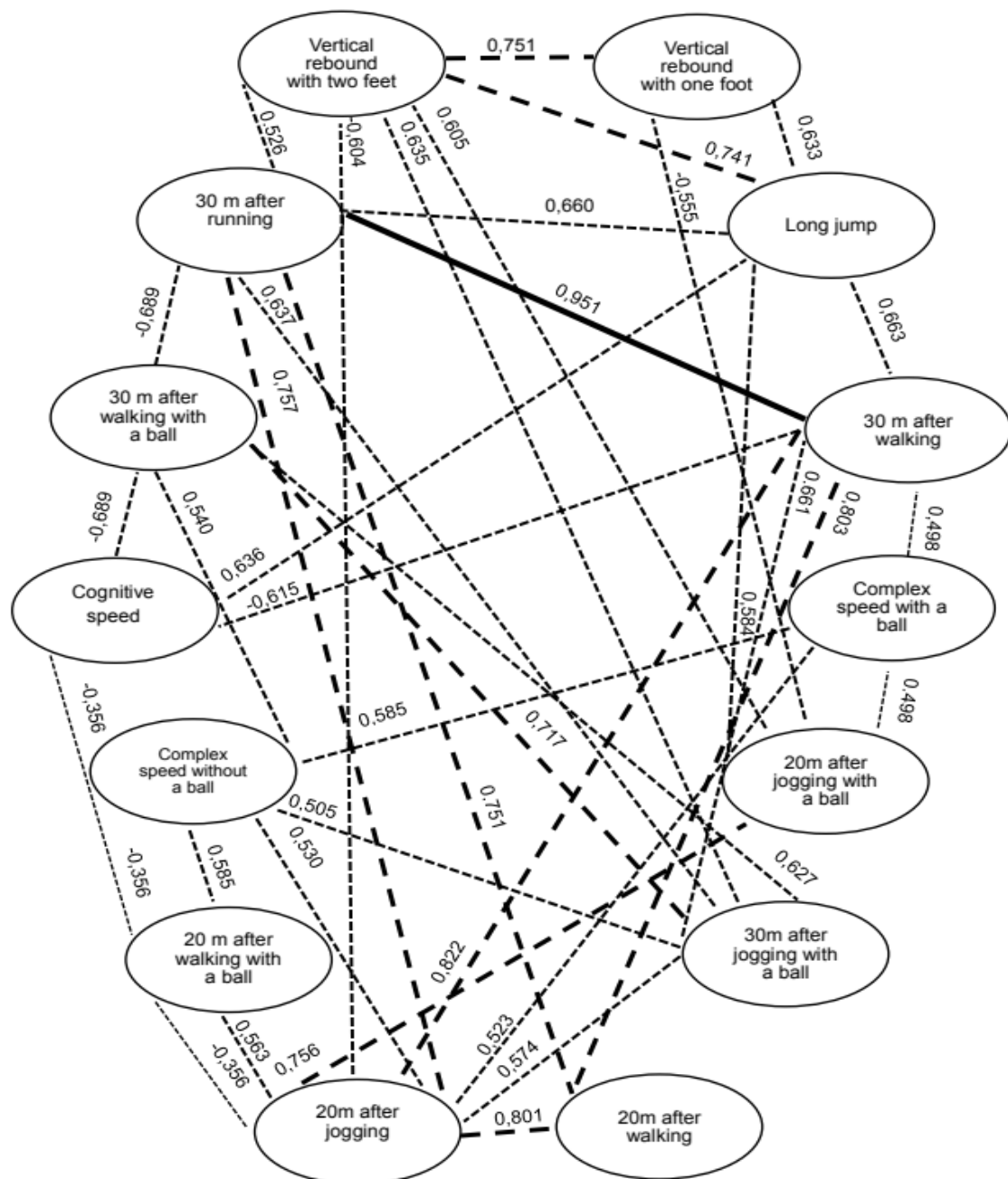


Figure 7. Correlation matrix from the first testing of the experimental group

The first matrix presented in Figure 7 shows the correlation structure of the experimental group before the experimental work. In the figure, we can clearly see the multiple correlations that can be said to demonstrate the low level of speed ability of the athletes in the experimental group. We refer this statement of ours to the achievements of many authors who claim that when the level of motor qualities is low, the impact on any quality affects the others.

In support of this assertion, there are the multiple relationships that exist between the tests that carry information about lower extremity explosive strength and almost all of the other tests. The strength of these links is within 0.526 and 0.741. After implementing the experimental work, as shown in Figure 8, most of these relationships decrease in strength or almost disappear, especially in the single-leg vertical rebound test.

From a practical-methodological point of view, this points us to the need to adjust the influences aimed at developing the explosive power of the lower limbs when applying the methodology in the future. These adjustments are also a consequence of the analyses in the previous subchapter, and of the need to apply specific means of developing explosive power that are largely individualized or differentiated according to the playing post of the athletes.

Correlations, which we should define as large before the experiment starts, are also revealed between the "Sprint 30 m" and "Sprint 20 m" tests performed without a ball. Here, the values of the coefficient of simple linear correlation range between 0.7 and 0.8. At the end of the experiment, most of them disappear or decrease in strength.

Prior to the experiment, the Cognitive Speed test correlated strongly with three of the other tests, namely the Two-Legged Long Jump from Place, where the r -value was 0.636, the 30-Meter Sprint without Ball from Running, and the 30-Meter Sprint without Ball from Walking, with Pearson's coefficient values of -0.689 and -0.615, respectively. The negative coefficient values are due to the difference in the scores of the two tests. In the cognitive speed test, the estimate is positive, i.e., a higher score indicates better achievement, whereas in the sprint tests the estimate is negative. After conducting the experiment, the relationships commented above change, with two of them

disappear, and the third - between the test "Cognitive speed" and the test "Sprint 30 meters without a ball from running", decreases in strength.

We notice similar changes in the Complex Speed test without and

c ball. At the top, there are statistically significant correlations between the Complex Speed test without ball and the Sprint 30m

c ball from walking", "Sprint 30 m with ball from running", "Sprint 20 m with change of direction 5 m at 45 degrees without ball from running" and "Sprint 20 m with change of direction 5 m at 45 degrees with ball from walking" with values of 0.540, 0.505, 0.530 and 0.585. Two of these relationships disappear with the exercise involving sprinting 20 meters, and the other two decrease in strength. For the "Complex Speed with Ball" test, before the methodology was tested, there were two relationships with strengths within 0.523 and 0.585 with the "Sprint 20 meters with a change of direction at 5 meters at 45 degrees without a running ball" and "Complex Speed without Ball" tests, which lost strength after the experiment.

CHAPTER FOUR

IV. CONCLUSIONS AND RECOMMENDATIONS

The implementation of the individual activities in connection with the development of the dissertation and the results obtained, analyzed and interpreted as a result allow us to draw the following **conclusions**:

1. The study carried out on the literature allows us to summarize that there are not many authors in the available literature that address the problem of developing speed and trace the changes in speed capabilities in 17-18 year old football players. At the same time, we can highlight the studies of Holt et al. (2006) and Körner et al. (2013), who identify the importance of speed for the overall performance of football players. The findings of the aforementioned studies clarify the relationship between improving speed capabilities on the one hand and their influence on different aspects of the game on the other. As such, we should point out the ability to release from and overcome opposing players, getting to the ball first, the ability to explosive actions.

2. Based on the literature study, we can derive some key factors that contribute to improved speed performance in football players. These are the state of motor qualities strength and flexibility, the level of technical preparation of the athletes and their mental preparation respectively. As the leading methods and approaches to improve the speed capabilities of athletes we should point out the methods aimed at developing explosive power with the most prominent representative the plyometric method. Along with this, the inclusion in the training regime of specific approaches will have an additional positive impact. Here we should point out the application of specific game situations, which will support the improvement of the relationship between motor habit and motor qualities, in this case the relationship sports technique, speed, explosive power.

3. The results of the conducted survey showed insufficient theoretical and methodological-practical preparation of the interviewed coaches regarding the place and dosage of methods and means for developing the motor quality of speed and, respectively, improving the speed abilities of football players.

4. According to the results of the analysis of anthropometric traits and body build indices, we can summarize that the standards developed to assess the physical development of U17 football players are in favor of sports practice. The determination of somatotype can further support the selection of appropriate playing position in adolescent athletes.

5. From the motor testing conducted, there was clearly a significant reserve in terms of explosive power and speed of the tested athletes. Considering the direct effect of both motor abilities on competitive performance, we believe that it is necessary to take measures in this direction and purposeful work to develop them in childhood and adolescence.

6. The systematic and purposeful development of the strength and speed-power abilities of 17-18 year old footballers, combined with high-intensity interval training, leads to an improvement in their speed abilities and special endurance, which contributes to their overall performance. The aforementioned improvement is a consequence of an increase in muscle mass and strength as well as an increase in anaerobic capacity. The combination of these two types of training allows players to maintain high intensity for longer periods, which is essential for their performance.

7. Targeted assessment and monitoring of players' progress is crucial to tailor training regimens to individual needs and ensure optimal results.

RECOMMENDATIONS

1. Based on the results of our study, we could recommend to the methodologists and coaches in the junior schools the inclusion in the training regimen of 17-18-year-old football players of plyometric exercises, those aimed at improving the technique of changing direction, improving the starting reaction, acceleration, the ability to change direction and release from an opponent, emphasis on the first step and reducing the contraction. These exercises help improve muscle explosiveness and nervous system quickness, resulting in faster muscle fiber activation and faster force production.

2. Based on the data from the comparative analysis, we can recommend the integration of training aimed at developing the different manifestations of the motor quality strength, and high-intensity interval training, which indirectly lead to an improvement in the speed capabilities of football players in the age period under consideration.

3. In order to optimize the training effects, continuous monitoring of the tools and methods applied individually to individual athletes is necessary to adapt the training regimen accordingly and ensure that athletes demonstrate the best possible results. This can be accomplished through the use of standardized tests of speed, flexibility, strength and anaerobic capacity along with coach feedback as well as self-evaluation.

4. Further research is needed to investigate the optimal balance between different types of training, e.g. plyometric, strength, high-intensity interval, and their impact on the overall performance of football players.

Publications on the topic

1. Valchinov, Y., Atanasov, E. (2022). Analysis of the tactical formations used in group "E" of the European U-21 championship qualifying football competition in the 2021/22 season. NSA, Sofia.
2. Valchinov, Y. (2023). An analysis of the impact of corners, penalty kicks and free kicks on the results and final ranking in Group F of the European Under-21 Football Qualifiers Press 2021-2022. SU, Sofia