Republic of Albania
Sports University of Tirana
Faculty of Movement Sciences
Third Level of Doctoral Studies

Doctoral Disertation

Summary

TOPIC:
"Improvement of physical and exercise parameters through proprioceptive exercises training in 17 years old-boys football players"

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Abbreviations

Test 2. SUT = Sit Ups Test

Test 3. SLJT = Standing Long Jump Test

Test 4. SJT = Sergeant Jump Test

Test 5. MB3 = Medicine Ball 3 step throw

Test 6. S15m = Sprint 15 Metre

Test 7. SHRT = Shutle Run Test

Test 8. 30m (S) = 30 Metre Sprint

Test 9. 60m (S) = 60 Metre Speed Test

Test 10. 100m (S) = 100-Metre Sprint Test

Test 11. 400 MDOFFT = 400 Metre Drop Off Test

Test 12. MFT = Modified Flexibility Test

Test 13. CV$O_{2\ max}$ Test = Cooper VO_{2max} Test (12÷2 = 6min)

Test 14. HOT= Hexagonal Obstacle Test

Test 15. ZZT= Zig-Zag Test

Test 16. ZZTB = Zig-Zag Test with Ball

Test 17. 505 AT = 505 Agility Test

Test 19. IART = Illinois Agility Run Test Ball

Test 20. GJ16.5 – 16.5m kicking the ball

Test 21. Gj8 – 8m head kick test

Abstract

Introduction: Football is one of the highest-ranked sports around the world but like most other sports it is associated with a certain risk of injury to players, both at the competitive and recreational level (Junge and Dvorak, 2004). Proprioception is defined as the ability of an individual to integrate sensory signals from different receptors to determine body position and movement in space (Han, G et al., 2015; DJ Goble., 2010).

Objectives: Objective 1 of this study was; Measurement and evaluation of physical and mobility parameters in 17 years old boys football players. Objective 2 was; The improvement of physical and mobility parameters through proprioceptive exercises training in 17 years old boys football players.

Methodology: Literature review research is conducted using some of the main search engines like; JabRef, PubMed, Medline. From many studies, only 19 were selected for use as reference studies. This study was conducted for a 7-month period. In the first phase of the study, a total of 124, 17-year-old players were involved, from which 62 were selected, randomly divided into 2 groups1. Experimental group, 31 subjects would conduct ownceptive exercises and 2. control group with 31 subjects who would perform standard exercises. Both programs consisted of 6 microcicles where each microcicle was 4 weeks and each week had 3 training sessions. Each training session lasted for a total of 45 minutes. The subjects underwent 21 different types of tests. Statistical analysis was carried out using as a working environment software for statistical processing "IBM SPSS Statistics 22".

Results: Referring to Objective 1, the results showed that the subjects involved in the study had good levels in physical and mobility parameters. The results showed that in most cases the subjects were within the recommended rating norms even in some cases the test results were very good. Concerning Objective 2, for the SUT 2 test, the highest SUT average found in the experimental group (28.93 ± 3.07) compared to the control group (25.77 ± 3.07) ascertained ($p < 0.05$). For test 3 (SLJT), the highest average for "SLJT" found in the experimental group proves a statistically significant difference ($p < 0.05$). For the 4 "Jumping Sergeant" (SLJ) test, a higher performance for "SJT" is shown in the experimental group and the ANOVA results prove a statistically significant difference ($p < 0.05$). For the 5 "Three-Step Medicine Ball" (MB3) test, a higher performance in the experimental group ($p < 0.05$) is evidenced. In terms of speed tests (Tests 7, 9, 10, 11), S15m, SHRT, 60m, 100m, 400 MODFT and 30m acceleration (Test 8), the ANOVA results prove that there was no significant difference ($p > 0.05$). Test 12. “Sit eand Reach” test "MFT", ANOVA results for the dependent variable "MFT", ($P < 0.0005$) prove that "Basic and proprioceptive exercise program affect performance enhancement in the SUT test. There is a higher performance for "MFT" in the experimental group (37.97 ± 5.8) compared to the control group (37.1 ± 3.4) and the ANOVA results show a statistically significant difference ($p < 0.05$). In Test 13, "Cooper" $VO_{2max\ test}$, ANOVA results for the dependent variable "CVO_{2max}", ($P < 0.0005$) prove that "Basic exercise and proprioceptive exercise affect

performance enhancement in the $VO_{2max\ test}$. Also, the ANOVA results showed a statistically not significant difference "(P> 0.05). Test 14. The Hegzagonal Skill Test (HOT) demonstrates a higher performance for the HOT (s) tests, the experimental group, and the ANOVA results prove a statistically significant difference (p <0.05) between the groups. For Tests 15 (Zig Zag Test) and Test 16. (Zig-Zag Test with Ball) as well as Test 17 (Agility Test 505), ANOVA results for the dependent variable "Average Time (s) ", (P <0.0005) prove that" Basic training and proprioceptive exercise training affect performance enhancement in Z-ZT (s), Z-ZTB (s), 505 AT (s) tests. The ANOVA results with 2 repetitive measurements for the dependent variable "Average Time (s)" (P <0.0005) and the group as independent variables identified a statistically significant difference. Test 18. The Illinois Agility Run Test (IART (s)) test shows a higher test performance (IART (s)), the experimental group compared to the control group, and the results of the ANOVAs show a statistically significant difference (p <0.05) between groups. At Test 19. The Illinois Agility Run Test Ball (IARTB (s)) test shows a higher test performance (IARTB (s)), the experimental group, and the ANOVA results prove a statistically significant difference (p <0.05) between groups.

Discussion: This study was very complex in its type because the number of tests and the results obtained was great but also the duration of the intervention was relatively long (6 months) but the study in its entirety came out to confirm the early hypothesis proving that improvement of physical and motion parameters through proprioceptive exercise was better in the experimental group compared to the control group. Whereas, with regard to Objective 2, referring to the results after the end of the intrusion exercise program, it results that the proprioceptive exercise conducted for a 6-month period significantly improved the majority of the physical and mobile parameters to the subjects of the control group

Cunclusion and Recommandations: This study highlights the importance of these training programs that focus on improving the physical and functional capabilities of football players in general and young players in particular. These types of exercises have already become part of contemporary football training programs. From the study results it is showed very clear that proprioceptive exercise can improve the physical and technical skills of football players, but it is necessary to further study the effectiveness the other training programs with different characteristics such as frequency, quantity, or types of exercises, at all ages not only in adolescents. We think it would be very interesting to develop programs or other study projects focusing on the more complex effects of the proprioceptive exercise and the more specific requirements aimed at changing the visual, sensory information etc, on the subjects practicing football. Also, a special focus should be placed on preventing injuries, improving orientation, coordination, balance, etc.

Key words: *Football, Adolescents, Proprioceptive training*

Theoretical aproach

Literature Review

Football is one of the highest-ranked sports around the world, but just like most other sports, it is associated with a certain risk of injury to players, both at the competitive and recreational levels (Junge and Dvorak, 2004). Football is a sport that requires a lot of technical skills, as well as static, semi-dynamic and dynamic balance. Most of these skills, such as passing, manipulating the ball into the air, dribling or taking the ball, are achieved by standing on one leg. The balance plays a major role in difficult situations that a footballer may have during a football match, situations such as; postponement of opponents, slippery grass, changes in the direction of the ball, movement, etc. Therefore, the successful and effective execution of any technical skill depends to a large extent on the ability of players to control their balance and to adapt better and faster to the changing positions of the posture and other parts of the body field. Football is a sport that requires high intensity and is characterized by constant course changes but also uniphodontic (high-legged) actions with high loads. Participation in football imposes high demands on neuromuscular control, agility and centric / concentric strength. Most of the injuries in football is related with the lower limbs in which muscle injuries are among the major problems (Ekstrand J et al., 2011; Emery CA et al., 2005). In childhood, inadequate levels of physical activity can cause significant health problems at the individual level but also in society (Janssen & Leblanc., 2010; Andersen et al., 2011). Children are immature in the skeleton and when they participate in sports, they are susceptible to a variety of injuries, both in hard tissue and soft tissues (Frank et al., 2007). Consequently, the World Health Organization recommends at least 60 minutes of medium and high intensity physical activity, which should, if possible, be developed daily to combat cardiovascular, neuromuscular and metabolic diseases (WHO, 2010). Sport and high levels of physical activity are associated with a high prevalence of injuries (Caine et al., 2006; Emery, 2010). For example, there is evidence from some countries like; Switzerland, the United States, Canada, France, the Netherlands, the United Kingdom and Sweden that sports (organized and unorganized) are the main cause of injury to children and adolescents with more than 50% of all injuries caused by (Bijur et al., 1995; Mummery et al., 1998; Belechri et al., 2001; Michaud et al., 2001; Hedstrom et al., 2012). To control the balance, the central nervous system (CNS) integrates visual, vestibular and proprioceptive information to produce motor controls that coordinate muscle activation patterns (AW Shumway-Cook & MH Woollacott., 2013; U. Röijezon et al., 2015 RA Speers et al., 2002). Proprioception is defined as the ability of an individual to integrate sensory signals from different receptors to determine body position and space movements (Han, G et al., 2015; DJ Goble., 2010) and plays a decisive role in controlling of equilibrium (U. Röijezon, NC Clark & J. Treleaven, 2015; RA Speers et al., 2002; JH Pasma, T. A et al., 2012; S. Bouisset and M.-C. Do., 2008 NC Clark et al.,

2015). Theoretically, proprioceptive information from any part of the body contributes to the control of the equilibrium. Significant reductions in the risk of damage to the lower extremities have been reported to be achieved by intervention programs by focusing on internal risk factors (Aaltonen S et al., 2007; Junge A et al., 2004). Force training reduced the risk of injury to m. hamstring in players from heterogeneous populations (Arnason A et al., 2008; Petersen J et al., 2011). In addition, plyometric exercise and exercise skills, which were the main components of a preventive program developed by Heidt et al (2000), proved to be effective in lowering the incidence of injuries in football. It has also been shown that neuromuscular exercise can significantly reduce the risk of cross-linked (ACL) injury to male and female footballers (Alentorn-Geli et al., 2009; Grindstaff TL et al., 2006). Equilibrium focus exercise has been proven to be effective in reducing non-contact injuries of ACLs in footballers, especially in women (Alentorn-Geli E et al., 2009). There is convincing evidence that training programs that focus on preventing injuries can reduce their overall rate by about 40% to children and adolescents who deal with sports (Rössler et al., 2014). Neuromuscular performance can be considered as the ability of the neuromuscular system to control and coordinate movements by appropriate use and coordination of muscular strength and muscular endurance, muscle recruitment pattern, proprioceptive responses and reflex activity (Huston & Wojtys, 1996, Zech et al., 2010). Neuromuscular deficiency can potentially increase the risk of injury, although scientific evidence in this regard is not conclusive to date (Bahr & Holme, 2003; Emery, 2003; Meeuwisse et al., 2007; Lehr et al., 2017). Successful prevention programs usually include exercises aimed at static and dynamic balance, plyometric exercises, and strength and strength of the lower limbs (Mandelbaum et al., 2005; Abernethy & Bleakley, 2007; Soligard et al., 2008; Kiani et al. al., 2010). There is strong evidence that age and gender affect the risk of injury (Emery, 2003 Frisch et al., 2009; Faude et al., 2013) and that the exercise dose determines the size of training adjustments to neuromuscular training programs (Lesinski et al. 2015, 2016). Football is considered to be the most ideal sport that can improve the balance of healthy and untrained individuals as it is the most effective exercise of all traditional training methods (Jakobsen et al., 2010), while football players are proven to pass basketball players in static and dynamic balance parameters and do not differ much from gymnasts (Bressel et al., 2007). Equilibrium or postural control can be defined as the ability to maintain a basis of minimum motion support and the ability to perform a certain task while maintaining a stable position. The equilibrium is maintained through the dynamic integration of internal and external forces and factors that encompass the environment (Lee A et al., 2006; Bressel E et al., 2007). Equilibrium regulation depends on visual, vestibular and proprioceptive stimuli (Subasi SS et al., 2008; Gribble PA et al., 2007). Static balance can be estimated by having an individual holding a stationary position while standing over one or two feet (Gribble PA, Hertel J., 2003). While, the dynamic equilibrium can be evaluated by controlling the one-leg mass balance while the other leg is extended to reach the maximum distance. Dynamic equilibrium test has a greater demand for equilibrium systems and

neuromuscular systems (Earl J & Hertel J, 2001; Gribble PA et al., 2009). Balance control includes a complex network of neural links and nerve centers, as well as central and peripheral reaction mechanisms (Gayton, 1991).

Many studies have shown the beneficial effect that resistance training may have on preventing and reducing injuries to players (but also to athletes in general) (Malliou et al., 2004), while the weak balance is associated with increased risk injuries to sportsmen (McLeod et al., 2009). Good balance seems to be effective in neuromuscular control performance (Zech et al., 2010), being at the same time a distinctive feature of high-level players (Paillard et al., 2006). The analysis of the technical skills of soccer in relation to the positioning and movement of the bust and the legs, the speed of execution etc., were analyzed with the aim of perfecting the technique of performance (Shinkai et al., 2009). Some studies have shown that the incidence of injuries in football can be reduced by adapting various strategies for preventing injuries, including: warming, giving more weight to streching; proper medical attention for injuries; methods and time appropriate for recovery; the right time to calm down at the end of the exercise; use of protective equipment; good condition of the field, etc. (Berbig, 1997, Blaser & Aeschlimann, 1992; Caraffa et al., 1996; Dvorak et al., 2000; Ekstrand et al., 1983; Hawkins & Fuller, 1999). In male adolescents (Junge et al., 2002) and women engaged in football (Heidt et al., 2000; Mandelbaum et al., 2005), but also in other team sports (Emery et al., 2005; Hewett et al. al., 1999; Myklebust et al., 2003; Olsen et al., 2005), has been shown the benefit of condition training programs to prevent injuries. Sport-specific strength training programs that include a balance training component are effective in improving the physical condition and reducing the risk of injury to adult sportsmen, but few research has taken into account such strategies with regard to children (pre-adolescents) and young people (MacKay et al., 2004). Pliometry is a training technique used by athletes of all sports in order to increase the power and explosiveness (Chu, 1998). Pliometry basically consists of or focuses on the rstretching / or rapid extension of a muscle (centric action) followed immediately by a shortening action (concentric action) of the same muscle and connective tissue (Baechle & Earle, 2000). The elastic energy stored within the muscle is used to produce more strength than what can be provided by a concentrated action (Asmussen & Bonde-Peterson, 1974, Cavagna, 1977; Komi, 1992; Miller et al., 2002; Pfeiffer, 1999; Wathen, 1993). Scientific researchers have shown and proved that plyometric exercise, when used with a periodic force training program, can contribute to improvements in vertical jumping performance, acceleration, leg strength, muscular strength, inscreased joint readiness and general proprioception (Adams et al., 1992; Anderst et al., 1994; Bebi et al., 1987; Harrison & Gaffney 2001; Hennessy & Kilty 2001; Miller et al., 2002; Paasuke et al., 2001). Plyometric exercises usually include stops, starts and direction changes in an explosive manner. These movements are components that can assist in the development of skills (Craig, 2004; Miller et al., 2001; Parsons et al., 1998; Yap et al., 2000; Young et al., 2001). Skill is the ability to maintain or control the body's position, rapidly changing the course during a series of movements

(Twist & Benickly, 1995). Skill training is thought to be a strengthening of motor programming through the neuromuscular state and nerve adaptation of muscular fibers, tendinous golgi organs and joint proprioceptors (Barnes & Attaway, 1996; Craig, 2004, Potteiger et al., 1999).

What is proprioception and proprioceptive training?

Proprioception is defined as the sense of body movement - the ability to feel body movement in space (Batson G., 2009). Proprioception is a specialized variant of sensory modality and involves the sensations of the joint movement (kinesty) and the joint position (the joint position sense). The joint position relates to the accuracy of position repetition and is the ability of the individual to reproduce a predetermined angle of joint. Proprioception is an important factor for promoting functional sustainability during a football game (Subasi SS et al., 2008; Safran MR et al., 1999). A decrease in the level of proprioceptive function is seen after the occurrence of an injury eg. in the cross section of the cross-knee ligament (Barrack RL et al., 1989) and may predispose to repeated injuries. Thorp et al. (1984) showed that football players with functional ankle instability and a weak balance had a significant increase in risk for re-injuring the ankle. In a recent systematic literature research, he analyzed seven well-done methodological studies focusing on the effectiveness of proprioceptive exercise in reducing the incidence of injuries, including knee injuries and ankle injuries, finding reduction significant risk of both (Hubscher et al., 2010). The assessment of proprioceptive function is valid in identifying proprioceptive deficits and subsequent planning of respective preventive and rehabilitative programs (Aydin T et al., 2002; Ozenci AM et al., 2007). Most of the researches has proved that proprioceptive exercises are those that can be very important if used during training sessions. Myer, G.D. et al., 2005; Zouita Ben Moussa et al., 2009 claim that women who practice football if involved in their exercise and proprioceptive exercises will benefit in terms of strength and neuromuscular control as well as in enhancing the dynamic stability of the articulations. The proprioceptive or neuromuscular exercise for a short time gained attention in sports performance both for prevention but also for recovery of muscular injuries and increased physical performance (Gidu, D.V., Oltean, A., 2016; http://www.scribd.com/doc/227803314/Prezentare-Pitesti-Ro#scribd).

The proprioceptive exercise technique is based on lightweight and controlled loads applied to the joints using exercises performed on unstable surfaces (gymnastics balls, equilibrium platforms, etc.). The exercises used in this type of training aim to stimulate proprioceptive systems and nerve centers responsible for controlling postural equilibrium (Cocucci R, Boni R., 2005). Changes on the flexibility training protocols have been proven to reduce injuries. hamstring to professional footballers (Dadebo B et al., 2004) although their conclusions were not entirely convincing because of changes in training patterns but also for the fact that not all clubs continued to be part of the study. It has been shown that the implementation of a proprioceptivo-coordinating training program increases all measured fitness parameters and resulted in a reduced incidence of 400% damage (Knobloch K et al., 2005). Also

evaluated is the effectiveness of neuromuscular training in reducing knee injury rate (Walden M et al., 2012): a 15-minute neuromuscular program reduced the overall cross-linked ACL rate by 64% teenage women playing football. By increasing the balance and control of body positions during movement, the readiness must theoretically be improved. It has been suggested that power and efficiency increase due to pliometry may increase skill training objectives (Stone & O'Bryant, 1984) and plyometric activities have been used in sports such as; football, tennis, etc., where skill is a very important element (Parsons & Jones, 1998, Renfro, 1999, Robinson & Owens, 2004, Roper, 1998, Yap & Brown, 2000). From a physiological and psychological point of view, four to six weeks of high intensity exercise is an optimal time duration for the SNC to adapt without any fatigue or strain (Adams et al., 1992). Some sports physiologists think that neuromuscular adaptations that contribute to the explosive power occur early in the cycle of empowerment of the periodic training phase (Adams et al., 1992).

Proprioception and knee joint

To describe the proprioceptive system, we must first discuss the issue of propriocepsion. A proprioceptor can be described as a sensory receptor that can detect the stimuli generated by the system itself (Enoka RM, 1988). These receptors provide the basis for the proprioceptive response system that would allow adaptive changes to occur during preventive training programs, thus helping to prevent injuries during the sport. In order to operate a proprioceptive training program, the premise is that adaptations will be made based on the stimuli that the proprioceptors receive during or before the start of the pacing movement. This information will change the programmed response possibly in a way that modifies the mechanical conditions operating in the Cruciat Anterior Ligaments. In order for this to happen, the injury mechanism or pattern of movement must be recognized by the sensory control system as harmful. Then it should begin a corrective response to modify the movement of the limbs involved in a way that reduces or alters the stresses applied to the articulations by implementing a different movement strategy. This implies a changed neuromuscular response as the only way to change a pattern of movement is to modify the internal forces applied to the system, i.e., by changing the muscle activation patterns. In the literature, the evidence supports the 2 main views where the corrective response may begin:

(1) Through peripheral reactions from sensory receptors or

(2) Based on the preparation through the central nervous system.

Hypothesis

- We think that there will be improvements in physical and mobility parameters in both groups.

- We think that improving physical and mobility parameters through proprioceptive exercises will be better in the experimental group compared to the control group

Objectives

- **Objective 1:** Measurement and evaluation of physical and mobility parameters in 17 years old boys football players.

- **Objective 2:** Improvement of physical and mobility parameters through proprioceptive exercises training in 17 years old boys football players.

Material and Methods

Literature review research is conducted using some of the main search engines like; JabRef, PubMed, Medline. From many studies, only 19 were selected for use as reference studies. This study was conducted during a 7-month period. In September 2014, all the subjects were selected and all the first tests were conducted, and during; October, November, December 2014 and also February, March, April 2015 has been involved the training intervention. On May 2015 the second tests were conducted. All the tests and the entire intervention training program was carried out near the indor gym and outdoor sports facilities of the "Municipal High School", "Drita" in the town of Kicevo.

In the first phase of the study, a total of 124 17-year-old players were involved, from which 62 were selected and randomly divided into 2 groups.

1. The experimental group consisting of 31 subjects that undergone the proprioceptive exercise training program.
2. The control group also comprised of 31 subjects that undergone standard exercise training program involving fotball technical-tactical elements like; receiving the ball, passing, controling the ball, dribbling and shooting.

Both programs consisted of 6 microcicles where each microcicle was 4 weeks and each week had 3 training sessions. Each training session lasted for a total of 45 minutes. The subjects underwent 21 different types of tests ranging from those for anthropometric measurements (weight, height, BMI) and continuing with other tests like those for measuring trength (upper and lower limbs), speed, resistance, agility, running ability with and without ball, strength, respiratory capacity VO_{2max}, etc.

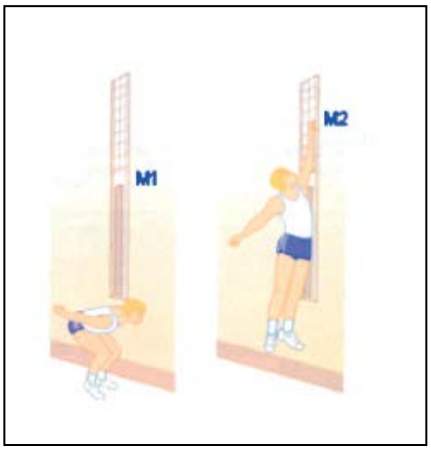
The tests carried out together with the methodology of their performance, as well as with the classification charts are presented as follows:

Anthropometric measurements

Test 1. Weight, Length, Body Mass Index (BMI)

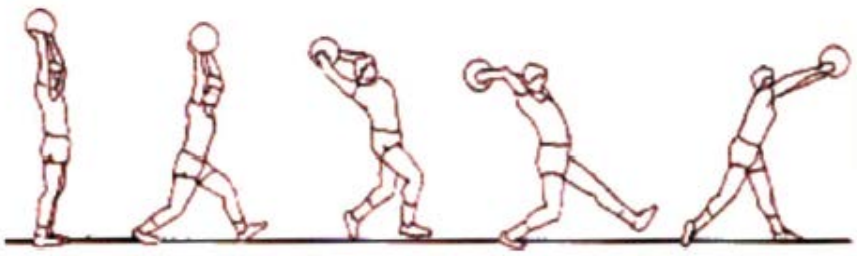
Test 2. Sit Ups Test (SUT)

Test 3. Standing long jump from (SLJT)



Testi 4. "Sergeant" jump (SJT)

Test 5. 3 steps medicine ball throw (MB3)



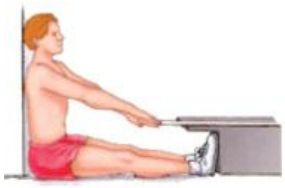
Test 6. 15-meter speed test (S15m)

Test 7. "Shuttle Run" (SHRT)

Test 8. Aceleration test, 30-meter (30m (S))

Test 9. 60-meter speed test (60m (S))

Test 10. 100-meter sprint (100m (S))

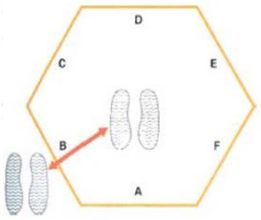


Test 11. 400-meter "Drop Off" (400 MDOFFT)

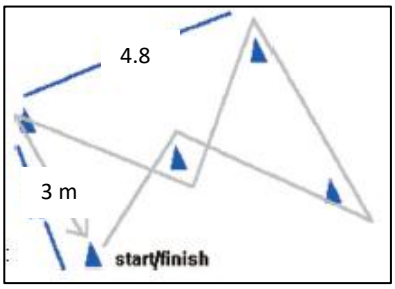
Test 12. Sit and reach test (MFT)

Test 13. "Cooper" VO_{2max} 12÷2 = 6min ($CVO_{2\ max}$ T)

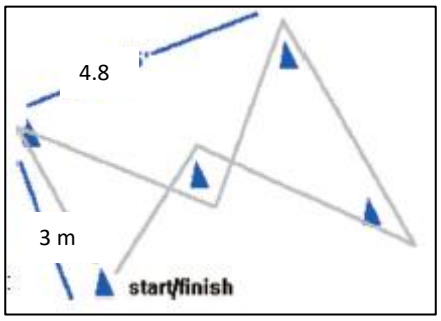
Test 14. Hegzagonal Agility test (HOT)



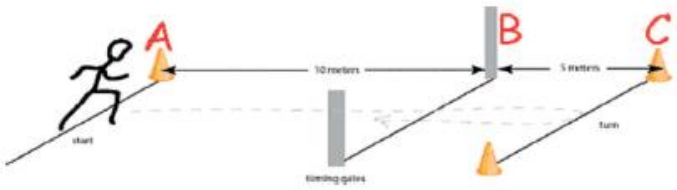
Test 15. Zig-Zag test (ZZT)



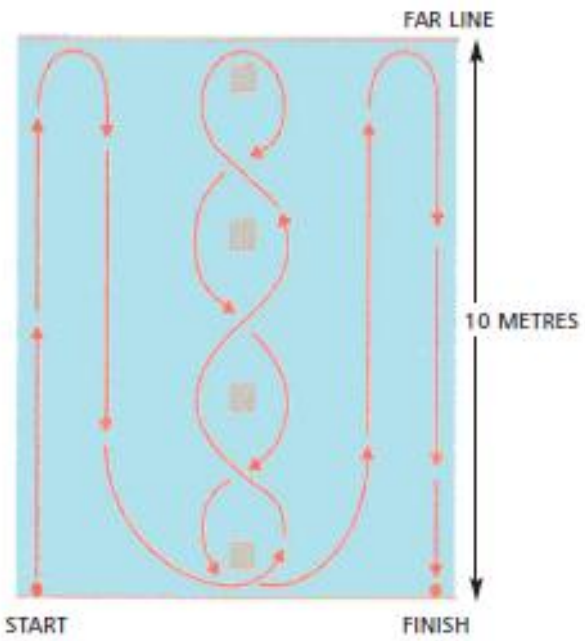
Test 16. Zig-Zag test with ball (ZZTB)



Test 17. Agility Test 505 (505 AT)



Test 19. Illinois Agility Run Test Ball (IART)



Test 20. 16.5m shooting at the goal post (GJ16.5)

Figure 1. 16.5m kicking the ball

Testi 21. 8m heading at the goal post (GJ8)

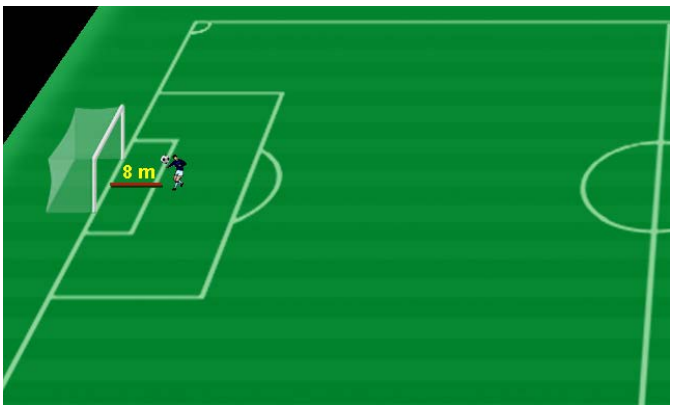


Figure 2 8m head kick test

Training Program

Proprioceptive training program

The proprioceptive program was subjected to an experimental group of 31 subjects with proprioceptive exercises. The proprioceptive program is comprised of a total of six microcicles where each microcicle includes four weeks, from which each week we have 3 training sessions. Each training session is made up of a 45-minute duration.

The microcycle were comprised of this set of proprioceptive exercises:

Ball hitting with the head standing / jumping over an elastic ball

• 5 series with as many repeats for 30 seconds

Over head ball shot standing over an equilibrium platform with both legs

• 5 series with as many repeats for 30 seconds

Rope jumping, subject standing over a elastik ball

• 5 series with as many repeats for 30 seconds

Passing of the ball with the inner foot, standing with one foot, subjecy standing on an equilibrium platform

• 5 series with as many as 30 seconds repeat for each foot

Headshot passes standing on one foot in a equilibrium equilibrium

• 5 series with as many as 30 seconds repeat for each foot

Ball passes with the inner foot, while the subject has tied around the waist a grip that is held by a partner

- 5 series with as many as 30 seconds repeat for each foot

Standart training program

The control group as well as the experimental group was made up of 31 subjects who have been subjected to the standard technical exercises of tactical tactical elements (ball possession, passage, controlling the ball, dribbling and shooting).

As during the proprioceptive program and in the standard exercise program, this program is comprised of a total of 6 microcicles per four weeks for each microcicle, and each week there are 3 training sessions. The duration of this program with standard exercises is 45 minutes as well as the proprioceptive training program.

Micro-cycles consisted of this set of standard exercises used in a training session in football.

1. **Receiving and passing of the ball at different distances**

   30-40 per person

2. **Dribling /leading the ball in different distances**

20-30 per person

3. **Ball dribblings with the ball with opponet infront**

20-30 for each side

4. **Shooting at goal post from different distances**

20-30 kicks

5. **Juggling with the ball**

120-150 Jugglings

Results

Statistical analysis

Statistical analysis was carried out using as a working environment software for statistical processing "IBM SPSS Statistics 22". The statistical techniques used include: Descriptive analysis through descriptive statistical indicators and inductive analysis methods through group variance analysis by repeated measurements. The method used for hypothesis control was ANOVA with 2 repeat measurements (initial measurement and final measurement) with 2 groups (control group and experimental group). The general descriptive analysis includes: descriptive summary table (average, standard deviation, minimum, maximum, standard error, confidence interval 95%, asymmetry, slope, standard error of asymmetry, standard slope error etc.); frequency tables; pillar graphics; data distribution through histograms; the distribution of data by groups across box-plot; graphs of averaging by groups and measurements, etc.

Data analysis using inferential (inductive) methods includes: Control for normal distribution, which is performed through normalization tests Kolmogorov-Smirnof and Shapiro-Wilk; Control of search hypotheses, which aim at identifying the impact or effect of the intervention using the comparison technique between pre and post (T1 and T2) measurements for variables dependent on ANOVA with 2 repeating measurements (Repeated Measures ANOVA); Reliability analysis through bivariate correlations between measurements, etc. Repeated measurements of ANOVA were used to assess the influence of independent variables on dependent variables. Various variables were considered the variables of the tests (Height, Weight, BMI, SUT, SLJT, SJT, MB3, S15 m, SHRT, 30 m, 60 m, 100 m, 400 MODFT, MFT, CVO_{2max}, MFT, GJ16.5, GJ8) while the independent variable was considered the group (experimental / control). The level of significance used for testing inferential methods is ($\alpha = 0.05$).

Descriptive Analysis Results *(Analysis of Anthropometric Parameters)*

Descriptive data analysis data for dependent variables, F(Start)_Height, P(Finish)_Height, F(Start)_Weight, P(Finish)_Weight, F(Start)_BMI, P(Finish)_BMI grouped by group are shown in the following tables.

Table 1: Summary of the descriptive statistical indicator for the variables: F(Start)_Height, P(Finish)_Height, F(Start)_Weight, P(Finish)_Weight, F(Start)_BMI, P(Finish)_BMI. Control group

Summary of the descriptive statistical indicator – Control group									
Group: gr.1 - Control									
	N	**Mean**	**Standart deviation**	**Error standart mean**	**Variance**	**Slope**	**Standart Slope Error**	**Asimmetry**	**Standart Asimmetry Error**
F (Start) _ Height (m)	31	1.7123	.04766	.00856	.002	-.327	.821	.020	.421
P(Finish)_ Height (m)	31	1.7261	.04849	.00871	.002	.084	.821	.167	.421
F(Start)_Weight (kg)	31	63.3871	7.97725	1.43276	63.636	1.775	.821	1.000	.421
P(Finish)_Weight (kg)	31	65.3871	7.95440	1.42865	63.272	1.041	.821	.747	.421
F (Start)_BMI	31	21.6371	2.71214	.48711	7.356	.590	.821	.782	.421
P(Finish)_BMI	31	21.9590	2.63667	.47356	6.952	.101	.821	.631	.421

Tabela 2: Summary of the descriptive statistical indicator for the variables: F(Start)_Height, P(Finish)_Height, F(Start)_Weight, P(Finish)_Weight, F(Start)_BMI, P(Finish)_BMI. Experimental group.

Summary of the descriptive statistical indicator – Experimental group									
Grou: gr.2 - experimental									
	N	**Mean**	**Standart deviation**	**Error standart mean**	**Variance**	**Slope**	**Standart Slope Error**	**Asimmetry**	**Standart Asimmetry Error**
F (Start) _ Height (m)	31	1.7584	.05763	.01035	.003	1.493	.821	-.749	.421
P(Finish)_ Height (m)	31	1.7700	.06126	.01100	.004	1.379	.821	-.366	.421
F(Start)_Weight (kg)	31	75.5129	17.15301	3.08077	294.226	-.417	.821	.725	.421
P(Finish)_Weight (kg)	31	77.3097	16.55513	2.97339	274.072	-.679	.821	.597	.421
F (Start)_BMI	31	24.3053	4.81503	.86481	23.185	.476	.821	.903	.421
P(Finish)_BMI	31	24.5703	4.55883	.81879	20.783	.174	.821	.757	.421

Tabela 3: Summary of the descriptive statistical indicator for the variables: F(Start)_Height, P(Finish)_Height, F(Start)_Weight, P(Finish)_Weight, F(Start)_BMI, P(Finish)_BMI. bOTH group.

Summary of the descriptive statistical indicator. Both groups									
Both groups									
	N	**Mean**	**Standart deviation**	**Error standart mean**	**Variance**	**Slope**	**Standart Slope Error**	**Asimmetry**	**Standart Asimmetry Error**
F (Start) _ Height (m)	62	1.7353	.05737	.00729	.003	-.046	.599	-.160	.304
P(Finish)_ Height (m)	62	1.7481	.05909	.00750	.003	.377	.599	.077	.304
F(Start)_Weight (kg)	62	69.4500	14.60682	1.85507	213.359	1.331	.599	1.320	.304
P(Finish)_Weight (kg)	62	71.3484	14.21361	1.80513	202.027	.883	.599	1.178	.304
F (Start)_BMI	62	22.9712	4.10228	.52099	16.829	1.836	.599	1.268	.304
P(Finish)_BMI	62	23.2646	3.92083	.49795	15.373	1.339	.599	1.113	.304

The averages for the aforementioned variables by measurements and groups are summarized as follows.

Table 4: Measurements and groups averages by variables

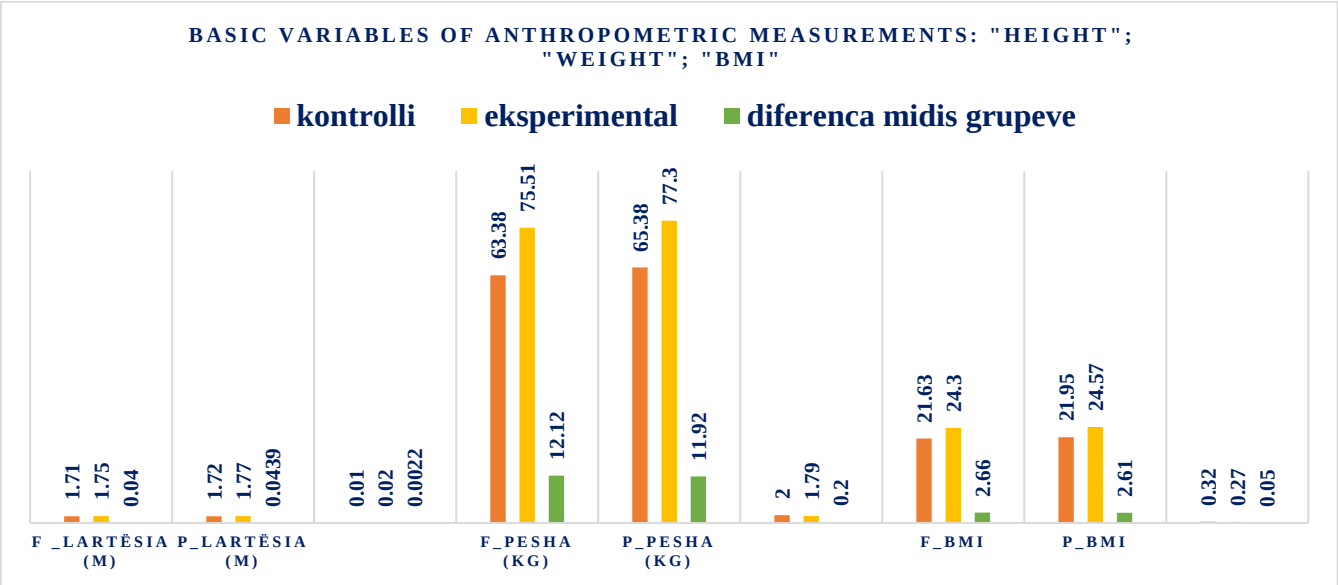
Averages						
Groups	**F (Start) _ Height (m)**	**F (Finish) _ Height (m)**	**F(Start)_Weight (kg)**	**F(Finish)_Weight (kg)**	**F(Start)_ BMI**	**P(Finish) _BMI**
Control	1.7123	1.7261	63.3871	65.3871	21.6371	21.9590
Experimental	1.7584	1.7700	75.5129	77.3097	24.3053	24.5703
Total	**1.7353**	**1.7481**	**69.4500**	**71.3484**	**22.9712**	**23.2646**

Differences of key variables, comparison between first measurement before intervention and second measurement after the intervention

a. Basic variables of anthropometric measurements: "Height"; "Weight"; "BMI"

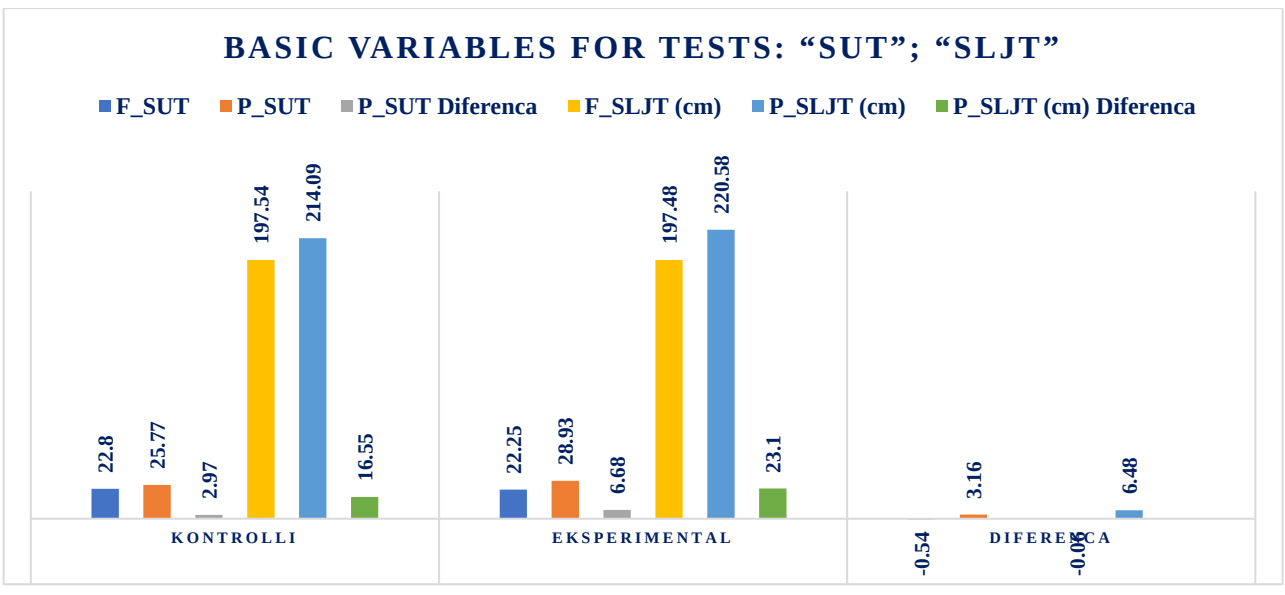
Group	F (Start) _ Height (m)	F (Finish) _ Height (m)	Difference	F(Start)_ Weight (kg)	F(Finish)_ Weight (kg)	Difference	F(Start)_ BMI	P(Finish)_ BMI	Difference
Control	1.71	1.72	0.01	63.38	65.38	0	21.63	21.95	0.32
Experimental	1.75	1.77	0.02	75.51	77.30	1.79	24.30	24.57	0.27

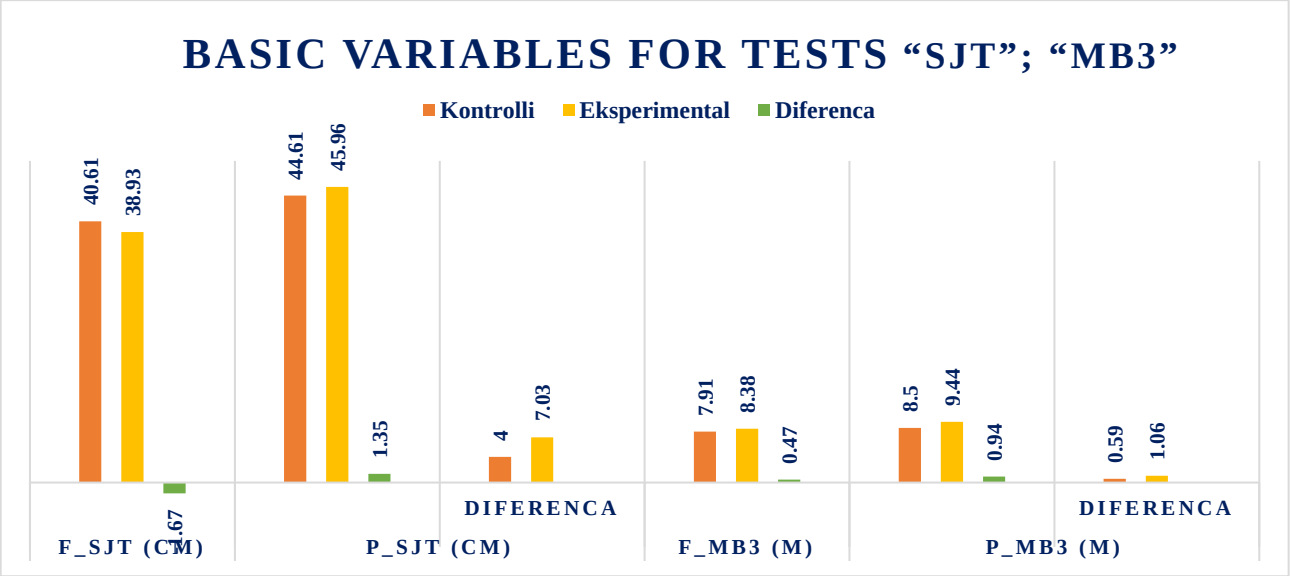
Difference between groups	0.04	0.04	0.0022	12.12	11.92	0.2	2.66	2.61	0.05



a. Basic variables for tests: "SUT"; "SLJT"; "SJT"; "MB3"

Group	F_SUT	P_SUT	Diferenca	F_SLJT (cm)	P_SLJT (cm)	Diferenca	F_SJT (cm)	P_SJT (cm)	Diferenca	F_MB3 (m)	P_MB3 (m)	Diferenca
Control	22.8	25.77	2.97	197.54	214.09	16.55	40.61	44.61	4	7.91	8.5	0.59
Experimental	22.25	28.93	6.68	197.48	220.58	23.1	38.93	45.96	7.03	8.38	9.44	1.06
Difference	-0.54	3.16		-0.06	6.48		-1.67	1.35		0.47	0.94	

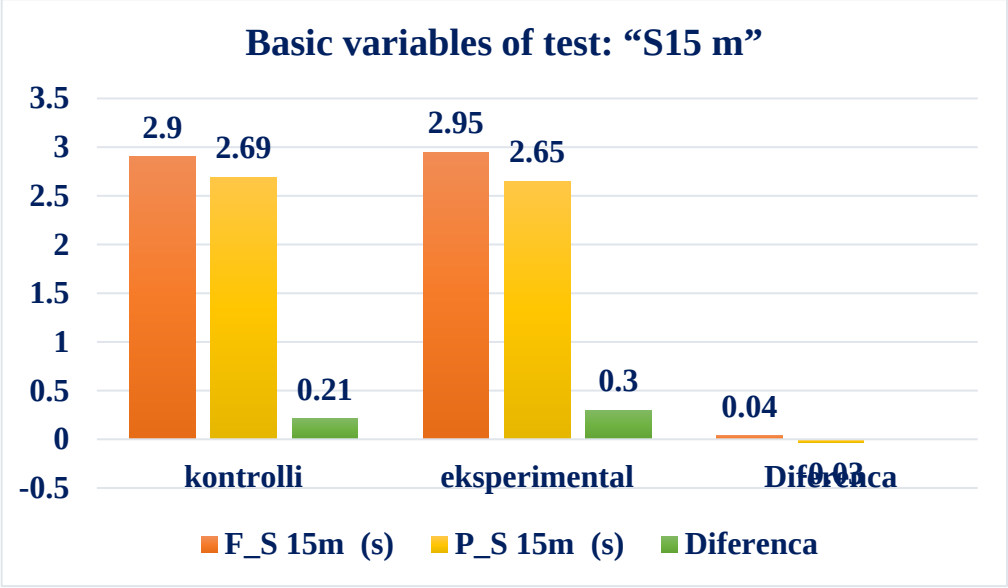




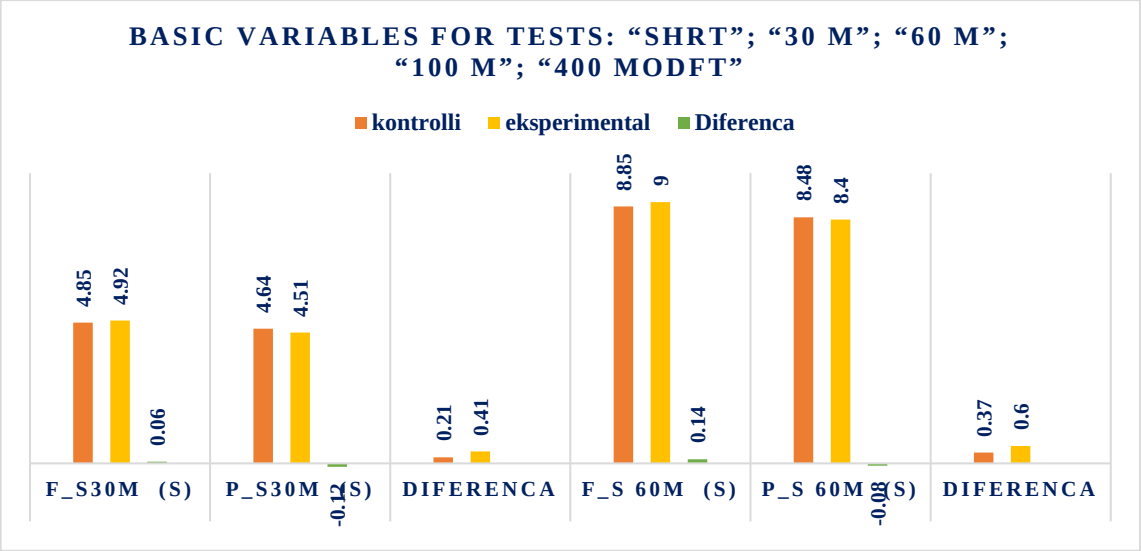
c.Basic variables for tests: "S15 m"; "SHRT"; "30 m"; "60 m"; "100 m"; "400 MODFT"

Group	F_S 15m (s)	P_S 15m(s)	Difference	F_S30m (s)	P_S30m (s)	Difference	F_S 60m(s)	P_S 60m(s)	Difference
Control	2.90	2.69	0.21	4.85	4.64	0.21	8.85	8.48	0.37
Experimental	2.95	2.65	0.3	4.92	4.51	0.41	9.00	8.40	0.6
Difference	0.04	-0.03		0.06	-0.12		0.14	-0.08	

c/1.Basic variables of test: "S15 m"



c/2. Basic variables for tests: "SHRT"; "30 m"; "60 m"; "100 m"; "400 MODFT"



c/1. Basic variables for tests: "100 m"; "400 MODFT"

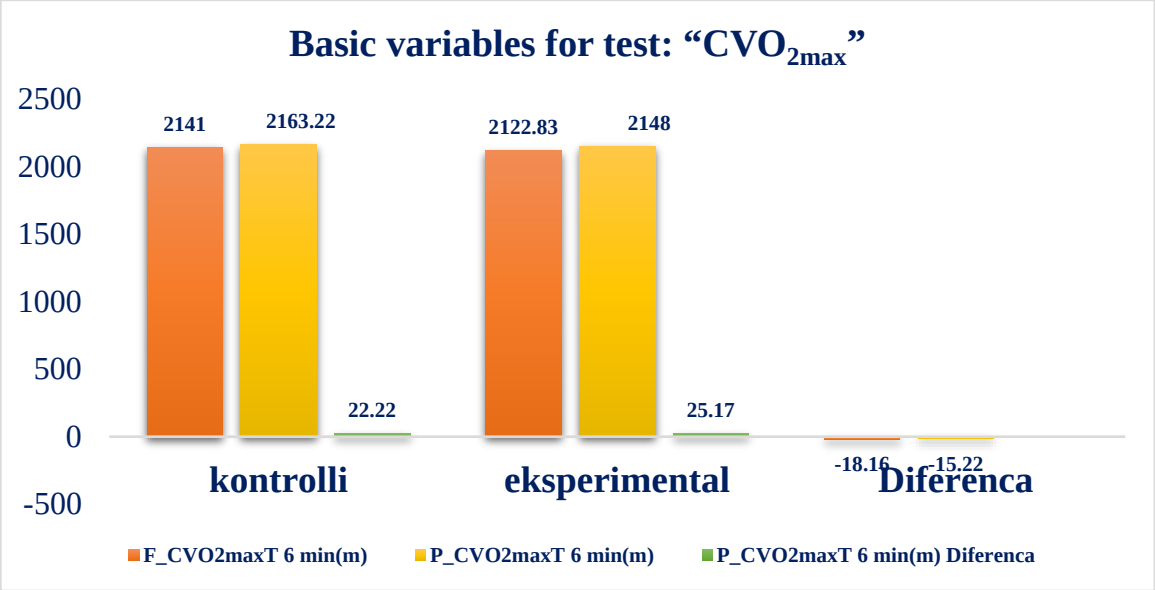
Group	F_S 100m (s)	P_S 100m (s)	Diferenca	F_400 MDOFFT (s)	P_400 MDOFFT (s)	Diferenca
Control	14.33	13.60	0.73	76.42	71.11	5.31
Experimental	14.61	13.75	0.86	77.58	73.40	4.18
Difference	0.27	0.15		1.15	2.28	

d. V Basic variables for test: "MFT"

Group	F_MFT (cm)	P_MFT (cm)	Difference
Control	41.35	37.12	4.23
Experimental	44.41	37.96	6.45
Difference	3.06	0.83	

e. Variablat bazë të testeve për: "CVO_{2max}"

Group	F_CVO_{2max}T 6 min(m)	P_CVO_{2max}T 6 min(m)	Difference
Control	2141	2163.22	22.22
Experimental	2122.83	2148	25.17
Difference	-18.16	-15.22	



f. Basic variables for tests: "HOT"; "ZZT"; "ZZTB"; "505 AT"; "IART"; "IARTB"

Group	F_HOT (s)	P_HOT (s)	F_Z-ZT (s)	P_Z-ZT (s)	F_Z-ZTB (s)	P_Z-ZTB (s)
Cont.	13.55	12.15	7.75	6.93	11.30	10.18
Exp.	13.30	11.52	7.89	6.96	10.77	9.26
Differ.	-0.247	-0.62	0.13	0.036	-0.52	-0.91

f/1. Basic variables for test: "505 AT"; "IART"; "IARTB"

Group	Grupi	F_505 AT (s)	P_505 AT (s)	F_IART (s)	P_IART (s)	F_IARTB (s)	P_IARTB (s)
Cont.	**Kont.**	2.91	2.69	17.50	16.03	23.01	20.77
Exp.	**Eksp.**	2.89	2.58	18.20	16.43	22.87	19.93
Differ.	**Difer.**	-0.01	-0.10	0.69	0.40	-0.14	-0.84

g. Basic variables for tests: "GJ16.5"; "GJ8"

Group	F_GJ 16.5m	P_GJ 16.5m	Difference	F_GJK 8m	P_GJK 8m	Difference
Control	1.83	2.54	0.71	1.80	2.77	0.97
Experimental	1.96	2.77	0.81	2.09	3.22	1.13
Difference	0.12	0.22		0.29	0.45	

Discussion

This study was very complex in its type because the number of tests and the results obtained was great but also the duration of the intervention was relatively long (6 months) but anyway the study in its entirety proved to confirm the initial hypothesis proving that improving physical and exercise parameters through proprioceptive exercise was better in the experimental group compared to the control group. Different exercises with flexion, stretching, gjanging, and movement of the other leg's ankle, with or without contact with the ball, stimulate functional movements such as kick, ball control, ball receiving., and when they are made progressively are more difficult to execute on soft and volatile surfaces, they become more demanding and more effective as they further activate the somatosensor tract (Swanik et al., 1997).

Static and semi-dynamic equilibrium exercises are important for improving proprioceptive readiness, reflexive stabilization, and posture orientation. Any attempt to adapt functional postural attitudes (in football or other sports) during the exercise of the exercises to improve the static balance, determine different requirements in the musculoskeletal structures about the articulation of the ankle, knee and femoral head (Prentice, 2004).

Regarding Objective 1, that was; measurement and evaluation of physical and mobility parameters in 17 years old football players, the results showed that the subjects involved in the study had good levels at physical and motion parameters referring to the results of the first tests. The data showed in most cases that the subjects were within the recommended rating norms, even in some cases the test results were very good.

Whereas, with regard to Objective 2, which was to improve physical and mobile parameters through proprioceptive exercise training in 17 years old football players.

Referring to the results after the end of the intervention training program, it turns out that the proprioceptive exercise training conducted for a 6-month period significantly improved the majority of the physical and mobility parameters of the control group subjects and more concretely;

- **Test 2 (SUT) Sit Ups Test, the highest SUT** found in the experimental group (28.93 ± 3.07) compared to the control group (25.77 ± 3.07) ascertained over measurements after the training plan, ANOVA scores prove a statistically significant difference ($p < 0.05$) between groups for the dependent variable "SUT". Consequently, it is proved that proprioceptive exercise is more effective than basic training in performance enhancement at the SUT test. Based on Table 2, the control group subjects are categorized at the mean level while the experimental group is categorized to the above-average level.

- **Test 3. (SLJT) High jump from the ground, the highest average for "SLJT"** found in the experimental group proves a statistically significant difference ($p < 0.05$) between groups for the dependent variable "SLJT". Consequently, it is proved that proprioceptive exercise is more effective than basic training in performance enhancement to the SLJT test. According to Table 3, the subjects of the control group are at the level of 11-20% while the subjects of the experimental group are at the level of 21-30%. Whereas, according to Table 5, the subjects of both groups are categorized below the average
- **Test 4 "Sergeant Jump" (SLJ),** according to the results it is concluded that there is a higher performance for "SJT" in the experimental group compared to the control group and that the ANOVA results prove a statistically significant difference ($p < 0.05$) between groups for the dependent variable "SJT". Consequently, it is proved that proprioceptive exercise is more effective than basic training in performance enhancement of the "SJT" test and according to Table 6 the subjects of both groups are included in the mid-level category.
- **Test 5. 3 steps medicine ball throw (MB3),** Based on the results we conclude that there is a higher performance for the "Three-Step Medical Ball Test" (MB3) test in the experimental group compared to the control group during measurements after the training plan, and that the ANOVA results prove a statistically significant difference ($p < 0.05$) between groups for the dependent variable "MB3". Consequently, it is again proved that proprioceptive exercise is more effective than the basic exercise in boosting MB3 test performance. According to Table 9, the control group is rated at 3 points and the experimental group is rated at 4 points.
- **Regarding speed tests** (Tests 7, 9, 10, 11)**,** *S15m, SHRT, 60 m, 100 m, 400 MODFT and* ***acceleration*** *30 m* (Test 8), we conclude that the ANOVA results prove that there is no significant difference ($p > 0.05$) between groups for the dependent variable "Average speed tests". Consequently, it can not be proven that proprioceptive exercise is more effective than the basic exercise in enhancing the performance of the above tests. Based on Table 10, the subjects of both groups for the 30m acceleration test are classified at the level "Under average".

- **Test 12. Sit and reach test,** "MFT", ANOVA results with 2 repetitive measurements for the dependent variable "MFT", ($P < 0.0005$) prove that "The basic exercise and proprioceptive exercise affect the performance enhancement in the SUT test. We conclude that higher performance for "MFT" in the experimental group (37.97 ± 5.8) compared with control group (37.1 ± 3.4) during measurements after training plan, and that ANOVA results prove a statistically significant difference ($p < 0.05$) between the groups for the dependent variable "MFT". Consequently, it is proved that proprioceptive exercise is more effective than the basic exercise in enhancing the performance of the "MFT" test. The ANOVA results with 2 repetitive measurements for the dependent variable "MFT" ($p = 0.005$) and the group as independent

variables identified a statistically significant (significant) difference between the experimental and control groups.

- **In test 13, "Cooper Test" VO_{2max},** the ANOVA results with 2 repetitive measurements for the dependent variable "CVO_{2max}" (P <0.0005) prove that "Basic and proprioceptive exercise program affect performance enhancement in the VO_{2max} test. Also, the ANOVA results with 2 repetitive measurements for the dependent variables "CVO_{2max}" (P> 0.05) and the group as independent variables revealed a statistically not significant (not significant) difference between the experimental and control groups. Consequently, it can not be proved that proprioceptive exercise is more effective than the basic exercise in boosting the "VO_{2max}" test performance.

- **Test 14. Hegzagonal Agility test (HOT), w**e conclude that there is evidence of higher performance for HOT (s) tests, in the experimental group compared to the control group during measurements after the training plan, and that ANOVA scores show a statistically significant difference (p <0.05) between groups for the variable dependent "Average Time (s)". Consequently, it is proved that proprioceptive exercise is more effective than basic training in the performance enhancement of the HOTk (s) test, and based on Table 11, group entities are classified as "Over Average".
- **For Test 15. Zig-Zag test; Test 16. Zig-Zag test with ball; Test 17. Agility Test 505,** the results of ANOVA with 2 repetitive measurements for the dependent variable "Average Time (s)" (P <0.0005) prove that "Basic and proprioceptive exercise program affect performance enhancement in Z-ZT (s), Z- ZTB (s), 505 AT (s). The ANOVA results with 2 repeat measurements for the dependent variable "Average Time (s)" (P <0,0005) and the independent variable group identified a statistically significant (significant) difference between the experimental and control groups. We conclude that there is evidence of higher test performance, Z-ZT (s), Z-ZTB (s), 505 AT (s), experimental group compared to control group during measurements after training plan and ANOVA results a statistically significant difference (p <0.05) between groups for the dependent variable "Average Time (s)". Consequently, it is proved that proprioceptive exercise is more effective than basic exercise in Z-ZT (s), Z-ZTB (s), 505 AT (s) performance enhancement.
- **Test 18. Illinois Agility Run Test (IART (s)),** We conclude that there is evidence of higher test performance (IART (s)), experimental group compared to control group during measurements after training plan, and that ANOVA scores show a statistically significant difference (p <0.05) between groups for dependent variable "Average Time (s)". Consequently, it is proved that proprioceptive exercise is more effective than the basic exercise in test performance enhancement (IART (s)), and based on Table 12, the subjects of the control

group from 17.50 s at the initial measurement went to 16.03 s in the measurement final and are classified as "On average" while on the other hand the experimental group from an average score of 18.20 s at the initial measurement went to 16.4384 s in the final measurement being classified at the "average" level but in this improvement group was greater .

- **Test 19. Illinois Agility Run Test Ball (IARTB (s)),** We conclude that there is evidence of higher test performance (IARTB (s)), experimental group compared to control group during measurements after training plan, and that ANOVA scores show a statistically significant difference ($p < 0.05$) between groups for dependent variable "Average Time (s)". Consequently, it is proved that proprioceptive exercise is more effective than the basic exercise in test performance enhancement (IARTB (s)), and based on Table 13, the subjects of both groups in the final measurement are classified as "Poor", but the subjects of the group experimentally improved.

- **Regarding Test 20. 16.5m kicking the ball,** ANOVA results with 2 repetitive measurements for the dependent variable "GJ 16.5m" ($p < 0.0005$) prove that "Basic and proprioceptive exercise program affect performance enhancement in the" GJ 16.5m "test. Also, the ANOVA results with 2 repeated measurements for the dependent variable "GJ 16.5m" ($p > 0.05$) and the group as independent variables showed a statistically non-significant difference between the experimental and control group. Consequently, it can not be proven that proprioceptive exercise is more effective than basic training in performance enhancement of the "GJ 16.5m" test.

- **And for the last test, test 21. 8m head kick test,** the ANOVA results with 2 repetitive measurements for the dependent variable "GJK 8m" ($p < 0.0005$) prove that "Basic and proprioceptive exercise program affect performance enhancement in the" GJK 8m "test. On the other hand, the ANOVA results with 2 repetitive measurements for the dependent variable "GJK 8m" ($p > 0.05$) and the group as independent variables revealed a statistically non-significant difference between the experimental and control group. Consequently, it can not be proved that proprioceptive exercise is more effective than basic training in performance enhancement of the "GJK 8m" test.

Conclusion and Recommendations

- Referring to Objective 1, which was the measurement and evaluation of physical and mobile parameters in 17 years old football players, from the data obtained from the study we can say that the groups surveyed resulted to have a good level of parameters physics and mobility based on the results of all the tests performed at the beginning of the study.

- Regarding Objective 2, the improvement of physical and mobile parameters through proprioceptive exercises in 17 years old foorball players, based on the second measurement results after the end of the intrusion exercise program, resulted that proprioceptive exercise improved markedly positively almost all physical and mobility parameters to the subjects of the control group.

- Our study confirms once again that the application of proprioceptive exercises significantly affects the improvement of coordination skills and physical qualities of subjects aged 17 years.

- At the same time, we express the conviction that these kinds of exercises, even if applied in pre-university education programs, would bring improvements to the physical qualities of children and young people.

- The values of proprioceptive exercises will be even better or greater if, during their execution, they will be accompanied by special equipment that improves and rises to a high level all the neuromuscular units of subjects that deal with this kind of exercises.

- Also, the use of such equipment during school curriculum classes can bring a great variety to the types of exercises, thus bringing a greater attainment and perks to the pupils.

- The study highlights the importance of these training programs that focus on improving the physical and functional capabilities of football players in general and young players in particular. These types of exercises have already become part of contemporary football training programs.

- We think it would be very interesting to develop programs or other study projects focusing on the more complex effects of the proprioceptive exercise training and the more specific requirements aimed at changing the visual, sensory information etc. to the subjects that play football. Also, a special focus should be placed on preventing injuries, improving orientation, coordination, balance, etc.

- From the study it is very clear that proprioceptive exercise can improve the physical and technical skills of football players, but it is necessary to study with great effectiveness the other training programs with different characteristics such as frequency, quantity, or types of exercises, at all ages not only in adolescents.

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