CHARLES UNIVERSITY IN PRAGUE
FACULTY OF PHYSICAL EDUCATION AND SPORT
DEPARTMENT OF PHYSIOTHERAPY

Comparing Effect of Static, Dynamic, and Combined Stretching Exercises for Semi-Professional Collage Football Players on Sprint Performance

Master Thesis

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Prague 2023

Abstrakt

Název

Porovnání vlivu statických, dynamických a kombinovaných protahovacích cvičení pro poloprofesionální vysokoškolské fotbalisty na výkon ve sprintu

Cíl

Záměrem naší experimentální studie bylo zkombinovat jedno odporové cvičení (bulharský split squat) se třemi typy strečinkových cvičení (statický, dynamický a kombinovaný strečink), s cílem zjistit, který strečinkový protokol prokáže pozitivní účinky na zlepšení výkonu v krátkém 20 m sprintu u poloprofesionálních vysokoškolských fotbalistů a to v pěti sezeních v akutní tréninkové fázi (10 dní).

Metodologie

Studie se zúčastnilo 20 zdravých poloprofesionálních fotbalistů, ve věku 18 až 30 let (průměr 25,5 let). Všichni účastníci hráli fotbal na různých pozicích a hráči byli náhodně rozřazeni tak, aby každá skupina zahrnovala shodně obránce, útočníky, záložníky a křídla. Nábor dobrovolníků do výzkumu zajišťoval autor studie. Intervenční program se konal na Fakultě tělesné výchovy a sportu. Délka programu byla 10 dní a uskutečnil se v pěti sezeních, každá skupina měla svůj specifický cvičení protokol, všechny skupiny měly zotavné procedury a dostaly informace o bezpečnosti, pravidlech a potenciálních rizikových faktorech. Účastníci byli rozdělení do čtyř skupin a v každé skupině bylo pět fotbalistů, první skupina byla kontrolní (CG), druhá prováděla statický strečink (SS), třetí skupina dynamický strečink (DS) a poslední čtvrtá skupina prováděla kombinovaný statický a dynamický strečink (CSD). Testování bylo provedeno bezdrátovým systémem Browser tymin, hlavním údajem byla doba výkon ve sprintu na 20 metrů.

Výsledky

Skupina 1: u kontrolní skupiny bylo zaznamenáno mírné zlepšení $p < 0,1$. Skupina 2: u skupiny cvičící protokol statického strečinku došlo k významnému poklesu výsledku časového skóre výkonu ve sprintu $p > 0,14$. Skupina 3: u skupiny cvičící protokol dynamického strečinku došlo k mírnému zlepšení časového skóre výkonu ve sprintu $p < 0,3$. Skupina 4: u skupiny cvičící kombinovaný statický a dynamický strečink došlo k významnému zlepšení časového skóre ve výkonu ve sprintu $p < 0,9$.

Závěr

Výsledky studie ukázaly, že u poloprofesionálních vysokoškolských fotbalistů lze doporučit před tréninkem a hrou protokol kombinovaného statického a dynamického strečinku, který může vést v krátkodobé fázi k lepší výkonnosti ve sprintu. Druhé doporučení se týká využití protokolu dynamického strečinku, které také pozitivně ovlivňuje výkon ve sprint. A konečně, protokol statického strečinku by neměl být používán, protože může v krátkodobé fázi výkon ve sprintu zhoršovat.

Klíčová slova: Statický strečink, dynamický strečink, kompenzační strečink, bulharský split squat, výkon ve sprintu, fyziologické faktory, bezdrátový systém Brower timing.

Abstract

Goal

The aim of our experimental study to combine one resistance-training exercise (Bulgarian Split Squat Exercise) with three types of stretching exercises (static, dynamic, and combination stretching exercises) to find which protocol has positive effective in improving the short-sprint time performance in 20 meters for semi-professional college football players in five sessions in acute term- phase (10days).

Methodology

The number of participants was 20 male healthy semi-professional college football players. They were all between the age of 18-30 (means 25.5). All participants played football in different positions in each group included defenders, attackers, midfields, wings position, and they were choosing randomly to each group from these positions. They were asked by the main researcher personally to participate in the experimental study. The place of the intervention program was at the Faculty of Physical Education and Sport. The program lasted for ten days in five sessions, each group had a specific protocol, and all groups had the recovery procedures and they received information on the safety, rules, and risk factors. The participants divided into four groups equally in each group five participants, the first group was control group (CG), second group performed static stretching (SS), third group dynamic stretching (DS), and last group combination stretching exercises (CSD). The test was conducted by the Brower Wireless Timer System; it was the major collecting date by recording the time score of the sprint performance in 20 meters.

Results

Group 1. Control group slight variables change improvement $p < 0.1$. Group 2. Static Stretching group protocol there was significant decrease in time score result of the sprint performance $p > 0.14$. Group 3. Dynamic Stretching group protocol there was slight improvement of time score in sprint performance $p < 0.3$. Group 4. Compensation Static following Dynamic group protocol there was significant improvement of time score in sprint performance by $p < 0.9$ variables change.

Conclusion

The first recommendation for semi-professional college football players applying CSD protocol pre training and game for better sprint time performance in the short term phase. The second recommendation using DS protocol pre training and game due the slight positive variables result in improving sprint time performance. Lastly, do not use SS protocol pre training and game due to reducing the sprint time performance in the short term phase.

Keywords: Static Stretching. Dynamic Stretching, Compensation Stretching, Bulgarian Split Squat Exercise, Sprint Performance, Physiological Factors. Brower Wireless Timer System.

Declarations

I declare that this study has been done by myself and it is my own work, this study was under the supervision of prof. MUDr. Jan Heller, CSc.

I would like to confirm this study was not submitted or published to achieve any degree at any university or educational systems.

Acknowledgments

In this paragraph, I want to express my excessive appreciation to all my teachers and professors at the Faculty of Physical Education and Sport in all departments. I learned and taught many things during the last five years in my bachelor and master studies. I gain valuable educational knowledge and experience. Special thanks to Physiotherapy, Physiology, and Human Laboratory Movement department for their advice and operative during my study. I would like to thank the head of the Department of Human Laboratory Movement department Doc. Ing. František Zahálka, Ph.D and the team PhDr. Mikulas Hank, ph.D, Msc. Osman Imal for providing me the tools to apply the procedure of the intervention program, as well as thanks for my supervisor MUDr. Jan Heller, CSc for his guide and been operative with my thesis project. In addition, thanks goes to my professors at the physiotherapy department during my master studies clinically and theoretically subject's Doc. PaedDr. Dagmar Pavlů, CSc, PhDr. Tereza Nováková, PhDr. Jitka Malá, Ph.D, Mgr. Helena Vomáčková, Ph.D. Finally, I would like to express my pleasure to be a part of this university during the journey of the last five years.

Dedication

I would like to dedicate my master thesis project to my family and I would like to thank them for the support and their help during my study. I would like to thank my supervisors, friends, and everyone who helped me. There have been hard moments during the studies and without you, it could be a harder journey.

Table of Content

1. Introduction

The study is to compare the effect of static, dynamic, and combination static dynamic stretching exercises on sprint performance in acute term phase (Ten days). The purpose of this study is to figure out which stretching techniques with resistance training exercises are improving the sprint performance for the semi-professional college football players.

Sprint Performance in semi-professional players is crucial due to absence of football proficiency found in professional players. Football game has developed with the techniques, plans, the speed, and physical power. Sprint performance is bonus and important for the team and players compared with skills. (Wallace, 2014).

The idea of our thought is that stretching exercises are a key to decreasing muscle injuries, which is true, but it's as well as has ability to improve the performance of acceleration and speed for athletes sports individually or group sports such as football sport. (Khorasani, 2010).

However, there are studies that investigate which stretching techniques have advantages and disadvantages significance related to sprint performance. For example, One study has reported that a dynamic stretching exercise improves performance compared with static stretching in speed and jump performance. (Little & Williams, 2006). Another study proving no effect of static stretching in sprint and vertical jump performances by six weeks program for athletics. (Bazett Jones, 2008). One year later another study confirmed the output by showing that static stretching reduces muscular performance. (Curry, 2009).

Then Amiri Khorasani had an experimental study demonstrating positive effects of dynamic stretching in acceleration; they suggested players should perform static and dynamic stretching exercises. (Khorasani, 2016).

Another experimental study in 2016 by de Oliveira showed Static stretching does not reduce variability, jump and speed performance in acute phases for athletics. (de Oliveira, 2016).

In all these studies above the methodological principles based on one factor, which is stretching exercise, In this experimental study I add other physiological factors to improve the sprint performance by adding special criteria procedures such as resistance-training exercises in the protocol due to sprint performance based on stride frequency and stride length as well as the recovery procedures for better muscular functions . (Bishop, 2013).

Background

2 Physiological Muscular System

2.1 Introduction

There are three types of the muscles in the human body skeletal, cardiac, and smooth muscle. Each type has specific cell components, special function, physiology, and pathology. (Noto, 2018).

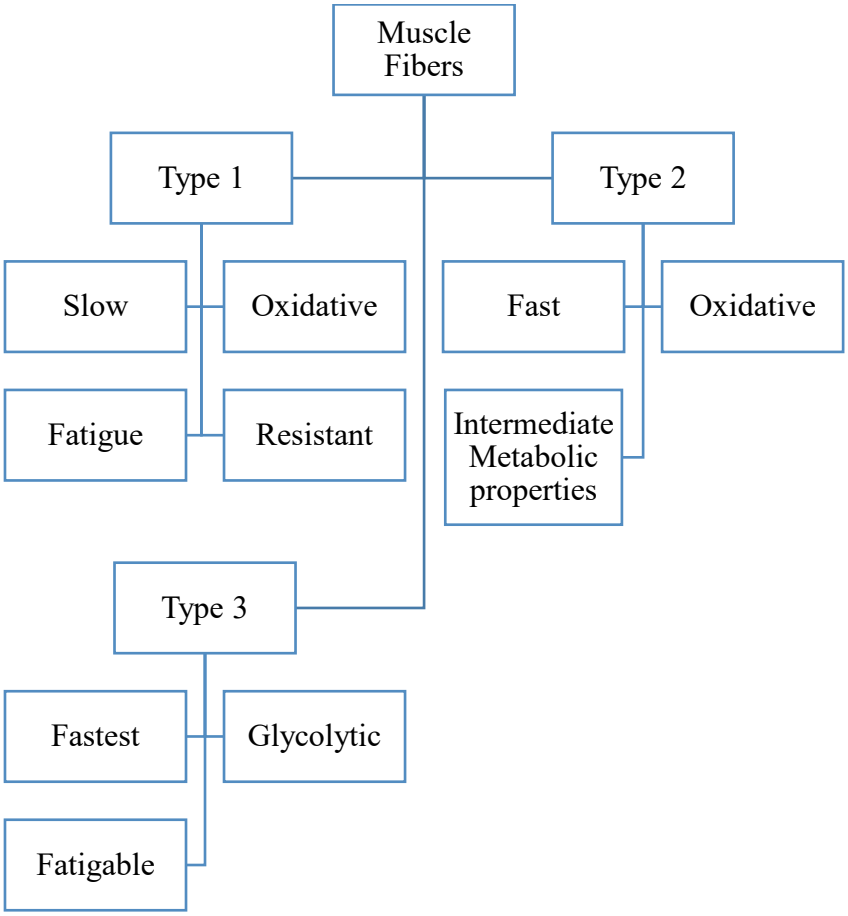
2.2 Skeletal Muscle

Organ cells that mainly control movement and posture. It constitutes around 40% of the completely human body weight. The structure of the skeletal muscle has many individual fibers bundled together into a muscle spindle and this provides the skeletal muscle a striated presence. The muscle fiber includes actin and myosin fibers covered by a cell membrane called a sarcolemma. These fibers are the functional unit of the organ in the stretching mechanism, which they are leading to contraction and relaxation. (Frontera, 2015).

2.3 Classification of Muscle Fibers

Muscle fibers are classified in special criteria in adult human limp in three types. The main function of skeletal muscle is to adapt chemical energy into mechanical energy to produce force and power, maintain posture for stability, and produce movement activity, which tolerates participation in social and occupational settings, maintains or improves health, and contributes to functional independence. See Table 1. (Frontera, 2015)

Table 1: Classification of Muscle Fibers (Frontera, W. R 2015)



3 Sprint Performance

3.1 Introduction

Sprint performance defined as a running velocity above a lower limit ranging from 19 to 25 km/h. Sprint performance based on stride length and stride frequency systems. (Gabbett, 2008). The short distance sprint performance between Five to 20 meters. It is a necessary part and bonus of athletic performance within the football codes. (Bishop, 2013).

The maximum intensity sprint exercise requires extreme high levels of neural activation. (Nummela, 1994). Football players sprint up to 35 times during a game as an average. (DiSalvo, 2010).

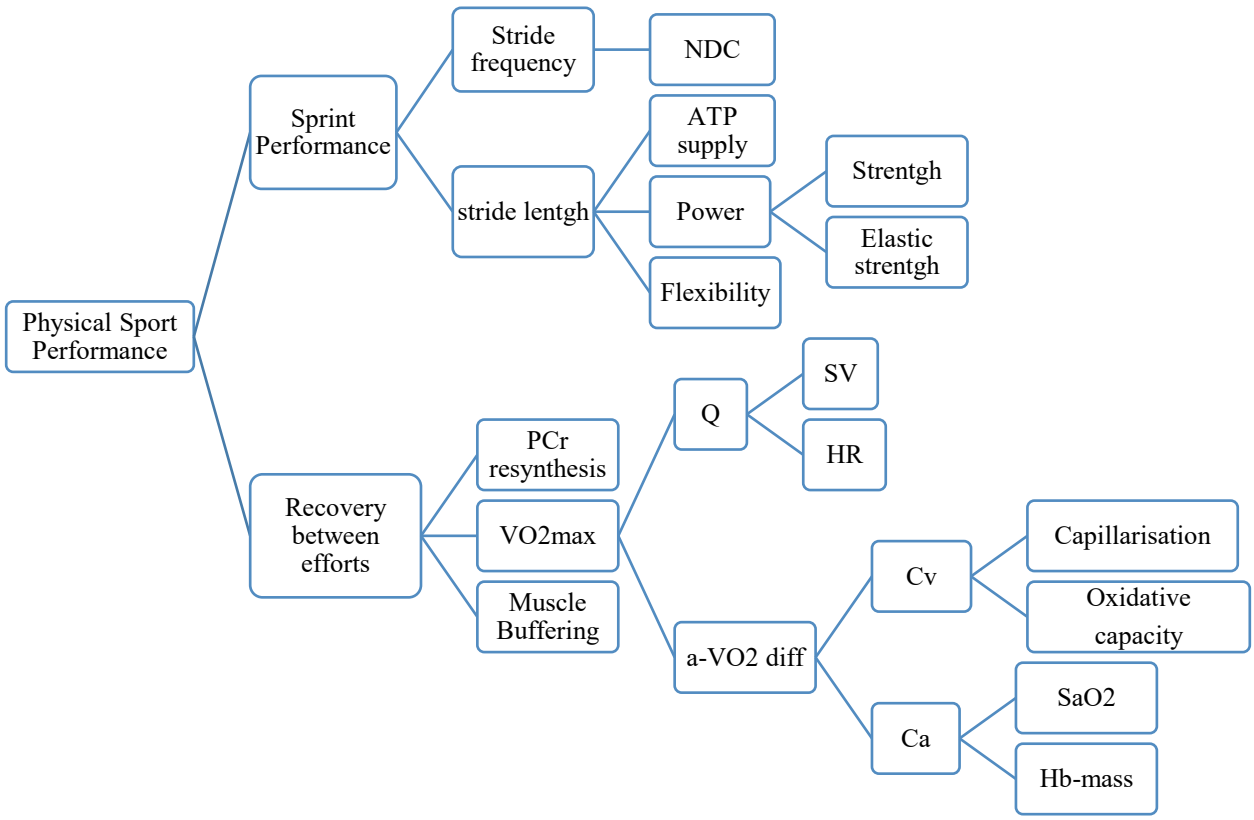
The sprint performance for team sport athletes especially in football sport has many categories such as rotation, straight liner, and change direction sprint. All these categories process by pressure and by the observation the straight liner, sprinting is the most frequent action preceding a goal in football. (Faude, 2012).

The structure of the football game for professional, semi-professional, and non-professional has changed and developed recently that football players need more and more dynamic speed and acceleration within techniques to perform high intensity performance. The new football concept is designated by shorter time of ball contact, increased passing rates, higher player density, and faster transitions from defending and attacking. Moreover, the less techniques and skills quality for semi-professional football players, the sprint performance is an important function and compensation of skills and techniques to develop the game and bonus for the team and players individually. (Wallace, 2014).

3.2 Physiological Factors of The Sprint Performance

There are two physiological physical factors that affect the physical performance, which are sprint performance and recovery procedures between efforts, which is the ability to recover the tonicity of the tissues to improve the mechanisim of the physical performance. See table 2 (Bishop, 2013). The establishment of the sprint performance based on stride frequency and stride length, to improve the sprint performance it needs to increase both of them which means stride length improving the strength, power, ATP, and flexibility of the tissues and elasticity function to give physiological ROM of the joints at high speed and reaction connection with human systems. Moreover, determined by stride frequency, which is connected to intramuscular coordination connections. See Table 2. (Ross, 2001).

Table 2: Physiological Factors Responsible to Sprint Performance (Bishop, 2013)



3.2.1 Adenosine Triphosphate Supply

The Adenosine Triphosphate system ‘is a universal mediator of metabolism and signaling across unicellular and multicellular specie’. (Rajendran, 2016).

The maximum sprint efforts rely on a fast and constant turnover of ATP, driven by three systems. The first and second systems are phosphocreatine (PCr) breakdown and glycolysis. Both are anaerobic systems meaning no oxygen needed to produce ATP.

The ATP-PCr systems last the movement five to 15 seconds and it functionally works in strength power movement such as throwing in baseball and swinging in golf sport, jumping, and short sprint performance. This character of quick movement by ATP sorted in the muscle fibers helps produce more ATP.

The glycolytic system is one of the forms of carbohydrates that is constantly circulating in the bloodstream. Its rapid breakdown of carbohydrates to create ATP through process creates a substance called lactate. It forms hydrogen ions which this accumulation of the hydrogen ions in the muscle cells cause the muscle fibers to become more acidic which contributes fatigue, to prevent this mechanism by breathing exercises or nutrition to decrease the acids such as hydrating the body by water. The function of the glycolytic system is producing ATP quickly, but not over long duration.

The last system is oxidative system it’s an aerobic system. It involved oxygen through two metabolic component and it slow the production of ATP in short duration, but it produce for longer duration. The first component is the crebs cycle and the second is electron transport chain both they can produce ATP as quickly as glycolytic and PCr- ATP.

Oxidative systems can produce carbs, protein, and fats. The mechanism works by breaking down fats and protein, so the processes become longer, an example of this mechanism is biking and running for long distances. A high recommendation of anaerobic energy release during sprint exercises has been proposed to be value tools stimulating to increase anaerobic capacity. (Calbet, 2003; McLellan ,1990; Chaudhry & Varacallo, 2021).

3.2.2 Power

The power of the muscles in sprint performance is divided into two concepts: strength and elastic strength. Strength should be in maximum individual muscle or muscle group force and it can generate at a specific velocity by resistance and continues mechanical stereotype. (Rhea, 2004).

In addition, hypoxia is insufficient to induce muscle hypertrophy, increase muscle strength and improve sprint performance (Nishimura, 2010).

The elastic strength plays an important role to achieve the power of the muscles based on the stretch-shortening cycle and the ability to apply maximal force during a high-speed movement. (Komi, 2000).

The elastic strength has been shown to be an important determinant of sprint performance. (Young, 1995).

3.2.3 Neural Drive Coordination

Intramuscular coordination plays one of the most important roles to improve the sprint performance by CNS and perception function leading to an increase of the coordination and reaction of initial starting position reaction, one of the factors to improve it by repeating the

sprint performance, which lead to an adaption by the motor behavior and motor control system. (Ross, 2001).

The function effect of the ability to repeat sprint performance has linked with the ability to maintain faster stride frequencies through retaining higher vertical stiffness. (Girard, 2011).

3.2.4 Recovery Between Physical Efforts

During physical activities the contract of the muscles exists, in football sports the eccentric contract repeated during the training, which is needed to reduce the stress load that could damage the disruption proteins in the muscle fibers tissues. (Dugué, 2015)

The recovery, methods such as nutrition by hydrating intake water to reduce the hypoxia mechanism as well as other methods such as massage therapy post and pre performance of physical activities, or cryotherapy post physical performance to reduces the reflex muscle spasm and vasodilation of the muscular and inner organs to maintained the physiological function of the body tissues to perform better function and decrease the risk of injuries. (Dupuy, 2018)

Cryotherapy application has high value to recover the muscle fibers and prevent the soreness and it decreases the temperature of the tissues stimulating cutaneous receptors to excite the sympathetic adrenergic fibers which causes the constriction of local arteriole. (Cheung, 2003).

The recommended duration for the ice water therapy application is not more than 20 minutes and the temperature of the water mines 5 °C to 15 °C degree. The output affection of the application is the vasoconstriction mechanism in the skin, which is analgesic, recovery, and decrees muscle temperature as well as prevent, and treat the procedures of muscle hypoxia. (Dupuy, 2018)

3.3 Biomechanics Factors of Sprints Performance

Sprint performance mechanically splits into two mechanisms: first is acceleration in short sprint and second is maximal sprinting velocity phases. See Table 3. (Brown & Vescovi 2004).

Maximum sprint and speed can be improved by increasing stride length and the number of the stride frequency and both of these factors increase the run and sprint performance. (Mero, 1986)

Knee extensor activities are very high in the first five meters but it reduces as the sprint progresses to 30 meter. It assists the sprint in pulling the leg forward to prepare for the next stride. The hip extensors, which are glutes and hamstrings muscles, were also active eccentric at the start phase, and their involvement increased slightly as running speed post- initial sprint performance. The outcome is that quadriceps muscles are more important for short sprints distance and the hip extensors are more important for faster sprints and speed after acceleration phase. The biomechanical view is that relatively the runner needs greater ROM at the knee joint in short sprints and greater hyperextension at the hip joint in maximum speed sprinting. (Frick, 1995)

The increase of sprint and speed procedures needs faster percentage flexion at the hip joint and long stride push toward the ground by hip extensors. The recovery of lower extremity muscles, tendon, ligament, and joint tissues is an advantage for maximum speed running because of mechanical reasons it allows for a shorter stride time and higher percentage of stride frequency. (Vonstein, 1996).

Table 3: Comparison of Short and Maximum of the Speed and Sprints in Relation to General Biomechanical Characteristics (Young, 2001).

	Short Sprint	Maximum Speed
Running posture	Forward lean	Upright
Stride length	Shorter	Longer
Stride frequency	Sub-maximum	Maximum
Minimum knee angle near mid-support	Smaller	Larger
Hyperextension at hip	Smaller	Larger
Ground contact time	Longer	Shorter

3.4 Kinematics Factors of Running Performance

The sprint performance needs strategies to perform it to achieve better performance, but the basic rule is that the human body can apply the run movement coordinated. The kinematic of running is defined as a movement cycle, which is a step from initial point to final point by repeating the movement. The movement cycle starts with A point which starts off the single foot and is terminated in point E. The state of foot taking off and contacting the ground is called various phases of movement for running. In A and B points it is called an initial non-support phase which the human body moves forward over the surface ground because of the momentum given by to it by the right lower extremity. In B and C it calls support phase which is left foot land in the ground to support the body. During the final state of C point, the body lean forward and lower extremity gives force to move forward. Then in D point is the second period of non-support phase when the right foot land in the ground and the body rotate to support the body until is projects off the ground. In E point is preparing for the new Cycle. See Figure 1. (Dillman, 1975)

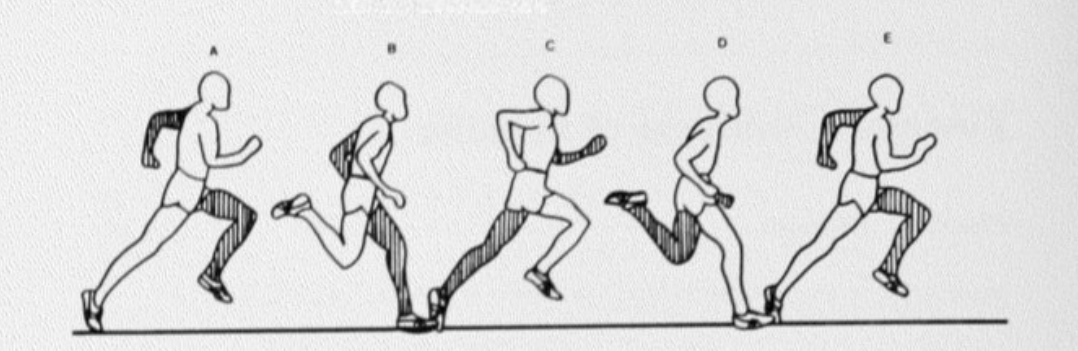


Figure 1: Movement Cycle of Running (Dillman, C. J. 1975)

3.5 Kinematics Factors of Sprints Performance

The technique of the sprint is very important to achieve the fastest time duration from starting position to final position. First of all, by leaning the trunk forward, in this posture it will increase the acceleration by maximizing horizontal velocity, especially in the first step. In this position the acceleration assists as the whole body's center of gravity and is brought directly to the base of the support and positioned close to the ground reaction force vector. See Figure 2. (Kugler, 2010).

Moreover, in deep leaning posture position the knee gives the highest force from initial position to point ten demonstrating 31% of power generation in the lower limb. See Figure 2. (Debaere, 2013).

Post-acceleration phase to reach maximum speed the body needs to adopt an upright posture, as it cannot exert a propelling force that cancels the downward gravitational moment see the position of the body from points 15 to 25. See Figure 2 (Nagahara, 2014).

The physiological muscle condition is important for the sprint mechanism. For example, during running and sprint performance it has been shown in a fatigued state the foot lands more flat at heel-strike than when they are non-fatigued. (Friesenbichler, 2011).

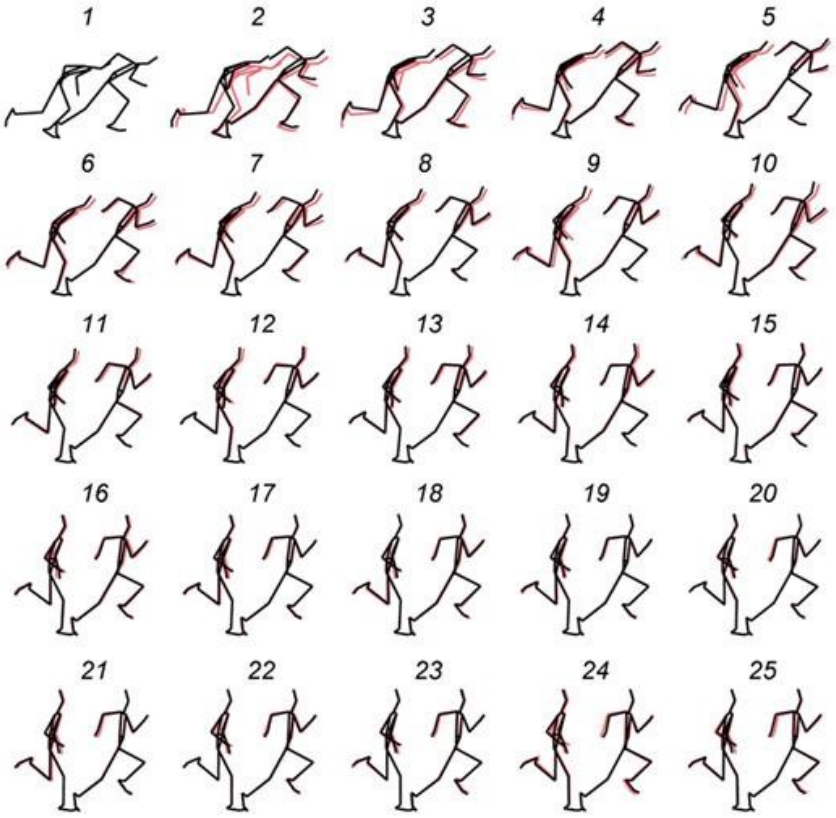


Figure 2: Kinematics of Initial Phase of the body in sprint performance to final phase position (Nagahara, 2014)

4. Stretching Methods (Flexibility)

4.1 Introduction

The stretching exercises can be applied to young, adult, and old age. Athletes and non-athletes as well as patients for rehabilitation. Stretching exercises defined as biomechanical terms that muscle tendon units are considered to have feedback viscoelasticity during stretching. The stereotype of the movement of the stretching applied by internal and external force to increase muscle flexibility and reach physiological joint barrier ROM. (Amiger, 2010).

The goal of the stretching program depends on the present state, factors, and techniques. The aim is to force the musculotendinous structure to achieve change of muscle fibers function by reducing the soreness of the muscle that increases the flexibility of the muscles and improves the ROM of the joint, improve the athletes' performance, and decrease the risk of injuries. (Gleim, 1997).

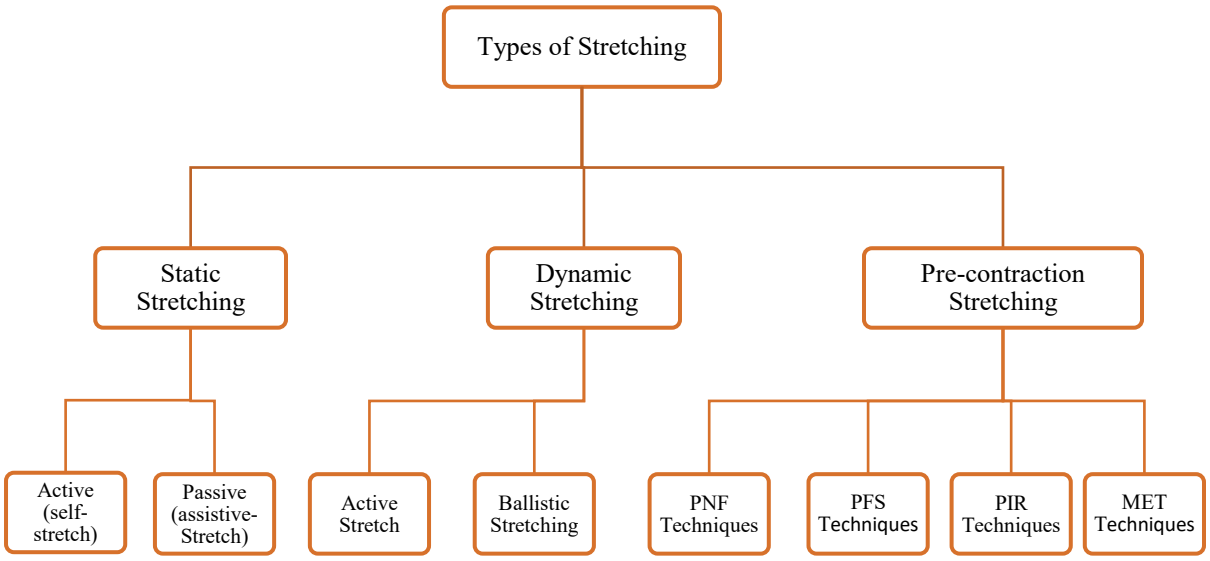
Stretching exercises can be used as prevention of injuries by improving the mechanism function of the tendon. (Kubo, 2001).

The applicant should choose the goal of the stretching before applying the exercises either to decrease the risk of injury or improve the performance of the tissues function in terms to improve the speed, sprints, jumping, or body posture (Bishop, 2013).

Increase ROM of the joint or relaxation muscles fibers by inhibition or activation of the antagonist. There are several types of the stretching exercises, which are static, dynamic, and pre-contraction stretches. The static stretching can be performed passively and actively. The dynamic stretching has two types active and ballistics. The pre-contraction stretching can be

applied by PNF techniques and other techniques such as PIR, PFS, and MET. See table 4 (Page, 2012).

Table 4: Stretching Exercices Types (Page, 2012).



4.2 Static Stretching Technique

The approach of the position is held with muscle tension to a point of stretching sensation in static position. The approach applied passively by another assistive person or actively by the subject. Static stretching increases the ROM of the joint by decreasing the tension of the muscles that increase the tolerance and not increase the length of the muscle. (Ylinen, 2009).

The most effective change of ROM with static stretching by holding between 15-30 seconds. (Bandy, 1994). Moreover, no elongation or different change after two to four repetition. (Taylor, 1990).

The static stretching program decreases the strength of the muscles and performance of running and humping in an acute phase. (Herda, 2008; Sekir, 2010; Behm, 2007, & Curry, 2009).

The mechanically decrease in musculotendinous units leads to a lower rate of force production and that will delay muscle activation. (Wilson, 1991 & Evetovich, 2003).

4.2 Dynamic Stretching Technique

There are two procedures of dynamic stretching exercises, the first one is active stretching which is moving actively by the subject in full ROM. (Page, 2012; Amiri, 2016 & Little, 2006).

Active stretching improves the performance of the running, strength, and aerobic training. (Herman, 2008).

The second procedure is Ballistic stretching includes alternating and rapid movements or bouncing at end range of motion and it recommended to apply slow static stretching before the procedures. (Page, 2012).

Ballistic stretching has high risk for injury due the fast rate of the stretched mechanism and then rebounded back repetitively, subsequent more tension and extra-absorbed energy within the muscle tendon unit (Taylor, 1990).

4.3 Pre-Contraction Stretching Techniques

4.3.1 Proprioceptive Neuromuscular Facilitation Techniques

It was recognized in the late 1940s by MUDr. Herman Kabat planned it as a rehabilitation approach promoting or accelerating the response of the neuromuscular mechanism through stimulation of the proprioceptors. (Westwater, 2010).

The target and benefit of the method is multiple muscles training, sustained contraction activity to inhibit or strengthen the muscles and improve muscle groups as results improving ROM and/or decrease the pain, as well as it improve the functional stereotype patterns, control and facilitate both co-cordination for groups muscle stability. (Ferber, 2002 & Godges, 2003).

There are several types of techniques by concentric, eccentric, and isometric muscle contraction mechanisms. See table 5. (Saliba, 1993).

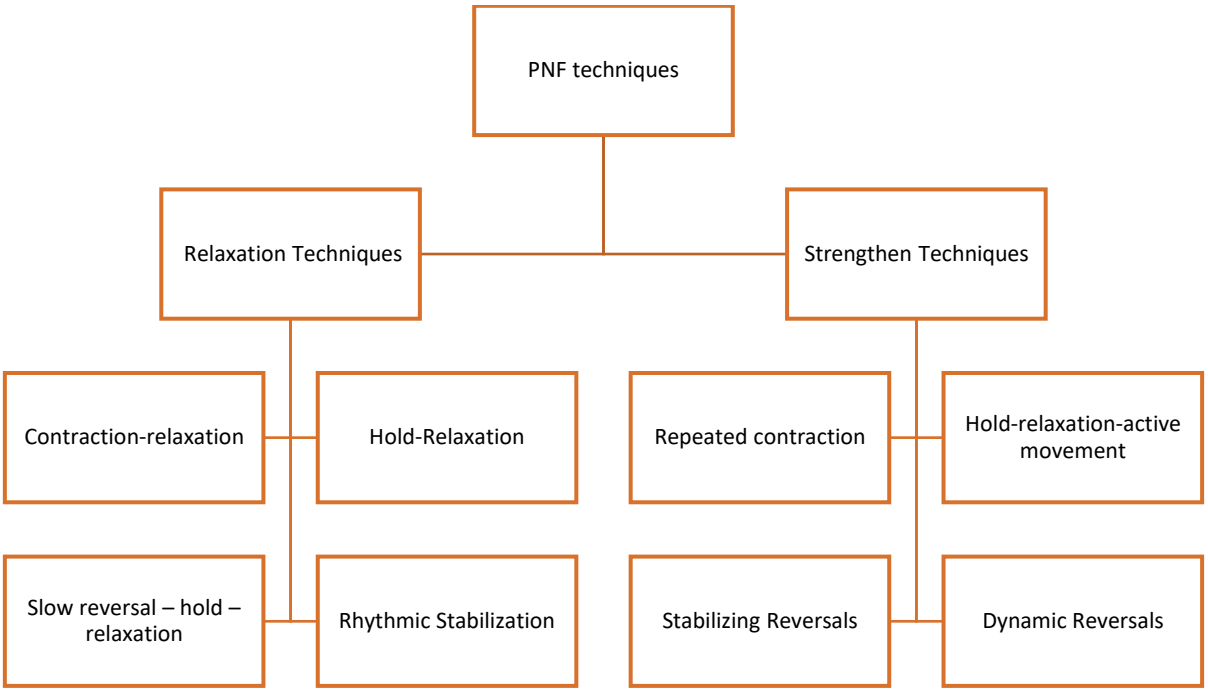
4.3.2 Post-Isometric Relaxation Technique

It is a gentle stretching technique used to relax hypertonic muscles and lengthen shortened muscles to achieve better ROM and muscle performance. The procedure has a smaller amount of muscle contraction 25% followed by inhalation, hold breathing, and exhalation with relaxation and slight stretch to achieve another segment. (Gupta, 2008 & Page, 2012).

4.3.3 Post-Facilitation Stretch Technique

PFS is a technique developed by Dr. Vladimir Janda, which involves a highest contraction of the muscle at mid-range of motion with a rapid movement to maximum length stretch followed by a 15-second static stretching. See Table 5 (Page, 2012).

Table 5: PNF Techniques (Saliba, V. L. 1993)



4.4 Stretching Related to Warm up Procedures

Stretching is generally performed post-warm-up, the benefit of the warm-up going to increase muscle temperature to help enhance tissue flexibility even though it cannot affect muscle properties during the stretching (Shellock, 1985 & Magnusson, 2000).

4.5 Stretching Related to Neurological Function

Stretching Methods procedures consist of acute neural inhibition, causing an increase in autogenic inhibition, which decreases the neural drive to the muscles resulting in less muscle activation. (Cramer, 2005).

4.6 Stretching Related to Biomechanics Factors

Static stretching, in pre or post-exercise, has been recommended as a preventative measure of DOMS to release the muscle spasm described in de Vries' muscle spasm theory. The viscoelastic material has benefit from the mechanism it holds at the same tension, which will increase in length over time. However, when viscoelastic material stretched to a new length and held constant, it will drop the tension over time, this mechanism is called stress-relaxation. This viscoelastic behavior could be beneficial in eccentric exercise as a decrease in force production at a given elongation may lead to a reduction in the level of damage to muscle and connective tissue. (Wessel, 1994).

5. Resist Training for Sprint Performance

5.1 Introduction

Resisted training includes strength and power exercises and they are one of the requirements as physiological factors to improve the short sprint performance or maximum speed performance. (Bishop, 2013).

The strength and power exercises based on three requirements stages: maximum strength, speed strength, and strength endurance. First, maximum strength refers to the ability to apply force with no attention for the percentage rate of force production or the ability to tolerate it. Second, speed strength is defined as any quality possessing significant force and speed components. Strength endurance defines a long duration period of muscle tension activity with minimum decrease of the quality in efficiency. All these stages are requirements depending on the sport activity or the goals to be achieved. For example, in long speed performance, the speed strength method is important but it is more and more important for short sprint performance. Another example, in short sprint performance the maximum strength method has effective, but in long speed performance, maximum strength method has higher effective output. (Young, 2001).

To strengthen the muscles to improve the performance of the sprint, you must know what is the goal of it, either to improve the short sprint or maximum speed performance. In short sprint performance, we strengthen quadriceps and gluteus muscles, and for maximum speed performance, we strengthen hamstring muscles. For trunk stabilizers muscles they need to be activated, strength to prevent spinal, and pelvis injuries more than of benefit to increase the kinematics of sprint performance. (Young, 2001).

The skills and requirements in resistance training include manipulative, locomotor, and stability actions while maintaining control of the movement chain. The kinematic movement starts in standing position and time reputation, post- warm up procedures. (Cook, 2006).

5.2 Bulgarian Split Squat Exercise

Rear foot elevated exercises or BSS has an effective and high value to activate and strengthen quadriceps and gluteus medius muscle as resistance training to improve the performance in sprint performance. The technique of the BSS exercise is standing upright and one foot in front of the ground and the other foot behind an object. Subjects held arms crossed on their chest, and maintained the upright upper part of the body. Lower back position is natural throughout the exercise. Subject lowered the body to perform knee joint flexion in 90 degree as eccentric activation of quadriceps and gluteus medius muscle and at the same time controlling an erect trunk position. The knee of the support leg should be not over the toes. Returned the body to the starting position with a full knee extension of the support leg. See Figure 3. (Aguilera, 2019).

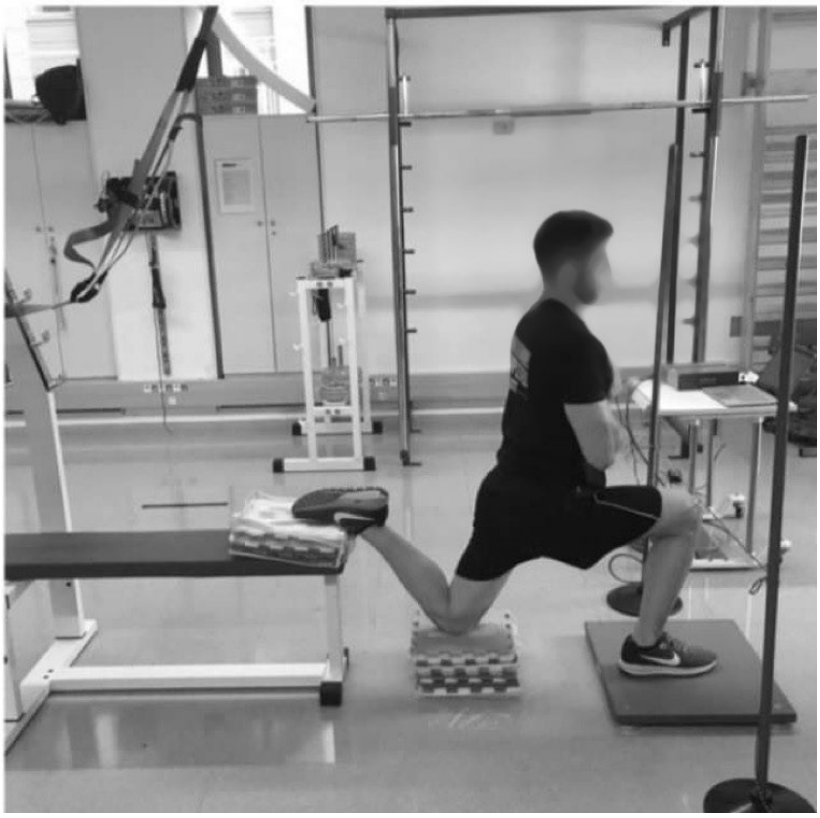


Figure 3: Bulgarian Split Exercise (Aguilera, 2019)

6. Muscular Anatomy of Intervention Program

In this chapter, explain the anatomical structures of the muscles group in the methodology according to Kendal. These muscles are gastrocnemius, hamstrings, quadriceps, hip flexors, hip extensors, and adductors. See Table 6. (Kendall, 2005).

Lower extremity includes three region of joints, which are the hip, knee, and ankle joint that the muscles originate and insert. The upper part of the leg has a tibia bone which articulates between hip and knee joints. In the lower leg part, It contains two bones which are the tibia and the fibula. The benefit of these two bones is to provide stability and support to the rest of the body. (Attum, 2018).

Table 6: Muscle Testing and Function with Posture and Pain 5th edition. Muscular Table (Kendall, 2005)

Muscle	Origin	Insertion	Nerve	Action
Rectus Femoris	Straight head: From anterior inferior iliac spine. Reflected head: From groove above rim of acetabulum	Proximal border of the patella and through the patellar ligament to the tuberosity of the tibia	Femoral L2,3,4	Extend the knee joint and flex the hip joint.
Vastus Medialis	Distal half of the in-tertrochanteric line, medial lip of the linea aspera, proximal part of the medial supracondylar line, tendons of the adductor longus and adductor magnus and medial intermuscular septum.	Proximal border of the patella and through the patellar ligament to the tuberosity of the tibia	Femoral L2,3,4	Extend the knee joint.
Vastus Intermedius	Anterior and lateral surfaces of the proximal 2/3 of the body of the femur, distal half of the linea aspera, and lateral intermuscular septum	Proximal border of the patella and through the patellar ligament to the tuberosity of the tibia	Femoral L2,3,4	Extends the knee joint
Vastus Lateralis	Proximal part of in-tertrochanteric line, anterior and inferior borders of greater trochanter, lateral lip of the gluteal tuberosity, proximal half of lateral lip of linea aspera, and lateral intermuscu- lar septum	Proximal border of the patella and through the patellar ligament to the tuberosity of the tibia.	Femoral L2,3,4	Extends the knee joint
Semimembranosus	Tuberosity of the	Posteromedial	Sciatic	Flexes and

	ischium, proximal and lateral of the biceps femoris and semitendinosus	aspect of the medial condyle of the tibia.	(tibial branch), L4,5, S1,2.	medially rotates the knee joint. Extends and assists in medial rotation of the hip Joint.
Semitendinosus	Tuberosity of the ischium by the tendon com- mon with the long head of the biceps femoris.	Proximal part of the medial surface of the body of the tibia and deep fascia of the leg.	Sciatic (tibial branch), L4,5, S1,2.	Flexes and medially rotates the knee joint. Extends and assists in medial rotation of the hip Joint.
Biceps Femoris	Long head: distal part of the sacrotuberous ligament and posterior of the tuberosity of the ischium. Short head: lateral lip of the linea aspera,	Lateral side of the head of the fibula, lateral condyle of the tibia.	Long head: Sciatic (tibial branch), L5, S1,2,3 Short head: Sciatic (peroneal branch), L5, S1, 2.	Flexes and laterally rotate of the knee joint. The long head extend and lateral rotation of the hip joint.
Pectineus	Superior pubis ramus	Pectineal line of the femur	Femoral and Obturator L2,3,4	ADD hip joint. Flex hip joint
Adductor Longus	Inferior pubis ramus at the junction of the crest and symphysis.	Middle lip of the linea aspera	Obturator L2,3,4	ADD hip joint. Flex hip joint

Adductor Brevis	Outer surface of the inferior ramus of the pubis.	Distal of the pectineal line and proximal half of the medial lip of the linea aspera	Obturator L2,3,4	ADD hip joint. Flex hip joint
Adductor Magnus	Inferior pubis ramus	Middle to the gluteal tuberosity. middle to lenea aspera	Obturator L2,3,4 Sciatic L4,5,S1	ADD hip joint. Flex hip joint
Gracilis	Inferior pubis ramus	Medial surface of the body of the tibia, distally to medial condyle	Obturator L2,3,4	ADD hip joint. Flexes and medial rotate the knee joint.
Psoas Major	Ventral surface of the transverse process of all lumbar spine segments	Lesser trochanter of the femur	Lumbar plexus L1,2,3,4	Flex hip joint be flexing femur to the trunk, in supine assist lateral rotation and abduction of the hip joint
Iliacus	Anterior superior of iliac fossa, internal iliac crest, and iliolumbar and ventral SI ligament.	Lateral side of the tendon of the psoas major and distal to the leaser trochanter of the femur.	Femoral L1,2,3,4	Flex hip joint be flexing femur to the trunk, in supine assist lateral rotation and abduction of the hip joint
Sartorius	Anterior superior iliac spine and superior half of the notch distal to the spine.	Proximal part of the medial surface of the tibia slightly the anterior border	Femoral L2,3,4	Flexes, lateral rotation, and abducts hip joint. Flexes and assist medial rotate of the knee joint

TFL	Anterior and external part of the lip of the Iliac crest. outer surface of the anterior superior iliac spine and deep surface of the fascia late.	Iliotibial tract of the fascia lata at the junction of the proximal medial third of the thigh.	Superior Gluteal L4,5,S1	Flexes,medialy rotates and abduct hip joint. assist knee joint extension.
Gastrocnemius	Medial origin is proximal and posterior part of the medial condyle of the femur, capsule of the knee joint. Lateral origin is lateral condyle and posterior surface of the femur.	Middle part of the posterior surface of the calcaneus.	Tibial S1,2.	Planter flex ankle joint and assist flexion of the knee joint

7. Methodology

7.1 Goal

The aim of our experimental study to combine one resistance-training exercise (Bulgarian Split Squat Exercise) with three types of stretching exercises (static, dynamic, and combination stretching exercises) to find which protocol has positive effective in improving the short-sprint time performance in 20 meters for semi-professional college football players in five sessions in acute term- phase (10 days).

7.2 Study Question

Which stretching exercises techniques (static, dynamic, and combination) combined resistance training exercise (Bulgarian Split Squat) can improve the sprint performance of semi-professional football players in five sessions in a short-term phase (10 days)?

7.3 Hypothesis

H1. We suggest there will be change result of performance in short sprint performance for all the groups except control group in acute-term phase due to three determine for sprint performance includes NDC, power, flexibility, and recovery between efforts.

H2. We suggest there will be positive improvement for the DS group and CSD group in sprint performance in the acute-term phase.

H3. We suggest there will be a decrease of sprint performance for the SS group compared with the DS group and CSD group in the acute-term phase.

H4. We suggest there will be higher significant improvement of CSD group than DS group in sprint performance in acute- term phase.

H5. We suggest there will be no significant result change for the control group in sprint performance in the acute-term phase.

7.4 Subjects

The number of participants in this experiment is 20 semi-professional college football players (FTVS). The entire participants are male and average age 25.5, weight and height is, 78 kg, and 177 cm retrospectively. The participants are international, they are from 12 countries,(Eritrea, Saudi Arabia, Egypt, Czech , Lebanon, Cyprus, Iraq, Palestine, Slovakia, Jordan, Syria, Sudan) and they are from different universities in Czech Republic and some participants are studying abroad. In all, they are from nine different universities. All participants were playing football in different positions for last six month, which can be defenders, attacker, midfield, wings position, and they were choosing randomly to divide them in four group. For example, in the control group it is include one striker, one defender, one attacker, and two wingers one is

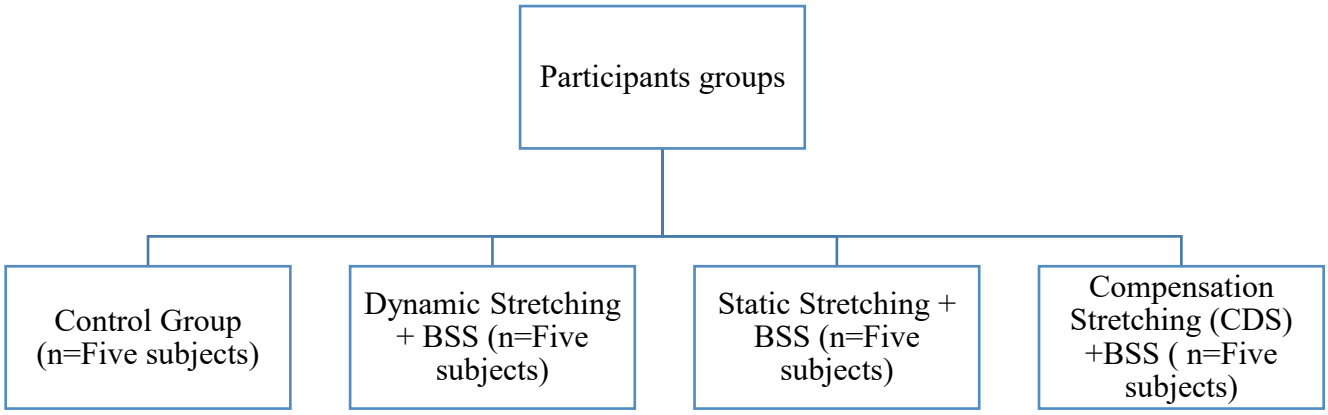
righter and second one is left leg controller and shooter. The procedures by divided four group each group has five player at the same positions then choosing randomly each player from each group. They were asked by the main researcher personally to participate in the experimental study. Each participant received theoretically and practically knowledge about the protocol for the whole intervention program before applying it. It includes all instructions, rules, safety, procedures, and policies.

7.5 Methods and Material

The intervention program in ten days by five sessions in total. The off days are fully relaxed without exercises or training, but it includes cryotherapy by application of cold ice water full body to the shoulder for 10 minute once a day. The first and last session of the intervention program, the participants are not applying any kind of training or physical activities pre or post the test.

The participants divided into four groups equally in each group five participants each participant has been practicing football in different positions on the field. The entire group applies the recovery approach. The first group is the control group and they applied only to warm up without any participation in the protocol. The second group they applied warm up and dynamic stretching exercises (DS). The third group they applied warm up and static stretching exercises (SS). The fourth group they applied warm up and compensation stretching exercises (CSD). The second, third and fourth group applied Bulgarian Split Squat post stretching exercises (BSS). See Table 7. (Aguilera-Castells, J, 2019 & Amiri Khorasani.M, 2010, 2013, 2016 & Dupuy, O. 2018 & Bishop, D. J 2013)

Table 7: The Participant Groups



The intervention program in ten days. Applying the protocol in five sessions and between each session a day off for recovering procedures except the third session there will be two days off.

First day of the program, in the FPES where the football field is, the program is applied at the runner track by applying the protocol for each group and applying the sprint test immediately. Started by warm up jogging+ SE+ BSS+ jogging then immediately apply sprint performance test 20 meters and individually apply ice water therapy for 10 minutes. Next day is an off day (recovery day), and the day after is the 2nd session the participants apply the protocol individually without sprint performance then they train for a football game for 30 min, last procedures ice cold water for 10 minutes. The next day is off day (recovery day and cryotherapy), and the next day is the 3rd session and it is the same as 2nd session. The next two days are off days (recovery days).

In the second week, starting the 4th session by applying the same protocol and procedures of the 2nd and 3rd sessions individually. The next day is my day off (recovery day). The day after is the last session of the intervention program by applying the protocol at the football field in the track at FPES and applying the final sprint test and individually applying ice water therapy for 10 minutes. See Table 8. (Khorasani, 2016 ; Aguilera, 2019 ; Randers, 2010 & Bishop, 2013)

Table 8: The Application of the Test for the Participants Groups. CG= Control Group, SS= Static Stretching, DS= Dynamic Stretching, CSD= Compensation Static Dynamic, BSS= Bulgarian Split Squat, (+) denotes activity included. (No) denotes no activity included.

The days of the Intervention program	Program	CG	SS+BSS	DS+BSS	CSD+ BSS
First day protocol + test	4 minute jogging	+	+	+	+
	Stretching protocol	**No**	+	+	+
	Bulgarian Split Squat exercise	**No**	+	+	+
Last day protocol + test	2 minute jogging	+	+	+	+
	Sprint Performance Test	+	+	+	+
	Cryotherapy (cold water) 10 minutes	+	+	+	+
Individual day protocol	4 minute jogging	+	+	+	+
	Stretching protocol	**No**	+	+	+
	Bulgarian Split Squat exercise	**No**	+	+	+
	2 minute jogging	+	+	+	+
	Training football session 30 minute	+	+	+	+
	Cryotherapy (cold water) 10 minutes	+	+	+	+

7. 6 Protocol and Procedure

In this study contains four protocols of warm up, stretching exercises, Bulgarian Split exercise and recovery approach except the control group will have only warm up protocol with recovery approach, with no stretching, and Bulgarian split squat exercises protocol. This clinical guideline protocol is the current research protocol that was adjusted from Taylor in 2012, Amiri Khorasani in 2010, 2012 and 2016, and Aguilera Castells, J. 2019. The Bulgarian Split exercises to improve the power and the recovery approach for safety and preventing injuries and improving better performance in our study. In this circumstance, the study extends to ten days instead of Five day according to the criteria of Bishop in 2013.

On the first day each group received theoretical and practical knowledge about the protocol before applying the exercises with all instructions, rules, safety, procedures, and policies.

If The participants feel other pain than threshold pain during the stretching in the lower extremities, they can stop immediately applying the exercises, write down the date of feeling pain, and contact the supervisor. If they are injured during the program, they stop applying any type of exercises immediately and contact the supervisor.

After the protocol exercises it follow up sprint test performance in short distance 20 meters, applying twice trial and better result will be collected.

The Bulgarian split squat exercise will be explained in detail at the end of this chapter. In 2nd, 3rd, 4th sessions participants apply the protocols following the train session without sprint performance.

- **First Group:**

The Protocol and procedures of the Dynamic Stretching Exercises + Bulgarian Split Squat exercise. The protocol starts by warm up and DS exercises following BSS exercise.

The instruction and safety policies of DS exercises:

- Starting by jogging for four minutes (low intensity 2-3 METS).
- Applying the exercises in standing position
- Applying the exercises with maximal ROM during each repetition.
- Contracted the target muscle antagonist once every second, stretching the target muscle.
- Performing five times for each leg, without any bouncing, starting with speed (slow, moderate, and as-fast-as-possible, in this order).
- Bulgarian Split Squat exercises five times repetition.
- Jogging for two minutes.
- Football game training for 30 minutes.
- Cryotherapy (ice water for ten minutes post all physical activities).
- The off days, applying ice water therapy for ten minutes without applying any resistance training exercises, or any physical activity.

The description of DS exercises program:

Main lower extremity muscle groups: gastrocnemius, hamstrings, quadriceps, hip flexors, hip extensors, and adductors.

First, gastrocnemius by raising one foot from the floor and fully extending the knee. Then intentionally contracted the dorsiflexes to point the foot upwards. Second, the hamstrings muscle starts from a standing position with both legs straight; the subject contracts the hip flexors to swing the leg forward. Third, quadriceps muscles by contracting the hamstrings to flex the leg so that the heel touches the buttocks. Forth, hip extensor by contracting the hip flexors with the knees flexed to bring the thigh to the chest. Fifth, hip flexors by standing position, the subject contracted the hip extensors to swing the leg backwards. Lastly, hip adductors intentionally by contracting the hip abductors with the knee extended to swing the leg laterally. See figure 4

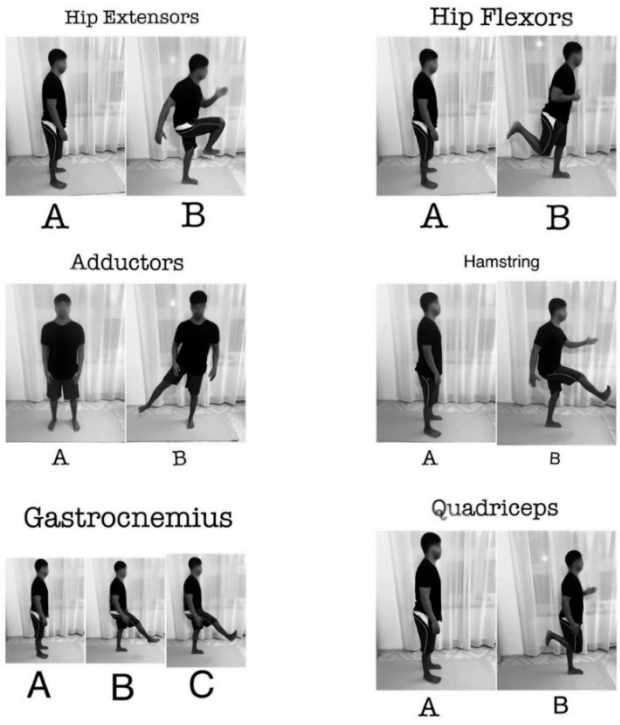


Figure 4: Dynamic Stretching Exercises Protocol (all group of muscles A= Initial Position. B= Final Position) (gastrocnemius ABC= Initial, Mid, Final).

- **Second Group:**

The protocol and procedures of the Static Stretching Exercises + Bulgarian Split Squat exercise. The protocol starts by warm up and SS exercises following BSS exercise.

The instruction and safety policies of SS exercises:

- Starting by jogging four minutes (low intensity two-three METS).
- Each muscle held the static stretching for 30 second on one leg, before changing to the contralateral side 'opposite leg' in a total of six minute.
- Stretching intensity until the end of the ROM but within the pain threshold
- Bulgarian Split Squat exercises five times reputation.
- Jogging for two minutes.
- Football game training for 30 minutes.
- Cryotherapy (ice water for ten minutes post all physical activities).
- The off days, applying ice water therapy for ten minutes without applying any resistance training exercises, or any physical activity.

The description of SS exercises program:

Main lower extremity muscle groups: gastrocnemius, hamstrings, quadriceps, hip flexors, hip extensors, and adductors.

First, gastrocnemius muscle starting from a push-up position, the subject moved his hands closer to his feet to raise his hips and form a triangle. At the highest point of the triangle, the subject slowly pressed his heels against the floor, or alternated slowly flexing one knee while keeping the opposite leg extended. Second, hamstrings start by sitting on the floor with both legs extended in front of the body, back straight, and flexed at the hips, before reaching to touch the feet with the hands. Third, hip extensors the kinetic by flexing the hip, by raising the knee toward the chest with the assistance of the force applied by the hands, which were interlocked behind the raised knee and hip flexion synchronized with inhalation. Fifth, hip flexor muscles by standing upright with the legs spread apart and the hands on the hips or one hand on the front knee and during exhalation flex the front knee to a 90-degree angle while keeping the rear knee extended. Sixth exercise for quadriceps muscles starting by slightly flexing the supporting leg, exhaled, and

grasped the raised foot with one hand before pulling the heel towards the buttocks during inhalation. Lastly, hip Adductors start in a sitting position on the floor with knees flexed so that the feet touched before. Placing the elbows on the inner inferior thighs and pushing the legs towards the floor during exhalation. See Figure 5.

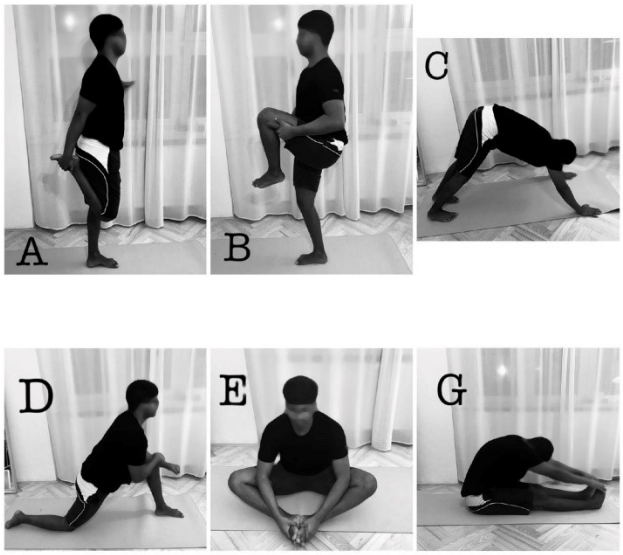


Figure 5: Static Stretching Exercises Protocol (A= Quadriceps muscles, B= Hip Extensors, C= Gastrocnemius muscle, D= Hip Flexors, E= Adductors, G= Hamstring muscles.

- **Third Group:**

The protocol and procedures of the Compensation 'Static following Dynamic Stretching Exercises + Bulgarian Split Squat exercise group. The introduction, description, and safety policies are the same of first and second group. Moreover, the protocol started by warm up, applying SS exercises following immediately DS exercises, and lastly BSS exercise.

- **Fourth Group:**

Fourth Group are the Control Group which they applies jogging four minutes in low intensity two-three METS then rest for two minutes following two minutes jogging, and applying sprint test in first and lest sessions. The 2^{nd} , 3^{rd}, and 4^{th} session include football

game training without sprint performance. During the intervention program, they should not apply any type of the protocol exercises.

Bulgarian Split Squat Exercise

The instruction, description, and safety policies: See Figure 3.

- The BSS apply post-stretching exercises in all groups except control group.
- Stand upright position and one foot in front in the ground and other foot behind over an object (bench or chair).
- Held arms crossed on your chest, and maintain upright upper part of the body. Lower back position is natural sway throughout the exercise.
- Lowered the body to perform flexion of the knee joint 90 degree and at the same time controlling an erect trunk position.
- The position of the support foot while lowering the body, the knee should be not over the toes.
- The exercise five reputations a day.
- Return the body to the starting position with a full knee extension of the support leg
- 90 seconds of rest between exercises.
- The off days without, applying any resistance training exercises, recovering methods, or any physical activity.

7.7 Tools

7.7.1 Stretching Exercises

Participants have not used any kind of assistance such as devices, tools, or objects for stretching exercise. The approach of the exercises in static stretching group is active self-stretch technique, dynamic stretching group is active stretch technique, and compensation apply both static and dynamic stretching exercises starting by static following dynamic. (Khorasani, 2016).

7.7.2 Bulgarian Split Squat Exercise

Participants used a bench as assistance object to balance and support the body during the exercises. See figure 6. (Aguilera, 2019).

Figure 6: Assistance Bench For Bulgarian Split Squat Exercise

7. 7.3 Recorder of Sprint Performance Test

The Brower Wireless Timer systems consist of a handheld coach monitor and four infrared beam/transmitter sets. Each set consists of an infrared sender and an infrared emitter with antennas mounted on tripods. When the participants cross the initial point in the red line and last point in the yellow line as shown in figure 8- B, the data automatically collected and sent directly from the beam sets to the handheld coach monitor. Both are battery driven. The Brower timing system radio frequency is given by the manufacturer to be 27.145 MHz. The measurement accuracy of the Brower wireless timing system is given by the manufacturer to be 1/100 s. See Figure. 7 (Shalfawi, 2012).

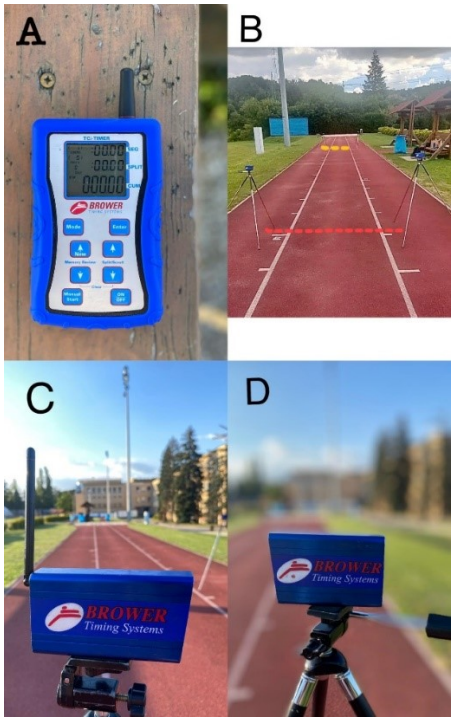


Figure 7: A) Handheld coach monitor- collecting data. B) 4 Standard to control the recorder systems- the red line is the initial starting position and yellow line is the final position. C and D) Beam and transmitter sets.

8. Physical Performance of Sprint Test

Starting position by leaning the trunk forward from point A to point B. Point A is the initial start position and point B is the final point position. The test is twice trial and the collection of data by better time performance is 20 meters distant. The test immediately after the protocol and between two trials 90 seconds to prevent muscle fatigue. (Aguilera, 2019).

9. Environment Factors

The place of the experimental study was at the FPES on the track beside the football field and all sessions were conducted in the afternoon period between 3:00 pm – 7:00 pm. The temperature on the first day of the intervention program was 27-30 degrees and on the last day 25-29 degrees. The humidity range on the first day of the intervention program was eight degrees and on the last day was ten degrees. The participants wore running shoes and sport clothes. The running surface in the track. See figure 8.

Figure 8: Environment State- Running Surface

10.Inclusion Criteria

- Healthy Adult.
- Male.
- Physically active with at least three sessions per week with a minimum duration of 30 minute.
- No food, drinks, or stimulants (caffeine) 3–4 hours before testing.
- Age between 18-30.

11.Exclusion Criteria

- Cardiovascular disease.
- Musculoskeletal disease.
- Neurological disorders.
- Sensory system disorders.
- Visual and vestibular deficits.
- Acute- lower extremity injuries.
- On medications that can influence postural stability and muscles activity.

12.Statistical Analysis

We applied pre and post testing to measure the time score different for evaluation of the effect of the protocol program. A paired t- test was our mathematic calculator, which included the pre and post results of all participants as well as the p-value was calculated. The p-value and t- test calculations were conducted using Excel 2013.

13.Data Analysis

The Brower Wireless Timer systems it calls photocell gates was the major collecting date of the intervention program by recording the time from initial point and final point of the sprint performance. It uses two gates, each gate has two beams and it needs to be faced each other so the wireless can calculate the time duration between point A and B when the participants go through it. The initial line gate will start recording the time when the participants go through it until the participants go through the final gate. The photocell it used in the first and last day of the program. After saving the record time, the data is filled manually in Excel 2013 for each participant and it is deleted from the controller hand. See figure 7

14.Results

14.1 Demographic Data

The number of participants in this experiment is 20 semi-professional college football players (FTVS). The entire participants are male and their age is between 18-30. The participant's weight was between 60.2 - 114.6 kg. The participant's height was between 166 - 184 cm. See table 9 for all participants mean and standard deviation according to Excel 2013 and see table 10, 11, 12, and 13 individualized each group means and including the standard deviation.

Table 9: Average of the all participants Group

Type	Average (mean) All Participants	Standard Deviation SD+ SD-
Age	25.5	±SD= 2.81
Weight	77.54 Kg	±SD= 13.28
Height	177 Cm	±SD= 5.21
Gender	20 Male	

Table 10: Average of the Control Group

Type	Average (mean) Control Group	Standard Deviation SD+ SD-
Age	25.2	1- 25 2- 23 3- 30 4- 23 5- 25 ±SD = 2.56
Weight (Kg)	68.12	1- 70.4 2- 60.2 3- 62 4- 70 5- 78 ±SD= 6.42
Height (Cm)	174.8	1- 180 2- 177 3- 166 4- 170 5- 181 ±SD= 5.84
Gender	5 Male	

Table 11: Average of the Static Stretching Exercises Group

Type	Average (mean) Static Stretching Exercises Group	**Standard Deviation** **SD + SD -**
Age	23.4	1- 22 2- 23 3- 22 4- 22 5- 28 ±SD= 2.33
Weight (Kg)	95.62 kg	1- 83.4 2- 85.7 3- 100.2 4- 114.6 5- 94.2 SD= 2.50 ±SD= 11.23
Height (Cm)	179.8 cm	1- 181 2- 179 3- 180 4- 183 5- 176 ±SD= 2.31
Gender	5 Male	

Table 12: Average of the Dynamic Stretching Exercises Group

Type	Average (mean) Dynamic Stretching Exercises Group	Standard Deviation SD + SD -
Age	26.6	1- 25 2- 22 3- 30 4- 30 5- 26 ±SD= 3.07
Weight (Kg)	70.6 kg	1- 76.9 2- 68.1 3- 71.2 4- 63.3 5- 73.5 ±SD= 4.64
Height (Cm)	174.4 cm	1- 170 2- 169 3- 179 4- 170 5- 184 ±SD= 6.01
Gender	5 Male	

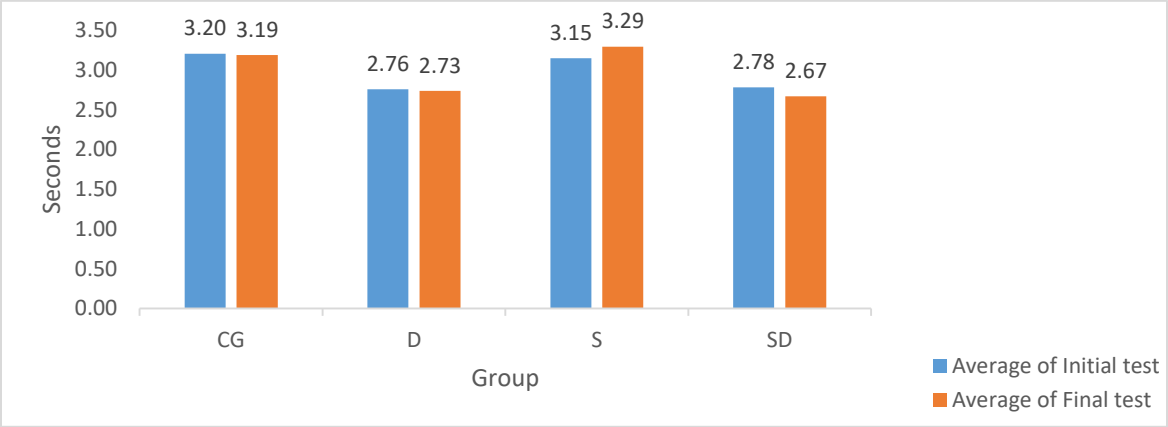
Table 13: Average of the Compensation Static Following Dynamic Exercises Group

Type	Average (mean) Compensation Static Following Dynamic Exercises Group	Standard Deviation SD+ SD-
Age	26.8	1- 27 2- 26 3- 26 4- 30 5- 25 ± SD= 1.72
Weight (Kg)	75.8 kg	1- 73.8 2- 73.2 3- 65.2 4- 85.4 5- 81.6 ± SD= 7.05
Height (Cm)	179.2 cm	1- 180 2- 178 3- 179 4- 175 5- 184 ±SD= 2.92
Gender	5 Male	

14.2 Outcome Results of The Sprint Performance Test

In the results of our intervention program, there are variable scores but each group has different time scores. In the control group, the variable change was very slight in the initial test (first day of the intervention program) the average score was 3.20 per-sec and in the final test (last day of the intervention program) was 3.19 per-sec, ± SD 0.1. In the second group Static Stretching Protocol group there was negative variables score in the intimal test (first day of the intervention program) the average score was 3.15 per-sec and in final test (last day of the intervention program) was 3.29 per-sec, ± SD >-0.14. For the Dynamic Stretching Protocol group there was slight improvement positively as variable score in initial test (first day of the intervention program) the average score was 2.76 per-sec and in final test (last day of the intervention program) was 2.73 per-sec, ± SD.0.3. In the last group Compensation Static following Dynamic Protocol group had the higher improvement score the variables result in the initial test (first day of the intervention program) the average score was 2.78 per-sec and in final test (last day of the intervention program) was 2.67 per-sec, ± SD 0.9. See the chart in table 14.

Table 14: Sprint Performance Test Results 20 meters (Score) CG= Control Group, D= Dynamic Stretching Group, S= Static Stretching Exercises Group, SD= Compensation Static Following Dynamic Stretching Exercises Group



15.Discussion

15.1 Introduction

By researching different articles and literature, regarding the effect of the utilization of stretching exercises we found the aim is to improve or prevent different conditions and it has different variables, goals in specific states and factors. The Stretching Exercises methods and protocols was an area of interest for many researchers to investigate the physiological function and the variables affection of the subjects in many cases such as performance in speeding, jumping, accelerating, or flexibility. It has been reported by many studies that stretching exercises have the ability to improve some factors in athletes and others individual conditions. Some methods for short action power and some for long term power circling such as running for long distance. In this chapter, you will find the limitation of my experimental study due to many uncontrolled factors that in the future can be developed as well as you read other studies comparing, and we discuss about our hypothesis statement either to be accepted or rejected.

15.2 Limitation of The Study

In the area of our topic (Stretching Exercises Methods to improve the Sprint Performance). It has been reported with similar studies the results were variables in positive and negative output and regarding to these states in our study we tried to close all the gaps that negatively affect the study outcomes, we include the physiological factors, so that the procedures are applied under mathematical and physiological criteria which were incomplete from other studies. However, in our study, there was a lack to achieve all the methodologies, which investigated the effect of this program, and we saw the need in this specific area.

In our study, the recovery methods included the relaxation day between the protocol program as well as the cryotherapy. It was difficult to control all the participants at the same time to have the procedures in post training but to reduce the interference of uncontrolled variables, all participants were instructed to maintain their cold-water application of time and temperature.

Furthermore, the nutrition measurement was not included in our mathematics regarding the amount of water intake and nutrients ergogenic aids that negatively affect the muscles tissues function. Another recommendation, including massage pre training to enhance the muscles and increase the vasodilation mechanism as well as compression garments as one of the major primary outcomes. Secondary outcome is the sleep hygiene strategy in the matter of time and temperature were not controlled. The difficulty was to provide all these principles and concepts in controlling the participants, but we can see that in reality these structures of the recovery methods don't exist in the style of the semi-professional college football players life. As well as its not usually provided in a public facilities for Semi-professional college football players including the idea to be provided for the group of semi-professional football players , so it more depends on the economic and awareness from the football player individually to provide itself these programs. (Altarriba, 2020; Clifford, 2018; Marqués, 2018; Fullagar, 2016 & Ascensão, 2011).

The number of the study was 20 participants; the willing to have more numbers as semi-professional soccer teams to improve the quality of the study. It was limited with the number of participants, but our aim mathematically was a margin of error less than 15% due to absent or injuries reasons. Higher than 15 % will affect the results, especially if 20 participants volunteer. According to this state, it leads us to find our criteria of the participants with high percentage to be attending in the first day of the program and last day of the program to avoid the risk factors of decreasing the number of data in the final day of the intervention program. Our criteria based on that the volunteer must be at the same city during the intervention program linking with part-time or full time job or other links in environment life state, so we were sure they attend and be able to apply the program to decrease the uncontrolled states individually. (Albert, 2013).

However, comparing with other studies numbers such as the study of Turki, O. in 2012 the numbers of the subjects were 17 participants, another study of Kurt, C in 2016 by comparing of the acute effects of static and dynamic stretching exercises on flexibility, agility and anaerobic performance in professional football players the numbers were 20 number of participants. In another state, the study of Bayomi in 2016 for comparing the warm up static Varus dynamic

stretching exercise included 45 numbers of participants. Amiri-Khorasani in 2016 his study of Acute Effect of Different Combined Stretching Methods on Acceleration and Speed in Soccer Players were included 20 soccer players as well as he did in 2013 another study of Evaluating the acute effects of combined static and dynamic stretch protocols on fitness performances in soccer player included 16 number of participants. Furthermore, in his study in 2010 acute effect of different stretching methods on Illinois agility test in soccer players, the number included the program 19-football players. Study of Bazett Jones in 2008 the numbers of participants 21 participants. Study of Curry, B. S. in 2009 the numbers of participants were 24 participants. Little in 2006 in his study included 18 participants. de Oliveira, in 2016 in his study included 22 participants.

The participants had a slightly different environment state of the football fields they divided into two soccer fields for their practice, train, and games even though they applied the same period of day training. The first field is 25 width-60 length yards for 7 vs 7 players and second field 40 width -70 length yards for 8 vs 8 players. Both football fields are artificial grass. The time of the intervention program in initial and final test day from 3:00 pm to 7:00 pm there was different with temperature, some participants felt tired as subjective feedback due the sun affection, the participants could not come on time due the other condition in life so we agreed within four hours all participants examine.

Regarding injuries and absence, they were not absent during the intervention program but, unfortunately one participant from the control group got injured during the program by muscle soreness during the first week of training in the 3rd session and he couldn’t apply for the final test. The feedback from the non-stretching group was fear to suffer any injuries due the adeptness of the stretching program even though there were no injuries except one participant, but we can't confirm if it is because the stretching program was not included or other etiologies related to the recovery procedures that missed.

The control group in sprint performance with no stretching exercise in this study we see there is no significant change results due no methods involves to change the physiological function. In the future, the control group with no application of stretching exercises it need to be non-included the methodology especially of semi-professional football players due the no significant change result and the motor control behavior of the athletes and participants has been mentally adapting with stretching and the requirement of not applying stretching need to avoid the fear from the athletes and participants.

15.3 Measurement of The Hypothesis

The goal and purpose of our experimental study was to find out which protocol has a positive effect in improving the short-sprint performance in 20 meters for semi-professional football college players in five sessions in short term- phase (10days). We used the BWTs at pre and post the protocol program to evaluate the effect. We can evaluate our hypothesis that four of them are accepted and one is rejected.

H1. We suggest there will be change result of performance in short sprint performance for all the groups except control group in acute-term phase due to three determine for sprint performance includes NDC, power, flexibility, and recovery between efforts. In the result, there was a variable change of the results even though in control group. According to this statement hypothesis is rejected.

H2. We suggest there will be positive improvement for the DS group and CSD group in sprint performance in the acute-term phase. In our result, there was slight improvement of time score of dynamic stretching group protocol $p< 0.3$ and significant improvement of compensation static following dynamic group protocol by $p< 0.9$ variables change. According to the hypothesis statement, it accepted. (Khorasani, Calleja, & Mogharabi, 2016)

H3. We suggest there will be a decrease of sprint performance for the SS group compared with the DS group and CSD group in the acute-term phase. In our final result, there was significant non-improvement in time score result $p > 0.14$. According to the hypothesis statement, it can be accepted. (Little, & Williams, 2006; Kurt & Fırtın, 2016; Khorasani, Calleja & Mogharabi, 2016)

H4. We suggest there will be improvement of CSD group than DS group in sprint performance in acute- term phase. The final results, we can agree on this hypothesis statement it can be accepted. The result of CSD had improvement score time than DS protocol. The CDS $p < 0.9$ – and DS $p< 0.3$. (Loughran, 2017 & Siatras, 2003)

H5. We suggest there will be no significant variables change for the control group in sprint performance in the acute-term phase. In our results there were very slight variables change $p <0.1$. According to this state, this hypothesis statement can be accepted.

16.Conclusion

The objective outcome of the experimental study, 20 volunteer participants all of them are male between age 18-30, they attend the intervention program for 10 days in five sessions, the first and last session were controlled and the rest (2^{nd},3^{rd}, and 4^{th}) were individually work. Nineteen participants could apply for the whole intervention program and one participant was injured during the 3^{rd} session of the program from the control group.

Our objective hypothesis four of them accepted and one is rejected. Our conclusion of the effectiveness of the Stretching Exercises protocols including BSS and recovery methods in short acute term phase (10 days) that the recommendation of the protocol for semi-professional college football players to apply CSD protocol pre training and not recommended to apply SS protocol due the reduction of the performance in short-term distance of the sprint performance. The second recommendation is DS due slight improvement of score time.

There were a number of limitations in our study that can be improved, developed, and included in the methodology. The full recovery applications include the nutrition mechanism, sleep controlling, pre-massage, and hydrotherapy. The protocol which the participants followed was under self-supervision and this could lead to unevenness in the effect of the program due to the differences in skills, techniques and commitment to the program.

The recommendation using more tools and methods for the recovery procedures, a bigger number of participants, investigate the effect in longer-term phase in speed and sprint performance for semi-professional college football players.

17.References

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List of Attachments

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List of abbreviations

Ethics Committee

Attachment 1: List of Tables and Chart

Attachment 2: List of Figures

Attachment 3: List of Abbreviations

ATP= Adenosine Triphosphate

BSS= Bulgarian Split Squat

BWTs= Brower Wireless Timer systems

CG = Control Group

CSD= Compensation Static Dynamic

DOMS= Delayed Onset Muscle Soreness

DS= Dynamic Stretching

FPES= Faculty of Physical Education and Sport.

HR= Heart Rate

MET = Muscle Energy Technique

METs = Metabolic Equivalents

NDC= Neural Drive Coordination

PCr = Phosphocreatine Resynthesis Rate

PIR= Post Isometric Relaxation

PNF = Post Facilitation Stretch Technique

ROM= Range of Motion

SE= Stretching Exercise

SS = Static Stretching

Attachment 4: Ethics Committee

UNIVERZITA KARLOVA
FAKULTA TĚLESNÉ VÝCHOVY A SPORTU
José Martího 31, 162 52 Praha 6-Veleslavín

Žádost o vyjádření Etické komise UK FTVS

k projektu výzkumné, kvalifikační či seminární práce zahrnující lidské účastníky

Název projektu: Sledování faktorů ovlivňujících fyzickou výkonnost a komplexní testování fyzické zdatnosti

Forma projektu: servisní činnost, aplikovaný výzkum, smluvní výzkum

Období realizace: 2018-2022

Předkladatel: prof. MUDr. Jan Heller, CSc. (UK FTVS, BML)

Hlavní řešitel: prof.. MUDr. Jan Heller, CSc. (UK FTVS, BML)

Místo výzkumu (pracoviště): Biomedicínská laboratoř, UK FTVS

Spoluřešitel(é): Ph.Dr. Klára Coufalová, Ph.D., Ing. Pavel Vodička, Mgr. Ivana Kinkorová, posluchači FTVS UK

Popis projektu: Cílem projektu je analýza faktorů ovlivňujících fyzickou výkonnost a komplexní testování fyzické zdatnosti. V rámci testování budou použity neinvazivní metody (antropometrická měření, analýza tělesného složení - kaliperace, BIA, BodPod; vyšetření pohybového systému pomocí modifikovaného kineziologického rozboru; dotazníky v rámci nutričního poradenství; spirometrie; anaerobní a aerobní testy; reaktometrie; handgrip; dynamometrie).

Charakteristika účastníků výzkumu: Projekt bude zaměřen na jednotlivé věkové kategorie dospělé populace, s případným rozlišením specifických skupin, tj. rekreačně a vrcholově sportující jedinci, osoby se specifickými potřebami apod. Všichni probandi se účastní testování dobrovolně, s plným vědomím svého individuálního zdravotního stavu. Účast nebude možná v případě výskytu následujících kontraindikací: akutní onemocnění doprovázené horečkou; při vyšetření BIA - kardiostimulátor, těhotenství, kovový materiál v těle, medikace a suplementy ovlivňující hydrataci těla; chronická onemocnění a medikace vyžadující zdravotnické zázemí např. kardiovaskulární onemocnění atd.

Zajištění bezpečnosti:

Vyšetření provede proškolený pracovník BML UK FTVS. Rizika prováděného výzkumu nebudou vyšší než běžně očekávaná rizika u aktivit a testování prováděných v rámci tohoto typu výzkumu. Všichni pracovníci BML UK FTVS jsou proškoleni a způsobilí k zajištění bezpečnosti a průběhu celého testování.

Etické aspekty výzkumu: Měření bude provedeno v souladu s Mezinárodními etickými směrnicemi pro biomedicínský výzkum s lidskými účastníky (CIOMS/WHO). Získaná data budou zpracovávána a bezpečně uchována v anonymní podobě a publikována např. jako součást závěrečných prací, v odborných časopisech, monografiích a prezentována na konferencích, případně budou využita při další výzkumné práci na UK FTVS. Po anonymizaci budou osobní data smazána. Během výzkumu nebudou pořizovány žádné fotografie ani videozáznam. V maximální možné míře zajistím, aby získaná data nebyla zneužita.

Text informovaného souhlasu: přiložen

Povinností **všech účastníků výzkumu na straně řešitele** je chránit život, zdraví, důstojnost, integritu, právo na sebeurčení, soukromí a osobní data zkoumaných subjektů, a podniknout k tomu veškerá preventivní opatření. Odpovědnost za ochranu zkoumaných subjektů leží vždy na účastnících výzkumu na straně řešitele, nikdy na zkoumaných, byť dali svůj souhlas k účasti na výzkumu. Všichni účastníci výzkumu na straně řešitele musí brát v potaz etické, právní a regulační normy a standardy výzkumu na lidských subjektech, které platí v České republice, stejně jako ty, jež platí mezinárodně.

Potvrzuji, že tento popis projektu odpovídá návrhu realizace projektu a že při jakékoli změně projektu, zejména použitých metod, zašlu Etické komisi UK FTVS revidovanou žádost.

V Praze dne: 15.9.2015 Podpis předkladatele:

Vyjádření Etické komise UK FTVS

Etická komise UK FTVS zhodnotila předložený projekt a **neshledala žádné rozpory** s platnými zásadami, předpisy a mezinárodní směrnicemi pro provádění výzkumu zahrnujícího lidské účastníky.

Řešitel projektu splnil podmínky nutné k získání souhlasu Etické komise.

Projekt práce byl schválen Etickou komisí UK FTVS pod jednacím číslem: 126/2015

dne: 14. 9. 2015

Etická komise UK FTVS zhodnotila předložený projekt a **neshledala žádné rozpory** s platnými zásadami, předpisy a mezinárodní směrnicemi pro provádění biomedicínského výzkumu, zahrnujícího lidské účastníky.

Řešitel projektu splnil podmínky nutné k získání souhlasu etické komise.

razítko školy UNIVERZITA KARLOVA v Praze Fakulta tělesné výchovy a sportu José Martího 31, 162 52, Praha 6

podpis předsedy EK

1

INFORMED CONSENT to the application form 126/2015

Dear Sir or Madam,

In line with The Universal Declaration of Human Rights, the rules given by European Union no. 2016/679 and the Czech Act no. 110/2019 Coll. – on personal data processing, and other generally binding legal regulations *(such as especially the Helsinki declaration, adopted by the 18th WMA General Assembly, Helsinki, Finland, June 1964 and its later amendments (Fortaleza, Brazil, 2013); Act No. 372/2011 Coll., on Health Services (especially Section 28, paragraph 1) and the Convention on Human Rights and Biomedicine, Act No. 96/2001 Coll., if applicable),* I ask you for your consent to your participation in a research project with the title Comparing Effect of Static, Dynamic, and Combined Stretching Exercises for Semi-Professional Collage Football Players on Sprint Performance carried out at Faculty of Physical Education and Sport- Charles University.

1. The project took place on 1st of August – 10th of August 2022. The aim of our experimental study to combine one resistance-training exercise (Bulgarian Split Squat Exercise) with three types of stretching exercises (static, dynamic, and combination stretching exercises) to find which protocol has positive effective in improving the short-sprint time performance in 20 meters for semi-professional college football players in five sessions in acute term- phase (10days).

2. Methods and techniques that are being used:
   - Stretching exercises (Static – Dynamic – Compensation).
   - Bulgarian Split Squat post stretching exercises. (Eccentric contraction exercise).
   - Sprint Performance. (20 meters).
   - The Brower Wireless Timer systems. (Recorder timer of sprint performance).
   - Cryotherapy (cold water).

3. Non-invasive intervention use. The time context of the intervention:
   - 10 days of the program.
   - Two days- participants attend to be under control at the Faculty of Physical Education and Sport at Charles University, Three days- individual applying of the protocol. In total, five day's exercises and five days of recovery procedures.

4. Possible risks of the project and discomforts has reduced by using stretching exercise, warm-up exercises, and recovery procedures. There will be applied exclusion criteria:
   - Cardiovascular disease.
   - Musculoskeletal disease.
   - Neurological disorders.
   - Sensory system disorders.
   - Visual and vestibular deficits.

- Recent lower extremity injuries.
- On medications that can influence postural stability and muscle activity.

5. Any further important information, relevant to the research:
- The methodological principles to improve the sprint performance based on factors, which are stretching exercises. I add other physiological factors to improve the sprint performance by adding special criteria procedures, which is a resistance-training exercise due to sprint performance based on stride frequency and stride length as well as the recovery procedures between the efforts.

6. Expected contribution of the project outcomes:
- There will be positive improvement for the dynamic stretching exercises group and compensation static following dynamic stretching exercises group in sprint performance in the acute-term phase.
- There will be a decrease of sprint performance for the static stretching exercises group compared with the dynamic stretching exercises group and compensation static following dynamic stretching exercises group in the acute-term phase.
- There will be higher significant improvement of compensation static following dynamic stretching exercises group than dynamic stretching exercises group in sprint performance in acute- term phase.

7. All participants are volunteers, without any reward for his/her participation.

8. All the participants have individual access to their own overall results and conclusions of the research project, and the means of their publication.
- It will be during 15th of September to 1st of October in 2022 at the supervisor office Prof. MUDr. Jan Heller, CSc., at the Faculty of Physical Education and Sport- Charles University.

9. Data will be collected in line with the rules given by European Union no. 2016/679 and the Czech Act no. 110/2019 Coll. – on personal data processing. Personal data that will be collected (name, age, emails, weight, height, nationality, personal contact numbers, and their results will be saved in a PC protected by a password and they will be accessible only to the main researcher, the supervisors and able to be given to the ethical committees.
The collected data will be anonymized within one week after the end of working with the participants. I understand that anonymization means that the text does not use any item of information or combination of items that could lead to the identification of a person. I will be careful not to enable recognition of the participant's character or in image be covered in the text of the thesis. After the text has been anonymized, any personal data still kept elsewhere will be deleted. The personal data will be anonymized and processed and safely retained in an anonymized form and published in the master thesis, possibly also in journals, monographs, and presented at conferences, possibly also used in further research at UK FTVS. After the anonymization, the personal data will be deleted.

10. Photographs: I will not show a non-anonymized version during the defense. I will show an anonymized version during the defense by blurring the face, parts of the body or any

characteristics that could lead to identification of the person. After anonymization only the supervisor Prof. Jan Heller, CSc, and defense committees has access on request during defense of thesis state and any non-anonymized photographs will be deleted immediately after the defense thesis presentation. Only anonymous photos will be published. When taking photographs, I will take care that no people other than the research participants are included in the photographs. The reason to show the anonymized photo during the presentation of thesis defense is to clarify how the stretching and Bulgarian Split Squat exercises were used and give a better idea of the place and environment of the intervention program and by adding the tools method which recorded the time of the sprint performance.

11. Videos: Yes it will be recorded and they will not be published. Non-anonymized videos will be safely stored on a PC safeguarded by a keyword in a locked room, they will be viewed only by the main researcher and supervisors and they will be deleted one week after testing. Only one sample of non-anonymized video will be shown during the presentation of the thesis defense, the reason to clarify comparison of the sprint performance of the participants, and it will be deleted immediately after the presentation.

12. I shall ensure to the maximum extent possible that the research data will not be misused.

Name and surname of the applicant. Bc. Osama Trombi Signature:.....

Name and surname of the main researcher and co-researcher(s) .....

Name and surname of the person, who informs the participant .....

Signature: .....

I declare and with my below mentioned personal signature confirm that I voluntarily agree with my participation in the above mentioned project and that I have been given an opportunity to ask questions and consider all relevant information about the research project and my participation, and that I received clear and comprehensible answers to my questions**.** I was informed about my right to refuse participation within the research project or to withdraw my consent at any time without penalization, by writing to the UK FTVS Ethics Committee, which will consequently inform the applicant.

Place and date .....

Name and surname of participant.....

Signature: .....