INTRODUCTION

"Football is god's gift to humanity"

Football is a multidimensional and complex spasmodic team game that combines cyclic and acyclic movements (**Erculj, Blas, and Bracic, 2010**). Despite the fact that football execution requires a great oxygen-consuming ability for recovery after high-intensity activity, numerous researchers concur that the way of football execution lies in anaerobic capacity (**Delextrat and Cohen, 2009**). Many changes of speed, kind of locomotion, change of direction, and lot of footwork that occur amid the game require explosive power and agility development in training.

Football is played at a professional level everywhere throughout the world. A large number of individuals consistently go to football stadia to follow their most loved football teams, while billions more watch the game on television. Many of them additionally play football at a beginner level. At least 200 million licensed players participate in football and 20 million football games are arranged each year in the world. 265 million male and female players along with 5 million referees and officials make a splendid aggregate of 270 million people – or 4% of the world's population – who are dynamically involved in the game of football.

Football otherwise called soccer is a game in which two groups of 11 players, utilizing any part of their body with the exception of their hands and arms, endeavor to move the ball into the opposite team goal. The goalkeeper is permitted to handle the ball inside his own penalty area. Playing any sports offers the opportunity for players to develop qualities that will help them as they strive for excellence in their lives. It is the sports that

demand its players take on a lot of responsibility for what happens in the game. The game runs uninterrupted. Much responsibility for the team's success and excellence rests with each individual player. **(Roberts, 2010)**

1.1 HISTORY OF FOOTBALL

Modern football originated in Britain in the 19th century. Since medieval times, "folk football" games had been played in towns and villages according to local customs and with a minimum of rules. In 1863 a series of meetings involving clubs from metropolitan London and surrounding counties produced the printed rules of football, which prohibited carrying of the ball. Thus, the "handling" game of rugby remained outside the newly formed Football Association (FA). By the early 20th century, football had spread across Europe, in 1904, representatives from the football associations of Belgium, Denmark, France, the Netherlands, Spain, Sweden, and Switzerland founded the Federation Internationale de Football Association (**FIFA**). The FIFA World Cup is the main international football competition organized by FIFA and held once in every four years by different host nations. FIFA also grew steadily—especially in the latter half of the 20th century, when it strengthened its standing as the game's global authority and regulator of competition. Since the 21st century, more than 200 countries were registered FIFA members, FIFA membership is open to all national associations. They must accept FIFA's authority, observe the laws of football, and possess a suitable football infrastructure (i.e., facilities and internal organization).

Football easily arrived in Asia and Oceania in the latter half of the nineteenth century, but not at all like in Europe, it neglected to wind up a unifying national sport. Football in India was especially noticeable in Kolkata among British soldiers, yet local

people adopted cricket. At the turn of the 21st century, football turned out to be progressively essential in Asian societies. The all India football federation (**AIFF**), the governing body in football, introduced the national football league in 1996, in a bid to raise the standard of the game in India. Kolkata is the state of West Bengal is considered to be the home of Indian football. Despite football being a very well-spread game in India, the number of victories on the global stage is rare. While the national team languishes at the rock bottom of the rankings, the All India Football Federation has done precious little to raise the standard of the game of India. (**Subhash K, 2009**)

1.2 LAWS OF FOOTBALL

The main set of football rules were composed at Eton school in 1815. The Cambridge school laws were encryption of football laws. It was codified based on the mid-nineteenth century endeavors to standardized the widely varying types of football played at the government-aided schools of England.

Football has 17 laws by which the game is played. Most of these laws are straightforward. The laws are designed to make football fun, safe, and fair for all participants. The object of football for a player is to get the football into the other team's goal by using any part of the body except the player's hands and arms. The goalie is the only player allowed to touch the ball with the hands and arms and then only while the player is located in his own penalty area. (**Goyal,2009**)

1.3 PLYOMETRIC TRAINING

Plio = More, Metric = Measure. 'Actions that enable the muscle to extent extreme force in the shortest conceivable time'. Plyometric Training is one of the most effective forms of training to improve your vertical jump height, speed, power, and coordination.

Plyometric preparation (PT) is one of the most widely used strategies in team games for advancing the previously described qualities and is often involved in rehabilitation programs. **(Shiner, 2005)**

The results of the research have confirmed that plyometric training can enhance muscle strength and power (**Fleck, 2004; Markovic, 2007; Soundara, 2010**), speed, and agility (**Kotzamanidis, Miller**, **Schmidtbleicher, 2006**) and running economy (**Turner, 2003**). These abilities are the basic skills in various team games including Football since they empower players to perform exercises during the game at the necessary speed at the correct second **(Gamble, 2010).** Plyometric training consists of a rapid eccentric action followed promptly by a focused muscle and connective tissue action that focuses on the development of the greatest force in the shortest possible time. (**Bosco, 1985; Potach & Chu, 2008**). This stretch-shortening period (SSC) mechanism of muscle contractions is a common part of muscle movement in various basic football skills such as receiving, passing, shooting, acceleration, changing the direction of running, vertical jump (butting, goalkeeping).

Plyometric training comprises of dynamic and quick stretching of muscles (eccentric activity) instantaneously pursued by a concentric shortening activity of similar muscles and connective tissues. This training focuses on how to move in a fast or 'explosive' way from a muscle extension to a contraction, such as in specific non-stop jumping. Exercises are of high-force, explosive muscular contractions merging strength and speed for acquisitions of advantages in power. plyometric training includes bounces and hops used to gain by the stretch-shortening cycle of the muscle (**Hakkinen K, 1985**). It is recognized by a fast deceleration of mass followed quickly by its fast acceleration on

the contrary vertical way. For the lower limbs, plyometric training entails exercise such as hopping, bounding, or drop-jumping (depth jumping) from a raised box or platform and immediately jumping vertically after an 'amortization' period of ground contact (**Boocock MG, 1990**). The plyometric training programme typically includes sport-specific exercises including exercises for the shoulder and muscles of the arms (**Carter AB, 2007**), and has traditionally been used for sprinting, jumping, and sports with rapid changes in direction. (**Schulte-Edelmann JA, 2005**)

The adaptability of plyometric training has increased in popularity, thereby proven valuable for application to a range of sports as an effective tool in increasing lower body power (**Paasuke M, 2001**), as measured in several studies using adult subjects (**Luebbers PE, 2003**). However, it has been reported that plyometric training may also have negative aspects, particularly in its early phase. High intensity and repetition of eccentric contraction lead to a delayed onset of muscle soreness (**Clarkson PM**, **1999**). Besides, only athletes who have already achieved a high level of strength through standard resistance training should engage in plyometric drills (**Bowers EJ, 2004**). It has been also shown that gains in jump performance followed by plyometric training were due to progress in mechanical properties of muscle-ligament complex more than to muscle enactment (**Kubo K,2007**). Taken all together these data suggest that plyometric training may constitute a high risk of injury of the youth growth plate (**Brown ME, 1986**) and may contraindicate them.

Additionally, vigorous movements that incorporate sprinting, jumping, and throwing actions (**Pezzullo DJ, 1995**) in plyometric training may be damaging for youth subjects or adult females, even if improvements in balance, coordination and agility, and injury avoidance after use all through pre-season training are likely, despite the suggestion

is less well supported by experimental evidence. (**Wilk KE, 1993**) Nevertheless, data demonstrating the use of plyometric training for developing skill performance in football players (**Myer GD, 2006**), Although there is currently limited scientific evidence available on whether plyometric training improves the performance of skills among football players, it is especially available for young and female players. The aim of this research study was to analyze the outcome of plyometric training in young and adult athletes of both genders among football players.

1.4 EFFECT OF PLYOMETRIC TRAINING

- Plyometric training strengthens fast-twitch fibers in the muscles. The stronger the fast-twitch fiber, the faster the muscle contraction—which leads to an increase in power.
- Plyometric training strengthens the tendons and improves their elasticity by placing stress on them in a controlled setting.
- Plyometric training boosts the efficiency of the neuromuscular system. The more efficiently the neuromuscular system can transmit a signal to the muscle, the faster the muscles contract and relax, which in turn increases your speed and power.
- Plyometric exercising will help intensify your energy and increase your stamina just in time for the main event. Plyometric exercising builds up an explosive amount of intense energy that will increase your muscular endurance.
- By training the body in a plyometric way, the body makes demands on the muscular system, whose needs are met first by the nervous system. The body figures out how to recruit additional motor units for that particular action or movement. With increasingly motor units going to your aid, this will expand the power created for that activity.

1.5 PLYOMETRIC TRAINING ON PHYSICAL PERFORMANCES

Plyometrics, the exercises that involve a stretch-shortening cycle (SSC). The SSC is where muscles move from an eccentric action (lengthening), immediately into a concentric action (shortening).

There are two types of SSC;

1.Fast <250ms ground contact time and

2.Slow >250ms ground contact time.

Primarily used by athletes to improve the performances of jumps, plyometric training has developed into two methods that have advanced since 1980.

1.**Shock method** - It is appropriate for the athlete to fall from a height and feel a 'shock' upon landing. In addition, this resulted in a minimal forced contraction on the muscle, As the athlete bounced upwards, that was then quickly changed to a concentric contraction. In an extremely short period (0.1-0.2 sec), the landing and take-off were performed. After the growth of a strong quality base, the shock method or technique is the best approach used by different athletes to boost their speed, power and strength. (**Russian scientist Yuri Verkhoshansky 1968**).

2. **General method** -The second version of plyometrics relates to doing any form of jump regardless of execution time. This involves jumps that are lower in intensity and execution, while the time required for transitioning from eccentric to concentric contraction is much greater.

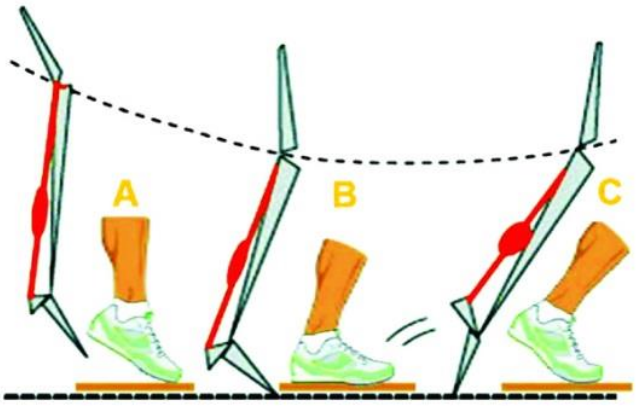

Figure 1 - Phases of plyometric training

Currently, typical plyometric training consists of three phases (Fig. 1). The first phase is an "eccentric phase" (rapid muscle lengthening movement). The second phase is the "amortization phase" (involves a short resting period), the third phase is the "concentric phase", (explosive muscle shortening movement). The athlete repeats this three-part cycle as quickly as possible, intending to decrease the amount of time between the eccentric and concentric movements. The athlete will become faster and more powerful when the time in between eccentric and concentric movement is reduced. This quick cycle primarily improves muscular, tendon, and nerve functions (**Behrens M, 2016**). The increase in physical power makes athletes run faster, jump higher, and hit harder, and develop specific skills such as injury protections relative to specific practiced sport (**Asadi A, 2015**). Also, the forces included and the speediness of execution activated the involvement of the central sensory system (**Bentley S, 1996**).

The three basis phase of plyometric training includes: phase I or eccentric (A) correspond to the pre-activation phase or stretch of agonist muscle. The elastic energy is put away in the series of the elastic element. Muscle spindles are stimulated; phase II or amortization (B) is the pause between phases I and III. Type l, a different nerve synapse with α motor neurons. α motor neurons transmit a signal to the agonist muscle group. The phase III or concentric (C) is the shortening of agonist muscle fibers. The elastic energy is out from the series elastic element. α motor neurons stimulate the agonist muscle group.

1.6 PLYOMETRIC TRAINING AND FOOTBALL PLAYERS

Football is an intermittent, highly-intensive, and complex sport. A successful performance is dependent on basic abilities, in particular, repeated explosive burst, power, kicking, tackling, and their derivatives such as jumping, turning, sprinting, and changing pace (**Hewett TE, 1996**), all making important contributions to the performance of the football player. Nevertheless, football relies primarily on aerobic metabolic for energy, and it has been suggested that up to 98% of the total energy expenditure during 90 min of gameplay is derived from aerobic metabolism (**Ferretti A, 1992**). Aerobic endurance performance in football is governed by three interrelated mechanisms including, VO_2 max, lactate threshold, and resistance exercise (**Gray J et al., 1985**). The average intensity is high, with a range of 75–80% of VO_2 max, despite periods of recovery (**Hutchinson MR, 1995**). Consequently, maximal oxygen consumption corresponds to the most important component of aerobic endurance performance in football (**Ferretti A, 1992**).

Football is concerned with explosive pushing power in the lower extremities and upper extremities. The ability to explode upwards and outwards will allow you to either tackle a player or push a player away from you. Plyometric movements that improve explosive pushing power in the legs, arms, chest, and shoulder should be highlighted as well as movements that help your body absorb the forces of being hit.

1.7 UNILATERAL PLYOMETRIC TRAINING

Uni-lateral plyometric training (UPT) are movements produced by a single limb.

Unilateral exercises focus on each limb working independently of each other so that the stress is placed only on one limb. Example: - Skater hops.

1.7.1 EFFECT OF UNILATERAL PLYOMETRIC TRAINING

"Unilateral plyometric training that works on the same muscle gives a great way to focus on the mind-muscle connection and feel the contraction you're after,"

- **Stoppani (2006)** states that because there is a crossover effect from training a muscle on one side of the body, one-sided training can be encouraged for better muscle growth on the untrained side.
- Unilateral weight-bearing exercises in an attempt to simulate functional muscle recruitment patterns required for activities of daily living, recreation, and sports **(Simenz, 2012).**
- Unilateral training will highlight any strength imbalances and muscular weaknesses that might exist between the athletes left and right sides.
- Research suggests that unilateral exercises are more effective at strengthening core muscles. **Stefanyshyn, (1998)** the unilateral jump favors increased activation of the hip extensor musculature or the gluteals, this may be because the body must use more stabilizing muscles to keep the individual standing up straight and balanced.
- **Behm, (2005)** states that 'trunk strengthening' can occur when exercises are performed unilaterally, most likely through much higher muscle recruitment within core muscles and stabilizers.

1.8 BILATERAL PLYOMETRIC TRAINING

Bi-lateral plyometric training (BPT) are movements produced by both limbs.

Bilateral exercises utilize the two limbs as one to interchange a load with the goal that the resistance is being shared between two limps, Example: - Plyo jacks.

1.8.1 EFFECT OF BILATERAL PLYOMETRIC TRAINING

- Bi-lateral movements are generally associated with an advantageous form of training to incorporate within training plans to be regarded as safe, effective, and highly functional.
- Athletes are in a mechanically advantageous position when training bilaterally, resulting in a large base of support and enabling increased performance.
- Bilateral exercises have a better transfer of performance to unilateral exercises than unilateral exercises do to bilateral exercises.
- Bi-lateral exercises allow an increased ability to sustain greater amounts of resistance which is expected to coincide with the increase in physiological changes to your body. These adaptations include both neurological changes over time along with structural adaptations which include the development of physical features.

1.9 COMBINED PLYOMETRIC TRAINING

Combined plyometric training consists of two different types of training such as bilateral and unilateral plyometric training.

1.10 PLYOMETRIC TRAINING VOLUME AND INTENSITY GUIDELINES

Based on the strength and progression of objectives in any plyometric session, the proposed volume of individual jumps can differ. For standing hops, test foot contact volume. As a researcher, 60-100 foot contacts of low intensity movements could be done by a novice in a single pre-season workout. In one workout and 100 moderate-intensity exercises in another, the intermediate athlete may be able to perform 100-150 foot contacts of low-intensity exercises, while an advanced player may be able to perform 150-200 foot contacts of low-to-moderate intensity exercises in a single session. The key is intensity: the

more vibrant the step and the better the power caused, the less foot contacts are essential. Sustaining consistency is important as training phases progress and the number of foot contacts should be decreased, as maximum power and speed need to control the performance.

Yuri Verhoshansky proposed a limit of 5-10 jumps in a session per set, with no more than 50-75 contacts on the ground. The number of reps should be decreased if run-on is used. Athletes or players should not allow themselves to become exhausted for the maximum sports-specific training impact. The rest should be at least 1-2 minutes between sets; rest not less than 15-30 seconds and should be isolated by intervals for progressive depth jumps or drop jumps or much more if very deep multiple jumps and hops schedules are being performed. The rest or recovery breaks will enable the stretch reflex mechanism to come back to ideal ability. As far as the number of sessions, 2-3 per week should do the training yet they should not be performed on back to back days or 7-10 days before competitions.

1.11 NEUROMUSCULAR VARIABLES

A combination of the nervous system (neural) and the muscular system (muscular) is called the neuromuscular system. In essence, our nerves and muscles work together. Sports performance typically relies on neuromuscular fitness, i.e. speed, mobility, power, agility, balance of flexibility, and co-ordination skills. Conditioning is sometimes called the method of improving a motor skill. Neuromuscular health in the game of football or soccer is a matter of fundamental importance to the well-being of any player. Neuromuscular fitness variables and specific training packages of technical skills are very

important elements for football players to enable them to efficiently use their technical and tactical skills in the matches.

Not only exercise is one of the most significant keys to a healthy body, it is the cornerstone of intellectual activity that is complex and innovative. (**John F. Kennedy)**

The following neuromuscular variables namely explosive power, agility, and dynamic balance were selected for this study after taking into consideration practicability, standard, availability of the equipment, and significance of variables.

1.11.2 Explosive Power

The ability to produce maximum force in a vertical jump is explosive power. The predominant requirement for success in a large number of sports skills is explosive power. For the lower body, this may be best exemplified by the vertical jump. It represents the product of strength and speed of movements which is very essential. **(Hardayal Singh, 1991).**

1.11.2 Agility

Agility is one of the components of physical fitness, motor fitness, and motor ability. Agility may be defined as the physical ability which permits an athlete to rapidly change body position and direction in a specific and accurate manner. Agility is an important ability in many sports activities, as exemplified in a fast game. **(Yobu, 2010)**

Agility is central to successful football performance because of the requirements to twist, turn, jump, and sprint. Agility refers to the controlled ability to change position and direction rapidly and accurately. Two conditions exist under which the ability of the performer should be influenced diversely (1) a reaction of a known type and in a known direction, to a stimulus that is anticipated; and (2) a reaction of an undermined type and in

an unknown direction to a set of stimuli that may vary widely and hence, unpredictable. **(Gupta, 2003).**

1.11.3 Dynamic Balance

Dynamic balance is the ability to balance whilst in motion or when switching between positions. The ability to keep up a focal point of gravity over a continually shifting base of support is basic to progress and is the substance of dynamic balance. The strength of the posture and control is likewise important to accomplish dynamic stability. **(Mark Dilworth 2007)**

1.12 PHYSIOLOGICAL VARIABLES

Physiology is the study of the functioning of an organism's whole organs and structures. The physique to be fit for the physiological system must work well enough to sustain a particular activity that the athlete often conducts distinct activity, making various demands on the organism regarding the activity-specific respiratory (lungs), circulatory (heart), metabolic (liver), and neurological processes. **(Raben B. Frost, 2001).**

In physiology, one can learn how cells operate inside organs, structures, tissues, cells, and molecules and how their functions are placed together to protect the inner environment. The science concerned with the study of human body functions is physiology. Exercise physiology is the study of the structures and functions of the human body and how exercise induces changes. It applies the principle of exercise physiology to the preparation of the athlete or player and to the athletic success of the athlete. **(Ajmeer Singh, 2005).**

Exercise physiology is the pragmatic study of physiological changes that influence exercise in the athlete’s physique, whether long or short term. There are several similar

correlations with the optimum performance of an athlete or player with various environmental changes, namely, diet, temperature, altitude, etc. **(Shyamal Kaloy, 2007).** The lungs, heart, and blood play a crucial role in the supply system of the body. They provide essential fuels, oxygen, and transport waste such as carbon dioxide and lactic acid to the muscle. Consequently, it is important to improve the cardiorespiratory system in athletes.

Pulse rate, blood pressure, breath-holding time, vital ability, anaerobic strength, aerobic power etcetera are the various physiological variables. For this analysis, the VO_2 max, resting pulse rate, and breath-holding time were selected.

1.12.1 VO_2 Max

VO_2 max (also maximum oxygen intake, maximum oxygen absorption, or aerobic ability) is the maximum capacity of the body of an organism to transport and use oxygen during incremental exercise, exposing the person's physical well-being. The name is derived from V - volume per time, O_2 - oxygen, max - maximum. VO_2 max is represented either as a full oxygen rate every minute in liters of oxygen (l/min) or as a relative oxygen rate every minute in milliliters of oxygen per kilogram of body weight (ml/kg/min), the latter term is regularly used to refer to the execution of endurance sports competitors.

As the single best indication of cardiovascular fitness and optimal aerobic strength, maximum oxygen uptake (VO_2max) is generally accepted.' Typically, absolute values of VO_2 max are 40-60 percent greater in males than in females. In the population, VO_2 max varies greatly, with sex being a key deciding factor in this variability. **(P.J. Strukic, 1981).**

1.12.2 Resting Pulse Rate

The number of beats stroked in just one minute is the pulse rate. In a healthy adult, the average pulse rate is 72±5 beats a minute. The number of beats of a pulse per minute or the number of beats of the heart. The pulse rate or heart rate differs significantly among various individuals under various circumstances. The American Heart Rate Association acknowledges it as a typical range from 50 to 100 pumps for every minute. The average rate is 72 beats for each minute but the rate may go faster to 220 per minute. Good performance in all sports and games relies on the lessor pulse rate of an athlete.

The total number of beats of the heart per minute is called the heart rate. The automatic nervous system which supplies parasympathetic or vagus nerves and the sympathetic or acceleratory nerves to the Sinovial artery node plays a prime role in regulating the heart rate **(Sharer Larry, 1982).**

1.12.3 Breath Holding Time

The length of time one can catch his or her breath without inhale and exhale after a profound inhalation, there are two forms of breath-holding time:

1. Positive breath-holding time.

2. Negative breath-holding time. The form of training for endurance will increase the breath-holding time. In sports breath-holding time also plays a critical role in sports victory. **(P.J. Strukic,1981).**

1.13 SKILL VARIABLES

Skill is an indicator of one's current level of proficiency on a given task and represents a combination of the athlete's abilities, capabilities, and practices or experience with the task. Skills are classified into three categories technical, tactical, and mental.

The technical skill requires the effective execution of a particular movement. Tactical skill refers to the kind of decision-making that enables athletes to gain an advantage over their opponent.

The mental skill involves the effective mobilization of the thought and feelings. Athletes need to remain poised and confident while executing their technical and tactical skills. **(Craig A, Wrisberg, 2007)**

Skill is undoubtedly one of the most essential factors for a footballer who uses it automatically. Skill is a natural prerequisite of a good footballer for solving all requirements at any stage of the game. Every player should have the maneuverability of the ball at any tempo. Even at a very fast tempo and under great pressure from the opponent, a player should not lose sight of the ball. A player who is physically fit and technically sound always looks around him by keeping his head up and acts decisively. **(Sukumar Saha, 2008).**

A skill in football involving large numbers of participants tends to be complex, making it difficult to understand and to participate fully. Many hours of practice and experience in a variety of situations are required before a player can be recognized as a competent or advanced performer. The rate of progress towards competence depends on factors such as ability, fitness level, knowledge, and experience of similar events, age, time, and degree of involvement in practice and playing. All sports involve the application of the skill of some kind of cognitive or intellectual, perceptual, or motor. Football involves all three skill types operating simultaneously in a rapidly changing environment. Skill is defined as “the learned ability to bring about predetermined results with maximum certainty and minimum outlay of time and energy”. Skills have been classified as ‘open’

or ‘closed’. Open skills are those which are dictated by and are varied according to external situations. Closed skills are pre-learned sequences of movements, little affected by the environment, and are well-timed and coordinated. Football is an ‘open skilled’ game requiring rapid responses to unpredictable situations but with some ‘closed skill’ events also evident, such as free kicks, corner kicks, etcetera. Football skill involves making correct decisions and then executing that which has been decided upon. **(Knapp, 1974)**

Skill movement must be executed under match situations, such as defined playfield, limited duration, physical and mental fatigue, and opposing team players. Football players have to possess moderate to high aerobic and anaerobic power, have good agility and joint flexibility, and be capable of generating high torques during fast movements. **(Reilly, Bangsbo, and Franks, 2000).**

The game football is demanding excellent physical fitness and excellent technique in a unique way. A player would not be able to score goals or efficiently defend without good technical skills. Dribbling, passing, shooting, kicking, and heading is fundamental techniques. **(Thomas E, Larkin, 2008)**

1.13.1 PASSING

Football is a passing game. Passing means the action of sending the ball to a team-mate. No other skill shows teamwork better than passing. Passing is the main form of communication between players. A pass is considered to be good if executed in the nick of time, in the right direction, and with proper force, so that it can be controlled without any difficulty by the receiver and carry out the movement easily. Every pass must have some purpose and it is better to vary the nature of a pass from short to long, low to high. **(Sukumar Saha, 2008)**

1.13.2 SHOOTING

Shooting in football is an effort to strike the ball into the opponent's goal with the intention to score. It is based on individual and team activities. During the training session, the shooting skill is called technique, while shooting at the target in the game is tactical. **(Sukumar Saha, 2008)**

1.13.3 DRIBBLING

Dribbling is the ability to run with the ball at your feet. **(Scott Murray, 2010).**

Dribbling means to attack the defender using the dribble as a way of advancing toward your opponent's goal. Players should attack the open space behind the defender in a manner that takes them directly toward the opponent's goal by being creative and using different dribbling feints to beat the defender. Emphasize the importance of exploding, or accelerating, into the open space that was created by the feint. This change of pace allows the player with the ball to leave the defender behind and penetrate towards the goal. **(Thomas E, Larkin, 2008)**

1.13.4 OVERALL PLAYING ABILITY

The performance of the players on the playfield during training and match. When the players get mastery over the fundamental skills, it may put them into specific football games. To play better football, the fundamental, as well as final skills, need to be worked on and perfected. The team with high offensive and defensive skills is capable of winning a high percentage of competitive matches.

Evaluating individual playing ability or performance within a team sport environment can present a difficult task for team sport coaches. In football, the players' performance relies on the interplay of individuals in tactical moves, the competence of

players in the basic skills of passing, dribbling, shooting, kicking, tackling, and in the more specific skills associated with particular playing positions. Defensive skills include guarding opponents, tackling and positioning to defend from the opponent team players using quickness to intercept or steal the ball, and rebounding missed shots. **(Thomas Reilly, 2001)**

1.14 REASON FOR SELECTION OF THE TOPIC AND VARIABLES

Football is an amazing sport that needs high levels of physical fitness which is important to all levels of players. Numerous researches have evidenced that plyometric training will enhance physical fitness variables like explosive power, agility, and dynamic balance. Still, there is a major lack in researches that to which extent, specific unilateral, bilateral, and combined plyometric training with game drills will influence the selected neuromuscular fitness variables namely explosive power, agility, and dynamic balance. A football player needs to be able to detonate rapidly and with a lot of power, in each short sprint, adjust his movement in less than a split second to take advantage of the space, ability to react to sudden changes of direction to reduce the risk of an accidental fall. Hence, the investigator chose the above mentioned neuromuscular fitness variables for this research.

The physical capacity of a football player is an important element of success in competitions. It involves a huge number of different capacities, with aerobic capacity being its major component. VO_2 max refers to the intensity of aerobic processes and represents the capacity of the organism to utilize at a certain moment the maximum amount of oxygen. (**Zivanic S, 1999)** Exercise strengthens the heart muscle. It allows it to pump a greater amount of blood with each heartbeat. More oxygen goes to the muscles. This means the heart beats fewer times per minute than it would in a non-athlete. However, an athlete's

heart rate may go up from 180 bpm to 200 bpm during exercise. The Players' heart muscle gets strengthen and it allows it to pump more amount of blood with each beat of the heart. More oxygen is additionally heading off to the muscles. It means the heart beats a lesser time per minute than it would in an untrained individual. Players' performance relies upon oxygen. At the point when you breathe in, oxygen is carried to the muscles through the circulatory system. Some portion of the oxygen is utilized quickly, while some portion of it is stored in the body to break down glucose and make fuel for the muscles in what is called ATP energy, which supplies energy during a strenuous workout. Hence, the investigator chose VO_2 max, resting pulse rate & breath holding time as physiological variables for this research.

Football is a game in which a player requires the basic ball skills to run faster with the ball, to make a goal, and to make successful dribbling throughout the game. Skills such as passing, shooting, and dribbling are considered the fundamental skills of football. Many research and experience have already evidenced that the football skills and overall playing ability during competition and practice session goes by the result of proper physical fitness and football drills. There is still a lack of researches that to which extent the use of proper plyometric training will improve game fitness to execute skills and playing ability. Hence, the investigator has selected the game skill variables namely passing, shooting, dribbling, and overall playing ability for this study.

There are plenty of studies that have been carried out on football training. Plyometric training deserves to be the top in physical training of the football players. In many sports & games, success arises from using and augmenting a combination of neuromuscular, physiological, technical, and tactical capacities.

Having kept this in mind and since it was found that plyometric training yields a host of advantageous and vital role on neuromuscular and physiological performance among football players. Hence the investigator was motivated to ascertain the effect of unilateral, bilateral, and combined plyometric training in this research.

The variables were selected based on the discussions with experts, the feasibility of the criteria, availability of equipment, and the significance of the variables to the present study. Hence, the investigator selected the research entitled “Effect of unilateral bilateral and combined plyometric training on selected neuromuscular physiological and performance variables among engineering college football players”.

1.15 STATEMENT OF THE PROBLEM

The prime intention of the study was to govern, “The effect of unilateral bilateral and combined plyometric training on selected neuromuscular physiological and performance variables among engineering college football players”.

1.16 SIGNIFICANCE OF THE STUDY

The present investigation has the following significant aspects:

- This study would identify the status of plyometric training on neuromuscular, physiological, and performance variables of engineering college football players.
- This study would identify the way to train the central nervous system (CNS) to react quickly and autonomously (subconsciously without thinking) and determines how explosively a football player moves forward, backward, laterally, or jumps.
- This study will help football players to improve efficiency in their play.

- The study was of great significance because it would provide an opportunity to the football coaches, researchers to assess the performance changes among the engineering college football players.
- This study maybe helps to know the importance of plyometric training toward engineering college football players.
- It may also be helpful to improve the theoretical knowledge about unilateral plyometric training, bilateral plyometric training, and combined training.

1.17 THE OBJECTIVES OF THE STUDY

- To analyze the effect of unilateral, bilateral, and combined plyometric training on selected neuromuscular variables among engineering college football players.
- To find out the conclusion of unilateral, bilateral, and combined plyometric training on selected physiological variables among engineering college football players.
- To find out the impact of unilateral, bilateral, and combined plyometric training on selected performance variables among engineering college football players.

1.18 HYPOTHESES

1. It was hypothesized that there would be a significant difference in selected neuromuscular variables such as explosive power, agility, and dynamic balance between the control group and experimental groups.
2. It was hypothesized that there would be a significant difference in selected physiological variables such as VO_2 max, resting pulse rate, and breath-holding time between the control group and experimental groups.

3. It was hypothesized that there would be a significant difference in selected performance variables such as football passing, shooting, dribbling, and overall playing ability between the control group and experimental groups.
4. It was hypothesized that there would be a significant difference among experimental groups on selected neuromuscular variables such as explosive power, agility, and when compared with other training groups.
5. It was hypothesized that there would be a significant difference among experimental groups on selected physiological variables such as VO_2 max, resting pulse rate, and breath-holding time when compared with other training groups.
6. It was hypothesized that there would be a significant difference among experimental groups on selected performance variables such as football passing, shooting, dribbling, and overall playing ability when compared with other training groups.

1.19 DELIMITATIONS

- The study was administered only on 60 engineering college-level football players (men).
- Age level of the subject was between 18.5 (± 0.5) and 22.4 (± 0.5) years.
- Selected lower extremity unilateral plyometric training, bilateral plyometric training, and combined training were applied to the subject in the evening session.
- The experimental period was delimited to 12 weeks and the training was given for three sessions per week on alternate days.
- The study was restricted to intercollegiate level engineering college football players from various engineering colleges at Chittoor, Andhra Pradesh.

- The selected neuromuscular variables were delimited to explosive power, agility, and dynamic balance.
- The selected physiological variables were delimited to VO_2 max, resting pulse rate, and breath-holding time.
- The selected performance-related variables were delimited to football passing, shooting, dribbling, and overall playing ability.

1.20 LIMITATIONS

- Regular activities pertaining to the day to day affairs which will affect the performance are not controlled
- The passive variation such as temperature, food habits during the testing period and their possible influence on the result of the study could not be considered.
- The subject's physique type and social and economic status were not taken into consideration.
- The diet, habits, previous training, and performance was not considered.
- Past experience in the fields of sports and games, which could have an impact on preparation and data collection, has not been taken into account.

1.21 DEFINITION OF OPERATIONAL TERMS

1.21.1 Football

It is a game played on a field between two groups of 11 players each with a spherical shape ball into the opponent's goal by kicking or by hitting it with any portion of the body except the hands and arms.

1.21.2 Plyometric training

Activity or exercises empower a muscle to achieve maximal power in the most limited measure of time **(National Strength and Conditional Association 2017).**

Plyometric training is utilized in specific sports training to improve power and performance. Plyometric exercises upgrade the series elastic element and the stretch reflex by utilizing movements like those used in the athlete's sport.

1.21.3 Unilateral Plyometric Training

The athlete's limbs work separately and the movements are produced by a single limb.

1.21.4 Bilateral Plyometric Training

The athlete's limbs work in unison and the movements are produced by both limbs.

1.21.5 Combined Plyometric Training

Combined training consists of two different types of training such as bilateral and unilateral plyometric training.

1.21.6 Explosive Power

The rate of peak force production is at the maximum for any type of muscle action in minimum time is explosive power.

1.21.7 Agility

The ability to change the body's position efficiently, and requires the integration of isolated movement skills using a combination of balance, coordination, speed, reflexes, strength, and endurance.

1.21.8 Dynamic Balance

The ability to keep up postural stability and introduction with the center of mass over the base of support while the body parts are in movement. **(Susan B O Sullivan, 2014)**

1.21.9 VO_2 max

The maximum rate of consumption, distribution, and utilization of oxygen in one min.

1.21.10 Resting Pulse rate

Pulse rate is means heart-beat and the number of times heart-beats per minute **(Moorehouse & Miller, 1983).**

Pulse rate wave of increased pressure, which is palpated at the blood vessel (Artery) when blood is propelled out of the heart **(Pearece, 1989).**

1.21.11 Breath-holding time

Breath-holding is well-defined as the period of time between the deep inhalation and the first definite reaction of your body to take a breath. **(Chaterjee, 2003).**

1.21.12 Football Passing

The technique of passing allows the ball to travel up the field and reduces the risk of giving away possession.

1.21.13 Football Shooting

The technique shooting intends to hit the ball with the lace of the shoe following through the ball keeping the foot firm all through.

1.21.14 Football Dribbling

Dribbling means roving with the ball. Dribbling allows the player to move the ball around the field without losing possession.

1.21.15 Overall Playing Ability

Overall playing ability is the all-round performance of the players on the playfield during practice sessions and competitions with experience of fine-tuned skills of the football.