EFFECT OF SELECTED PLYOMETRIC EXERCISE ON POWER, STRENGTH AND SPEED OF SHORT DISTANCE ATHLETICS PROJECT FEMALE ATHLETES IN CASE OF ASSOSA WEREDA BENISHANGUL GUMUZ, WESTERN ETHIOPIA

MEd THESIS

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JUNE, 2018

HARAMAYA UNIVERSITY, HARAMAYA

Effect of Selected Plyometric Exercise on Power, Strength and Speed of Short Distance Athletics Project Female Athletes In Case of Assosa Wereda Benishangul Gumuz, Western Ethiopia

A Thesis Submitted to the Department of Sport Science

Postgraduate Program Directorate

HARAMAYA UNIVERSITY

In partial Fulfillment of the Requirements for the Degree of

MASTER OF EDUCATION IN TEACNHING PHYSICAL EDUCATION

Goitom Abraha Birhane

June 2018

Haramaya University, Haramaya

HARAMAYA UNIVERSITY

POSTGRADUATE PROGRAM DIRECTORATE

As research advisors we hereby certify that we have read and evaluated this thesis entitled **"Effect of Selected Plyometric Exercise on Power, Strength and Speed of Short Distance Athletics Project Female Athletes In Case of Assosa Wereda Benishangul Gumuz, Western Ethiopia."** Prepared under our guidance by Goitom Abraha Birhane we recommend that it was submitted as fulfilling the thesis requirements.

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As a member of the Board of Examiners of MEd. Thesis Open Defenses Examination, we certify that we have read and evaluated the thesis work prepared by Goitom Abraha Birhane and examined the candidate. We recommend that the thesis be accepted as fulfilling the thesis requirements for the Degree of Master of Education in Teaching Physical Education.

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DEDICATION

This thesis is dedicated to my families and parent for their constant physical, emotional, and financial support throughout my educational career and life. Without their tolerance, understanding, support and most of all love, the completion of the work would have been impossible.

STATEMENT OF THE AUTHOR

First, I declare that this thesis is my genuine work and that all sources of materials used for this thesis have been duly acknowledged .This thesis has been submitted in partial fulfillment of the requirements for M.Ed. Degree at Haramaya University and is deposited at the university library to be made available to browsers under rule of library. I solemnly declare that this thesis is not submitted to other institutions anywhere for the award of any academy degree diploma or certificate.

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BIOGRAPHICAL SKETCH

The author was born in November 19, 1988 in Nebelet Centeral Tigray Regional State. He started his elementary education at Nebelet primary school and he attended his secondary and preparatory education at adigrat Agazi and Edaga Arbi preparatory and senior secondary school.

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ACKNOWLEGEMENT

First and foremost, I thank the Almighty God who gave me the health, the stamina and strength to go through the rigor of graduate study and helped me to finish the research work, thesis write up and lead to successful completion of the study.

I would like to express my deepest gratitude to Dr.Wegene Waltenegus, my major thesis advisor and Dr. Abinet Ayalew my thesis co-advisor for their constructive comments and encouragements throughout this study. It would have been impossible to complete this study without their unreserved support and guidance.

I would like to give special thanks to Hoha number 2 and Nebar komshga secondary school to support deferent materials i.e. medicine ball, stop watch and Mr. Bekele Kasa serving in Assosa Wereda short distance athletics females coach, support and pursue the ordinal training of control group and during pre- post test data collection. My great gratitude also goes to all Assosa wereda female Athletes who agreed to participate in the study and for their patience during the data collection process.

I would like to thank all my friends, especially to Kidu Gebru and Mehari Takele for their conceptual support, constructive comments and sharing me their computer skills during the whole thesis writing. My genuine pleasure is also extended to Ministry of Education (MOE), Haramaya University and Benishangul Gumuz Regional State educational bureau for funding and fully sponsoring my graduate studies. For the inner core of my heart I would like to express my deep sense of gratitude and appreciation to my mother Atsede Gebru , my father Abraha Birhane , my sisters Genet Abraha , Selam Abraha, and my brother Hadush Abraha, Kibrom Abraha, for their unconditional love, moral support and immeasurable scarifies they paid to reach me at this spot.

Lastly, I thank to, Hoha number two secondary school all staff members.

ACRONYMS AND ABBREVIATIONS

ACSM	American College of Sport Medicine
BGBOARD	Benishangul Gumuz Bureau of Agricultural Rural Development
BGRSSA	Benishangul Gumuz Regional State Statically Agency
BGRSSYB	Benishangul Gumuz Regional State Youth Sport Bureau
BGRSYAR	Benishangul Gumuz Regional State Youth Sport Bureau Annual Report
BJT	Broad Jump Test
H_A	Alternative Hypothesis
H_O	Null Hypothesis
MoE	Ministry of Education
NSCA	National Strength Conditioning Association
PoT	Post- Test
PT	Pre-Test
SJT	Sergeant Jump Test
SSC	Stretch Shortening Cycle
SUPT	Sit Up Test
WST	Wall Squat Test

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ABSTRACT

selected plyometric exercise were important to improve physical fitness components.The main objective of this study was to examine the effect of selected plyometric exercise on power, strength and speed, on short distance female athlete trainees. To employ the study, by simple random sampling technique 22 experimental groups and, 22 control group totals, of 44 female athletes was selected to perform plyometric exercise for three months, three days per a week. And out of the total number of, 44 female athletes, 8, participants terminate the training coincidence from both groups due to this study subjects become 36. The Weight and height average of experimental group and control group were almost all similar that is (48.99kg $\pm$1.94*) and (49.36kg* $\pm$ 1.84*) and,* (1.56m$\pm$.0231 and 1.55m$\pm$.0102) *respectively. Before training, both groups of ,18 athletes has done pre-test (BJ , SJ of anaerobic power tests, sit up, wall squat strength tests, and 35m, 60m dash speed tests) and recorded. The selected plyometric exercise were implemented on the EG three day per week, (60) minutes per a day. After three months, post test measurement on the same parameters was taken. The difference between the tests were analyzed statistically, with paired sample t-test at (P<0.05) Consequently it was observed that selected plyometric exercise implemented on adolescence brought about significant improvements from pre-test and post test results of power, in which length and height of BJ and SJ test result were increased by a mean difference of, (4.11 at P=.000 and 4.27at P=.000) respectively Strength in which duration of sit up and wall squat strength test result was increased by a mean difference of (8.39 rep/seconds at P=0.000 and 7.83seconds resist at P=0.000) respectively. And. speed, in which duration to complete (35m and 60m) was decreased by a mean difference of, (0.51seconds at P=0.000 and 1.28seconds at P=0.000.) According to the result the investigator recommended that adding selected plyomtric exercise program helps to improve adolescence athlete's power, speed, and strength performance.*

Keywords: *plyometric, Power, Strength, Speed, Eccentric, concentric and Amortization.*

1. INTRODUCTION

This section present the background of the study, statement of the problem, scope of the study, hypothesis ,significance of the study, general and specific objectives of the study.

1.1. Background of the Study

Plyometric training (PT) has been proven to improve strength, agility and specific fitness performance. The main reason is because PT activates the stretch-shorting cycle (SSC) mechanism. The SSC can be best described as the lengthening of a muscle (eccentric phase) prior to an immediate shortening of a muscle (concentric phase). PT is mostly used when training athletes from pre puberty to late puberty. Due to building muscle mass and thus neural adaptations are easier to focus on (Sohnlein et. al., 2014).

Conditioning professionals have long depended on plyometrics as one of the primary tools for developing athletic power, Strength and speed. That exercises such as plyometrics, which are performed with high movement speeds, would improve the performance of activities requiring speed, such as jumping, running, and agility. The technical term for this idea is specificity. In other words, training that is specific or similar to the activity to be performed is believed to be optimal (William, 2007).

Power, the combination of speed and strength, is crucial for success in many sporting events. The purpose of plyometric work is the same as that of strength training, to develop greater physical power. Many athletes spend all their time in the weight room trying to increase power with barbell and dumbbell exercises. While these exercises have their place, they are not the most efficient means of developing power. Traditional weight room exercises do not allow the athlete to move at the speed, or use the movements needed, to develop sport specific power. While strength training can create the muscular and nervous system adaptations necessary for power development, plyometrics focuses on the speed component of power and transforms the physiological changes into athletic ability (McNeely, 2007).

Plyometric, also known as" jump training" or " plyos", exercise in which muscle exert maximum force in short interval of time ,with the goal of increasing power (speed-

strength).This training focuses on learning to move from a muscle extension to a contraction in a rapid or " explosive "manner ,such as in specialized repeated jumping. Study that indicate Plyometric are primarily used by athletes, especially martial artists, sprinters and high jumpers, to improve performance, and are used in the fitness field to a much lesser degree (k.savithri, 2014). Additionally Plyometric training jumping, bounding, and hopping exercises that use the stretch shortening cycle of the muscle unit have consistently been shown to improve the production of muscle force and power. In particular, the fast force production of the trained muscle improves, coupled with smaller increases in maximum isometric force (www.nsca-jscr.org).

Research evidence suggests that plyometric training (PT) is a method of choice when aiming to improve vertical jump ability and leg muscle speed-strength and power and also the ground reaction time is decreased then after that plyometric training helps to improve reactiontime and speed (Michael et al., 2006).

Moreover Study shows that 6 week plyometric program and control group. The researcher found that plyometric group decrease their time on all 3 agility tests measured by between 2.93% and 10% (Miller and Michael G, 2006).

1.2. Statement of the Problem

In conditioning exercise, strength or performance enhancement, plyometric exercises should play an integral part of the exercise program (George et al, 2015). So, it is essential that in every training aspect is done as efficiently in the limited time frame that is available to athlete and everyone involved in their performance development. The plyometric exercises used in a training program which match the individual needs of the athlete in relation to the characteristics of the sporting activity that they are involved with. It makes to optimize the performance athletes and also one study found that, Plyometric exercises were reflected the type of activity implicit in sport that is the principle of specificity. For example, jumping exercises that were non specific to running performance (i.e., vertical-type jump exercise) did not cause any effect on running speed when exercises were specific (E.g. speed bounding) to running performance, the training program had a positive effect on runningvelocity (Rimmer and sleivert, 2000).

According to recent evidence Plyometric exercise to build power, speed, coordination, agility and effectively improve the performance of athlete but it is important to recognize that these are high risk exercise, and they can increase the risk of injury if they performed incorrectly or without solid base of training (Elizabeth, 2016).Plyometric has high potential as a potentiating exercise to enhance specific athletic performance due to similarities in their technical structure (Margaritopouls and Theodorou, 2015).Moreover, one study found that Plyometric exercise is suitable for improving various measures and component of muscle power such as vertical jump ability, speed and acceleration (Fatouros et al, 2000). And also one study found that, Athletics can achieve top speed by maximizing their power production. When design and implement correctly, plyometric exercise is an effective and efficient way to increase the power produced in athletics stride. However, not every plyometric drill is suited for speed training (Wakai, 2013).

Currently, Benshangul Gumuz region has the known in the national level especially in long distance athletics in some area. Even though, the performance of short distance athletics activities haven’t satisfactory till now. Moreover, in Benishangul Gmuz the

main obstacles and cause that make to diminish or unable to obtain athlete in short distance event hasn't shown empirical research study.

Similarly,Assosa wereda is one of a district area of Benishangul Gumuz Region state. In this region especially in Assosa Woreda short distance female athletics projects are established in order to enlargement and fly kite of females Athlete participants in the region. Therefore, conducting research on selected plymotric exercises on power, strength and speed of short distance athletic event female athletes are better solution to performance enhancement and forward policy implications.

Thus, based on the researcher's knowledge no one researcher was conducted in the study area till this end. Therefore, the researcher was motivate to conduct a research on selected plymotric exercises on power, strength and speed on short distance event female athletes Benishangul Gumuz region by undertaking Assosa woreda as a case study.

1.3. Hypothesis

Based on the availability of the literature the researcher tried to test the following hypothesis:-

1. H_A: Selected plyometric exercise had an effect on speed of female's short distance athletics project?

H_O: Selected plyometric exercise hadn't effect on speed of female's short distance athletics project?

2. H_A: Selected plyometric exercise had an effect on strength of female's short distance athletics project?

H_O: Selected plyometric exercise hadn't effect on strength of female's short distance athletics project?

3. HA: Selected plyometric exercise has an effect on power female's short distance athletics project?

H_O: Selected plyometric exercise hadn't effect on power female's short distance athletics project?

1.4. Scope of the Study

This experimental research is focused on effects of selected plyometric exercise on power, strength and speed, of short distance female athlete project in Assosa wereda aged 16 to18 Thus, in this study only 36 female Athletes from Assosa wereda Athletics project were participated while males and other athletes from other projects i.e. football, basketball etc were not included on this study because of different potential reasons, like shortage of Data collecting materials, man power, money, time, access of materials, Due to this, the number of the subjects was limited to the proposed sample size. The research was conducted on volunteers who had interest to take part as a subject in this study.

1.5. Significance of the Study

The main aim of this study was examine the effect of selected plyometric exercise on power, speed and strength, of short distance female athletes. In addition the study intended to signify the following importance:-

The study was helpful to the participants able to put a better athletic performance in power, strength, speed, and it had a great significance in addressing and evaluating the selected plyometric exercise on athletic related performance for athlete, coaches, and clubs. In addition the study was expected to enhance the performance of short distance female athletes and it helped to know the value of selected plyometric exercise for short distance female athletes. Finally the study it helps to give concepts for the next researcher.

1.6. Objectives of the study

1.6.1 General objectives

The general objective of the study was to examine the effect of selected plyometric exercise on power, strength, and speed of short distance female athletes

1.6.2. Specific objectives

- To measure the effect of selected plyometric exercise on power of females' short distance athlete project.
- To evaluate the effect of selected plyometric on strength of females' short distance athlete project.
- To determine the effect of selected plyometric exercise on the speed of short distance females' athlete.

2. LITERATURE REVIEW

2.1. Concepts of Plyometric Exercise

Plyometric is a type of exercise which utilizes the stretch shorting cycle of muscle tends nous tissue. Eccentric stretching is followed by concentric shortening of the same muscles. Often involves rebound activities. Plyometric training also called stretch shortening drills or stretch strengthening drills or reactive neuromuscular training. Plyometric is thought of as missing link between weight training (strength) and athletic performance (power), with particular emphasis on the speed of activity. It is a form of training designed to develop explosive power for athletics. Running, walking and hopping are typical examples in human locomotion of how external forces (Example gravity) lengthen the muscle. In this lengthening phase the muscle is acting eccentrically then a concentric (shortening) action follows. The true definition of eccentric action indicates that the muscles must be active during stretch. This combination of eccentric and concentric actions forms a natural type of muscle function called the stretch-shortening cycle (SSC). The period of time between the stretch and shortening cycles is known as the amortization phase. Amortization phase is kept very brief by a rapid reversal of movements to capitalize on the increased tension in the muscle (Behrens et al, 2015).

2.2. The Science of Plyometric:

The basis of plyometric exercises is that they toughen muscles and condition nerve cells, which trigger a pattern of muscle contractions. Specifically, the exercises engage the mitotic reflex the release of power when muscles are stretched to their maximum. This reflex in turn stimulates neurons called stretch sensory receptors. The ultimate goal is achieving as strong a muscle contraction as possible in the shortest amount of time possible. Plyometric uses a key concept of exercise science. Muscle contractions that last the least amount of time produce more energy than a slower contraction or release regardless of the size or bulk of the muscle. Another key element of plyometric is concentric contraction. For a muscle to act, it first must "coil up," which is actually

stretching out to its maximum pre-action length. This loads the muscle, like cocking a gun. Then, as the muscle is held in this state, energy is stored, and energy grows as the muscle is held. That brief storage lasting a second or less allows for maximum storage and use of the energy Plyometric are an essential component of sports conditioning for all activities requiring strength, power and speed. It is a method of developing explosive power, and it refers to activities that enable a muscle to reach maximum force in the shortest period of time. Integrated correctly into an overall training program, plyometric can significantly improve athletic performance (Brian Boone, nd).

2.2.1. Plyometric Exercise

Plyometric is usually defined as a systematic process of repetitive, progressive exercise, which also involve learning processes and has the ultimate goal of improving the athlete's systems and functions in order to optimize athletic performance. A training plan must follow the concept of per iodization, well planned and structured, and be sport specific, so as to cause the athletes energy systems to adapt to the particular requirements of the sport. In order to achieve such goals, power is essential. Explosive, reactive power is the ability to apply force at a rapid rate in order to accelerate the body or projectile at a high momentum (Power = force x Velocity). An athlete can be very strong and still not be very powerful. This is simply due to low rate of utilization, i.e. the ability to contract already strong muscles in a very short period of time. The most important factors in determining jumping and sprinting performances are the ability to quickly apply forces to the ground. Previous research has shown that faster runners can apply greater amounts of force down into the ground during the brief ground contact period than slower runners. This high rate of vertical force application leads to shorter ground contact times as well as longer stride lengths, thus allowing the faster runners to attain greater maximum speeds (Jimson, 2012).

2.2.2. Plyometric Exercise Basics

Plyometric involve the stretch-shortening cycle in which elastic energy is stored in the eccentric muscle contraction lengthening of the muscle. Immediately following the

eccentric contraction, a concentric muscle contraction occur shortening of the muscle resulting in a rapid increase in force such as when you stretch a rubber band and then let it go quickly. Plyometric include high-intensity lower-body movements such as jumping, leaping and bounding, and upper-body movements such as throwing, catching and certain types of pushups (Heather, 2015).

2.3. Types of Plyometric Exercises

There are three general types of plyometric exercises: rhythm, power and speed. Each form develops different qualities of the neuromuscular system. As such, some exercises are better suited for different events. Conversely, some events are served well by all three types of drills.

2.3.1. Rhythm plyometric exercise

Rhythm plyometric help develop the coordinated movement skills required in track and field. Their primary purpose is to give the athlete greater kinesthetic awareness or body sense, coordination and rhythm. They promote general athletic ability. All track and field athletes benefit from these drills, but they are especially well-suited for less mature athletes and those without good natural skills. For example, many young distance runners have undeveloped strength, rhythm and coordination. For them, the greatest contribution of plyometric drills is to increase their coordination and sense of rhythm. Many young athletes have good ability but simply lack some basic movement skills because they are growing rapidly. Rhythm plyometric are quite useful in developing correct running mechanics. More important, these drills give the young athlete an improved sense of physical awareness – how his or her body moves through space. This applies to all athletes. Rhythm drills for sprinters and hurdlers are crucial to optimal success. Sprinting and hurdling are events where speed and power are expressed through proper technique and rhythm. Jumpers, too, need rhythm plyometric. Jumping events involve an explosive movement at the end of a controlled run-up. A smooth rhythm enables the athlete to convert run-up speed into the jump. Even high school throwers need rhythm and coordination. The discus is an event of smooth rhythmic motion building to an explosive

release. And shot putters need to have a sense of rhythm with the feet in order to move across the throwing circle and land in a solid power position. Rhythm plyometric exercises also serve as a bit of physical education. As funding and support for physical education curricula have eroded, many young high school athletes come to sports programs with poor coordination, movement skills and basic strength. This fact is particularly applicable to a track and field team, which usually has greater numbers and variety than most other school sports teams. Rhythm plyometric drills are mostly simple movements done repeatedly. Generally, they involve segments of the movements athletes use while running, jumping, or throwing. Some common rhythm drills are skipping, running with high knee lift, running butt kicks, fast feet running and cariocas. These drills develop the necessary technique and coordination to let speed and power be expressed most efficiently (LA84 Foundation.org, 2012,).

2.3.2. Power plyometric exercise

The primary goal of plyometric training is to increase power. The track and field athletes that need to stress power development most are jumpers, sprinter and throwers, so their exercise should utilize a large number of plyometric drills. Throwers should use power plyometric for the upper body as well as the lower body. Although athletes in all events should use power drills in their training at different points in the season, a coach must bear in mind that power movements are physically demanding. Sufficient rest is mandatory both within and between workouts. During the most competitive part of the season, these exercises should be tapered down. Power exercises for distance runners need to be closely monitored to avoid overtraining during high volume periods. Power plyometric emphasize the simultaneous application of maximum strength and quickness. The focus of movement is explosiveness. When doing jump repetitions, for example, the objective is to perform a set of jumps at high intensity, not to continue repetitions past the point of fatigue. Although plyometric training can be used for such purposes, the goal of power drills is not endurance. Explosiveness is greatest when the muscle is warmed and rested. Athletes should only do a given exercise to the point where performance declines. It is better to do an extra set of an exercise than to add repetitions that are not done powerfully. Power plyometric drills include a variety of jumping movement’s hops,

bounds, single jumps and leaps. Upper body exercises include medicine ball throws, pendulum throws and push-ups. Depth jumps and box jumps are advanced plyometric, but they are risky for most high school athletes (LA84 Foundation.org, 2012).

2.3.3. Speed Plyometric exercise

Speed plyometric emphasize the speed component of training. The overload principle is satisfied in the form of increased speed rather than force. In other words, movements are performed significantly faster than normal. The objective of speed-assisted, or over speed, training is to force the neuromuscular system to respond more quickly to a stimulus. The accelerated time frame of the action overloads the system, creating faster than normal response. This training effect then carries over into increased event speed .Speed exercises obviously apply to sprint and hurdle events. Maximizing running speed is the key to success in these events. Jumpers, too, rely heavily on sprint speed, most notably long jumpers and pole vaults. Throwers benefit from speed training through improvements in general quickness. Speed plyometric for distance runners are beneficial, but one should remember to coach them to be fast distance runners, not sprinters. The focus should be running mechanics as opposed to sprint speed. Many of these drills will be the same as those done for rhythmic development, stressing maximum quickness. Fast skips, arm swings and butt kicks are a few examples (LA84 Foundation.org, 2012).

2.4. Principal of Plyometric Exercise

Plyometric are a type of exercise that typically include hops, jumps, and medicine ball exercises that make use of the muscles' cycle of lengthening and shortening to increase muscle power. The following are general guideline to follow when incorporating plyometric drills into a training session:

1. Plyometric drills involving a particular muscle/joint complex should not be performed on consecutive days.

2. Plyometric drills should not be performed when an athlete is fatigued. Time for complete recovery should be allowed between plyometric exercise sets.

3. Footwear and landing surfaces used in plyometric drills should have good shock absorbing qualities and lateral support.

4. The athlete should have a good base level of strength, balance, and mobility in order to perform a plyometric training routine. Thus, the athlete should be able to demonstrate these abilities through proper movement mechanics and landing techniques prior to participating in such a program.

5. A generalized and specific warm-up utilizing dynamic flexibility drills should be performed before a plyometric training session.

6. To safely and systematically progress plyometric activities and drills, the frequency, intensity, and/or volume of training can all be manipulated to continue challenging the athlete.

Frequency - Plyometric training should be performed from1-to-3 times per week on non-consecutive days. Athletes should schedule plyometric training sessions at least 48-72 hours apart in order to allow the involved muscle groups an adequate amount of time to recover (Potash and Chu, 2008).

Intensity - Drills that are less demanding should be mastered prior to attempting more complex drills. Factors affecting the intensity of plyometric are the number of foot/hand contacts, speed, height of the drill, the participant's weight. In order to avoid overtraining it is important to remember that intensity of training is inversely proportionate to the volume of training. In general, intensity should increase as volume decreases throughout the year/season (Jason, 2007).

Volume - (the number of foot contacts (lower body) or throws or catches (upper body). Beginners should only perform between 80-100 contacts per training session, whereas the intermediate may be able to perform 100-120 per session. Older and more advanced athletes may perform as many as 120-140 contacts per session (human kinetic, 2008).

Specificity-Specificity in a plyometric program should be designed dependent upon the athletes sport and position whenever possible to enhance the specific goals of the program and to replicate the athletes given sport specific activities (George, 2015).

Progression –Plyometric is a form of resistance training and thus must follow the principles of progressive overload (the systematic increase in training frequency, volume, and intensity in various combinations (Potash and Chu; 2008).

Recovery: Recovery is important to prevent injury, over training and to determine the primary emphasis of the plyometric program. Because of the body with plyometric training, longer recovery periods between sets may be appropriate. There is limited research on the optimum recovery time, but recovery between training sessions is usually 48 to 72 hours between exercise bouts with plyometric is recommended (Jason, 2007 and George, 2015).

2.5. The Benefits of Plyometric for Runners

Plyometric or jumping exercise is something that every runner should do and that most runners don't do. Running is a form of jumping. Plyometric isolates and exaggerates the jumping element in running and thereby improves running performance in a way that running itself does not. This is a proven fact. One study found that runners who replaced one-third of their normal running with plyometric improved their race times, while runners who continued with their normal running schedule did not (Matt, 2014).

2.6. Phases of Plyometrics

Plyometric exercises even can be used for rehabilitation or performance enhancement in sports. Both lower extremity (LE) and upper extremity (UE) sports use the plyometric concept as part of functional movement patterns and skill when performing the sport. Plyometric training utilizes the stretch-shortening cycle (SSC) by using a lengthening movement (eccentric) which is quickly followed by a shortening movement concentric (Behrens, et al., 2015).

2.6.1. Eccentric Phase

First stage of plyometric movement, classified as eccentric phase, but also called deceleration, loading, yielding, counter movement, or cocking phase. Phase increases muscle spindle activity by pre stretching the muscle before activation. Potential energy stored in the elastic components of the muscle during this loading phase much like stretching a rubber band in eccentric contraction, the tension generated is insufficient to overcome the external load on the muscle and the muscle fibers lengthen as they contract. Rather than working to pull a joint in the direction of the muscle contraction, the muscle acts to decelerate the joint at the end of a movement or otherwise control the repositioning of a load. This can occur involuntarily (e.g., when attempting to move a weight too heavy for the muscle to lift) or voluntarily (e.g., when the muscle is 'smoothing out' a movement). Over the short-term, strength training involving both eccentric and concentric contractions appear to increase muscular strength more than training with concentric contractions alone (Nikolaidis, 2012;Behrens, et al., 2015).

2.6.2. Amortization Phase

Dynamic stabilization and is time between end of eccentric muscle action and initiation of concentric contraction. Prolonged amortization phase results in less than optimal neuromuscular efficiency from a loss of elastic potential energy. Rapid switch from eccentric loading to concentric contraction leads to a more powerful response (Behrens, et al., 2015).

2.6.3. Concentric phase

Occurs immediately after amortization phase, involves concentric contraction. In concentric contraction, muscle tension is sufficient to overcome the load, and the muscle shortens as it contracts. This occurs when the force generated by the muscle exceeds the load opposing its contraction. During a concentric contraction, a muscle is stimulated to contract according to the sliding filament theory. This occurs throughout the length of the muscle, generating a force at the origin and insertion, causing the muscle to shorten and changing the angle of the joint. In relation to the elbow, a concentric contraction of the

biceps would cause the arm to bend at the elbow as the hand moved from the leg to the shoulder (a biceps curl). A concentric contraction of the triceps would change the angle of the joint in the opposite direction, straightening the arm and moving the hand towards the leg (Faulkner, 2003; Behrens, et al., 2015).

2.6.4. Concentric and Eccentric Joint Actions

Correctly, the force-velocity relationship describes how the maximal force produced by single muscle fibers while they are shortening is inversely proportional to their contraction velocity. In other words, producing very high levels of force limits muscles to shortening slowly, while shortening limits muscles to producing a much smaller amount of force, even though the effort exerted is maximal in both cases. However, it is important to recognize that when studying lengthening (eccentric) contractions, we observe that the force-velocity relationship is the opposite way around, as can be seen in the chart below (Behrens et al., 2015).

2.7. Plyometric Strength Exercises

Exercises involve more dynamic eccentric and concentric movement through a full range of motion. Specificity, speed, and neural demand may also be progressed at this level. Exercises are intended to improve dynamic joint stabilization, eccentric strength, rate of force production, and neuromuscular efficiency of the entire human movement system. Performed in repetitive fashion (spending relatively short time on the ground before repeating the drill).Exercises: Squat jump, tuck jump, butt kick, power step-up (NASM, 2017).

2.8. Plyometric Power Exercises

Exercises involve entire muscle action spectrum and contraction-velocity spectrum used during integrated functional movements designed to further improve the rate of force production, eccentric strength, reactive strength, reactive joint stabilization, dynamic neuromuscular efficiency, and optimal force production Performed as fast and

explosively as possible. Exercises: Ice-skaters, single-leg power step-up, and proprioceptive plyometric (NASM, 2017).

2.9. Plyometric for Speed and Acceleration

Strength training in the gym will get you stronger, and plyometric are the secret to applying your strength to the track and field. Plyometric workouts for speed and acceleration increase your ability to rapidly contract your muscles after they have been partially stretched. This process, called the stretch-shortening cycle, acts like a rubber band to load and explode your muscles with greater force. Plyometric workouts train your muscles to contract more rapidly and explosively, but you must also train the direction of these explosive forces. The forces of sprinting at maximum speed are relatively vertical. Pushing your legs down into the ground causes your muscles to stretch quickly, then rebound explosively upward, pushing you forward (NASM, 2014).

2.10. Safety consideration of plyometric exercise

Experts in the field of exercise science have varying opinions of plyometric. The American College of Sports Medicine states that "that plyometric training is a safe, beneficial and fun activity for children and adolescents provided that the program is properly designed and supervised decreased Impact Forces and Increased Hamstring Torques (ACSM, 2017; Faigenbaum et al., 2017)

2.10.1. Plyometric Technique

It is important to follow certain guidelines to ensure safety and effective performance. All plyometric drills should be preceded by an adequate warm-up and conclude with a proper cool-down. Warm-ups should begin with general activities such as light jogging and calisthenics and then proceed to more specific movements, such as lateral running, skipping, or throwing motions based on the plyometric exercises to be performed. According to (James Radcliffe) the head strength and conditioning coach at the University of Oregon, workouts should consist of six basic elements: warming up, dynamic work with explosive movements (snatches, jumps and throws), strength work

with heavy multiple joint movements (squats, jerks), isolated work with lying or seated movements (bench press, leg press), mobility work with fluid full body movements (agility, stretching) and cool-down. Plyometric are not inherently dangerous, but the highly focused and intense movements used in repetition increase the potential level of stress on joints and musculo-tendonous units. Therefore, safety precautions are strong prerequisites to this particular method of exercise. Low-intensity variations of plyometric are frequently utilized in various stages of injury rehabilitation, indicating that the application of proper technique and appropriate safety precautions can make plyometric safe and effective for many people. Before you begin employing plyometric exercises in your training, you should learn how to perform take-off and landing mechanics for these routine. This is a necessary precaution to avoid any knee, ankle and hip injuries (Elizabeth, 2016).

Here are some safety tips for your ploys workout routine:

1. Plyometric should be done only if you are well conditioned and you should have a good background in general strength training before you incorporate ploys in your workout.

2. Ploys sessions should always begin with proper warm-ups your warm up should include small dynamic jumping exercises which then slowly lead to more intense activities.

3. Allow at least a day's rest between one plyometric workout and the next.

4. In repeated takeoffs absorb the shock of landing by placing your whole foot when youland on the ground or mat.

5. In case you feel any joint pain, stop immediately.

2.10.2. Lower-Body Plyometric

Lower-body plyometric will benefit any sport that requires an athlete to produce a maximum amount of force in a short amount of time. Jumps in place: This is simply jumping and landing in the same spot. Jumps in place emphasize the vertical component of jumping and should be performed repeatedly without rest between jumps. Variations can include squat jumps, knee tuck jumps and zigzag hops. Bounds: Bounding drills involve an emphasis on horizontal speed. Bounds can be equated to running with an exaggerated jumping movement. Drills are measured by distance covered rather than by repetitions. These drills can include single-leg and double-leg bounds. Box drills: These intense drills incorporate the use of a box to jump on or off. The greater the height of the box the more intense the exercise Box drills may involve one, both or alternating legs. Depth jumps: These drills use gravity and your weight to increase exercise intensity. You assume a position on top of a box, step off, land and immediately jump vertically, horizontally or to another box. This may involve one or both legs. Standing long jumps: These are repetitive. After finishing one standing long jump, immediately perform as many as you can in the space you have (Robin, 2016).

2.10.3. Upper-Body Plyometric

Rapid, powerful movements of the upper body are required for a variety of sports, including baseball, tennis and golf. Plyometric training of the shoulder joint and upper-body musculature will not only increase limb velocity, but also help to prevent injury. Although plyometric drills for the upper body are not used as often as those for the lower body, they are essential to athletes who require upper-body power. Such drills include medicine ball throws and catches, and plyometric push-up (Chelly et al, 2014).

3. MATERIALS AND METHODS

This Section description of Study area, experimental materials and tool, definition of variable, treatment and study design ,description of population and sample method, inclusion and exclusion criteria, source of data, method and procedures of data collection, methods of data analysis, data quality control protocol(DQC) and ethical consideration are briefly discussed.

3.1. Description of Study the Area

The research was conduct in Benishangul-Gumuz Regional State at assosa wereda which is 687km far from capital city of the country, Addis Ababa, in the west. Geographically it is located at 9^0 50′ 0” - 10^0 10′ 0” latitudes in the North and 34^0 10′ 0” - 34^0 50′ 0” longitudes in the east. The Region is bordered with Sudan in the west, Amhara regional state in the east and north, Oromiya regional state in the east and south east and Gambella regional state in the south. It covers a total area of about 5,038,100 hectares. Plain undulating slopes and mountains characterize the topography of the Region. The altitude of the region ranges from 600-2,731meter above sea level. The agro-climatic zone of the Region can be categorized as 75% lowland, 21% midland, and 4% highland (BGBOARD, 2015).

The study area had 74 kebeles. The land area of the district is 2317km2. Agro-ecologically, the district is mostly classified as lowland with an average rainfall of 1275 mm per annual and an altitude range of 600-1400 meter above sea level. The rainfall distribution pattern is mono-modal commencing towards end of April and ending in October (BGBOARD, 2017).The 2007 national census reported a total population for this district , 104,147, of whom 52,968 were men and 51,179 were women (BGBSSA, 2015).

3.2. Experimental Materials and Tool

The researcher would use the following equipment throughout the study in the field. That equipment were Stop watch, measuring tape, pen, paper, cone, flag, ropes, record sheet, medicine ball, and whistle were used during training as well as in the tests.

3.3. Definition of Variables

Plyometric: Plyometric , also known as "Jump training" or" plyos", are exercises based around having muscle exert maximum force in short interval of time, with the goal of increasing speed, strength and power (K.savithri, 2014).

Speed: Is the capacity to travel or move very quickly (Peter, 2005)

Muscular strength: Is the ability of a muscle or muscle group to exert force to overcome the most resistance in one effort (Luann, 2015).

Muscular Power: Is the interaction of strength and speed, the relationship between speed of contraction and speed of movement (Peter, 2005)

3.4. Treatment and Study design

In this research pre and post test experimental design on simple random sampling technique (flipping coin) selected from the total population of 44 female athletes (n=22) control group (CG) and (n=22) experimental group (EG) was engaged on selected plyometric exercises for three months (3day per week) were conducted for (EG) to see the effect of selected plyometric exercise on power, strength and speed of the subject. And from a total of 44 female athletes, eight participants terminate coincidence from both groups at the time of training. The participant took 3-4 consecutive years of athletic training in Assosa wereda which organized and supported by (BGRSSYB) and trained by the investigator himself and one assistant coach, were voluntarily participated in the research. Control group were not involved in any type of plyometric training at the time of the study but can perform the ordinal annual training.

3.5. Description of population and sampling Methods

The sources of population for this study were 57 short distance athletics trainees in to two different teams. The first project under took 14 female, 13 male, totally 27athletes the age of 15-16 year. The second project is also under took totally 30 short distance athlete

female with the age range of 17-18 year. From the given population of 57, 44 female subjects were selected purposely and among these female athletes with simple random sampling technique the researcher selected the treatment group and control group after the trainees fill medical history questionnaire by a physician with the given criteria of the study. The questionnaire would prepare with aim of whether they are free from heart disease, stroke, and kidney. Additionally, injury statuses would use as one-selection criteria. Eight participants terminate coincidence from both groups at the time of post test in different case but not injury status.

3.6. Inclusion and Exclusion Criteria

Short distance female athlete's project would be a part of the study while male athletes were excluded from this study. Additionally according to their health history questionnaire ~~a~~ result participant who had medical condition restricted and resent injury status were excluded from this study. Subjects, who had possibility to resign in between also excluded.

3.7. Source of Data and Data Collection Method

Only primary source of data were used for this study. The primary data were collect from pre designed experimental study group through Pre-Test, and Post-tests.

3.8. Method and Procedure of Data Collection

Primary data would be gathering from the subject in two phases, pre-test (PT), and at the end of the experiment post-test (POT). This quantitative data would be collected from the subjects in the area where comfortable place and fitness test instrument accessible throughout the program. To got data from the subjects tests were taken at the beginning of the training, and final data would collect at the end of the experiment. Data would collect at the same time of the day and by the same data collector to control variation between the subjects with the following physical fitness tests and procedures.

3.9. Exercise Training Protocol

The subject for this study was engaged in the selected plyometric exercise program as experimental groups the training program was consisted of a selected plyometric exercise variables for 12 weeks (consecutive three month) of study. Frequency and duration of the exercise should be 3 days per week and up to 60 minutes per session the weekly exercise was conducted on Monday, Wednesday and Friday in the morning 12:00-1:00 Local time from the binning up to the end of the program.

3.10. Measurement Tools and Applications

3.10.1. Medical Examination

All the participants was organized and selected based on their interest and their family consensus. While the participants joined in to the team, the researcher prepared questionnaire and medical check-up early for the identification of their current health status. And the researcher was followed serious of skill related fitness tests.

3.10.2. Muscular power Test

3.10.3. Standing long or Broad Jump

Standing Long Jump would conduct to measure subject's power and strength. In this test, the subject took crouch position by swinging his arm back ward with static position and jumped horizontally as far as possible with two feet. Three trials would be given and the longest distance would record as a score in meter (Wakai and Linthorne, 2005).

3.10.4. Sergeant Jump Test/Vertical jump

The objective of sergeant jump is to measure the development of the athlete's elastic leg strength and power. Chalks the end of his fingertips stands side onto the wall, keeping both feet remaining on the ground, reaches up as high as possible with one hand and marks the wall with the tips of the fingers (M1) from a static position jumps as high as

possible and marks the wall with the chalk on his fingertips (M2). Three trials would be given and the highest distance would be record as a score in meter (Dessales, 2014).

3.11. Muscular strength Test

3.11.1. Wall Squat Test

To monitor the development of the athlete's quadriceps strength endurance the athlete assumes a sitting position with their back against the wall, feet flat on the ground and a 90° angle at the hips and knees. The assistant gives the Command "GO" and starts the stopwatch; the athlete lifts the right foot 5cm off the ground and balance for as long as possible. The assistant stops the stopwatch and records the time when the athlete; foot is put back on the ground. Take a rest and then repeat the test with the other leg (Hinds.E, 2011, and Chom, 2013).

3.11.2. Sit Ups Test

The objective of this test is to monitor the development of the athlete's abdominal strength. Lie on the mat with the knees bent, feet flat on the floor and the arms folded across the chest and start each sits up with back on the floor by raise yourself to the 90 degree position and then return to the floor. The feet can be held by a partner then record the number of sits up complete in 30 seconds. One number of trial tests will be use (Whiting et al.; 1999)

3.12. Speed Test

3.12.1. 60m Speed Test

The Objective is to monitor the development of the athlete's maximum speed. The assistant marks out a 60 meter straight section (AC) with cones and places a cone at the 30 meter point (B). From a sprint start with appropriate start commands (on your marks, set, "GO") from the assistant the athlete sprints the 60m the assistant starts the stopwatch

on the command "GO". The assistant records the time the athlete torso crosses the 30 meter point (B) and the 60 meter point (C) (Davies , 2000).

3.12.2. 35 Meter speed Test

The purpose of this test is to determine acceleration, maximum running speed and speed endurance, depending on the distance run. The test involves running a single maximum sprint over a set distance, with time recorded. After a standardized warm up, the test is conducted over a certain distance, such as 10, 20, 35, 40 and/or 50 meters or yards, depending on the sport and what you are trying to measure. The starting position should be standardized, starting from a stationary position with a foot behind the starting line, with no rocking movements. If you have the equipment (e.g. timing gates), you can measure the time to run each split distances (e.g. 5, 10, 20,30m) during the same run, and then acceleration and peak velocity can also be determined. It is usual to give the athletes an adequate warm-up and practice first, and some encouragement to continue running hard past the finish line. (http://www.topendsports.com/testing/tests/sprint.htm)

3.13. Method of Data Analysis

The data collected through physical fitness test was analyzed, interpreted and tabulated in to meaningful idea using descriptive statistical and analyses by using computerized Statistical Package software for Social Sciences (SPSS version 20) was present as a group mean value and standard deviations. The paired sample t-test was used to compare the data between pre- test and post-test. The level of significance error was also at $p < 0.05$.

3.14. Protocol and Ethical Consideration

The study was deal with the ethical issue related to the investigation. It protected the privacy of research participants and makes guaranty and confidentiality of the information that had given to the study, and risk harm due to participation. Participation of subjects in this study was totally a voluntary based activity and their right not to participate and could resign at any time of training session had been respected. Therefore

the study was conducted all action based on the university rule, code of conduct and policies concerning research ethics. Ethical approval had been obtained from institutional research ethics review committee (IRERC) of Haramaya University College sport academy. The protocol was approved by the university guidelines and written consent had been given and informing the concern bodies.

4. RESULTS AND DISCUSSIONS

This chapter deals with the analysis of data collected from the 36 samples respondents. The purpose of this study was to examine the effects of selected plyometric exercise on speed, strength and power of short distance Athletics project female athlete trainees. Thirty six subjects of females' trainees with the age range of 16 – 18 years old. They were eighteen sample Experimental groups (EG) and eighteen sample control group (CG) simple.

In this study, field tests were taken two times (Pre and Post). Under this, three dependent variables (speed, power and muscular strength,) had been evaluated by sergeant jump, standing broad jump, wall squat, sit up and 60m and, 35 m speed test results of those variables are discussed as follows.

4.1 Anthropometric Characteristics of Participants

The anthropometrical character was shown that the pre and post test of height and weight of the two groups.

Table 1: The pre and post test of height and weight of both groups.

GROUP	N	Height(M)		Weight(KG)	
		PT	PoT	PT	PoT
EG	18	1.559[a]±.0231	1.559[a]±.0231	49.388 ± 1.786	48.61±2.062
CG	18	1.557±.0186	1.558±. 0194	49.50±1.855	49.22±1.833
Total	36				

EG= Experimental Group, CG= Control Group, PT= Pre Test, PoT= Post Test, M= Meter, KG= Kilogram.

4.2. Mean Difference of Broad Jump and Sergeant Jump Test

Table 2: Means Value and Standard Deviation of BJT and SJT in Pre Test and Post tests.

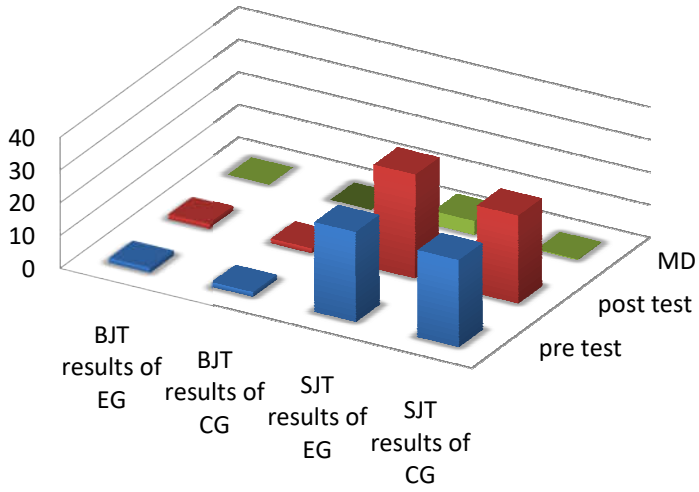
Groups	N	PT(X ,±SD)	PoT(X, ±SD)	X(PoT and PT)	P
BJT result of EG	18	1.477±.05391	1.518±.05242	.0411	.000
BJT result of CG	18	1.467±.03896	1.481±.04874	.0144	.004
SJT result of EG	18	27.56 ±2.036	31.83 ±2.249	4.27	.000
SJT result of CG	18	26.67±1.970	26.94 ±1.589	.278	0.0508

EG = experimental groups, CG, control groups, BJT=Broad Jump test, SJT= Sergeant Jump test, X=mean value of each tests, X= (MD) mean difference, PT=pre test result, PoT= post test results, p=significance level.

As Table 2 shows that Pre and Post BJ test mean of EG was1.4767 and post BJ test mean was 1.5178while the CG PT and Post result of BJ mean was1.4667 and1.4811 respectively. Besides, pre and Post SJ test results of the EG was, 27.56 and 31.83 respectively. And also the pre and Post SJ test results of CG was, 26.67 and 26.94respectively. Thus, from the above we can to summarize that there was a statically significant difference and also shows a gradual improvement between PT and PoT test results on the EG. Moreover, the above table revealed the BJT and SJT result of EG p value is 0.000 and the mean value difference was also 0.0411 and respectively 4.27. This indicated that there was a statically significance on the mean difference on BJ and SJ test between pre and post test results. In addition, the BJT result of CG p value is .004 and the mean value difference was also 0.0144, and indicated that there was a statically significance on the mean difference on BJT test between pre and post test results but the SJT result of CG p value is 0.0508 . As a result the investigator accepted alternative hypothesis and rejected the null hypothesis. Thus, the output of this study is similar with the findings of (Corey.M et al., 2006).A four weak plyometric training program on measurement of power in male collegiate hockey player results were interest to improve

strength and power endurance. Besides,(Heydar et al., 2013) showed in their research conducted on The effect of six- week plyometric exercise on performance of male athlete, 11-14 years old that significant increment was observed in Performance tests of (Standing Broad Jump, sergeant jump, 9.1 m Sprint, Shuttle Run) and recommend that polymeric exercises are improve general performance of athletes. Moreover, (Mohammed, 2016) deferent intensity plyometric training was significantly improved the explosive power of volley ball player and(Liao, 2005) A Comparison of two plyometric training program on vertical and horizontal power enhancement.

Figure 1: Comparative Means of Pre-test and Post-test results of BJT and SJT



	BJT results of EG	BJT results of CG	SJT results of EG	SJT results of CG
pre test	1.4767	1.4667	27.56	26.67
post test	1.5178	1.4811	31.83	26.94
MD	0.0411	0.0144	4.27	0.27

4.3. Mean Difference of wall Squat and Sit up repetition per Second

Table 3: Means Values and Standard Deviation of WST and SUPT in Pre and Post tests.

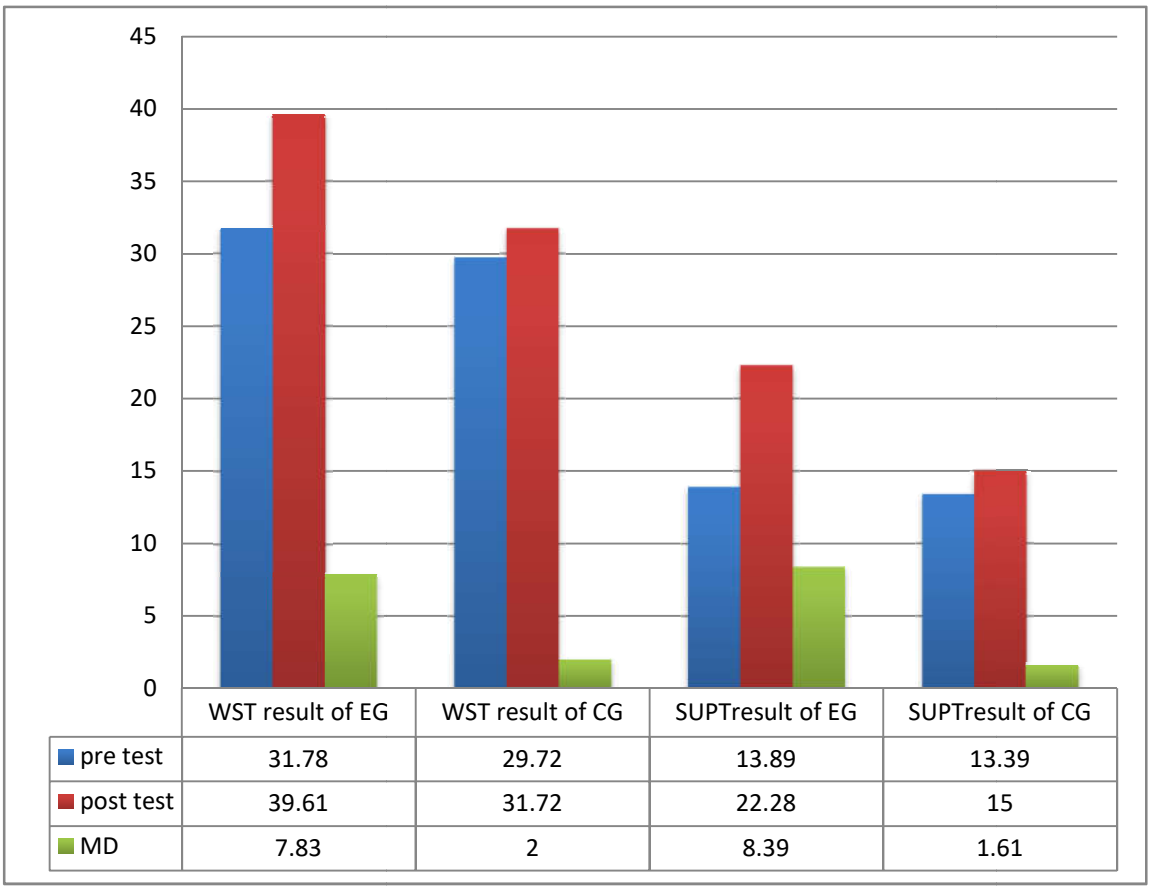
Groups	N	PT(X ,±SD)	PoT(X, ±SD)	X(PoT and PT)	P
WST result of EG	18	31.78±1.396	39.61 ±2.118	7.83	.000
WST result of CG	18	29.72 ±.2.396	31.72 ±1.708	2	0.01
SUPT result of EG	18	13.89 ±1.530	22.28 ±1.364	8.39	.000
SUPT result of CG	18	13.39 ±1.420	15.00 ±1.328	1.61	.000

EG = experimental groups, CG, control groups, WST= wall squat, SUPT=sit up test X=mean value of each tests, X= (MD) mean difference, PT=pre test result, PoT= post test results, p=significance level

As Table 3 shows that Pre and Post WST test mean of EG was 31.78and post WST test mean was 39.61while the CG PT and Post result of WST mean was 29.72and 31.72respectively. Besides, pre and Post SUPT test results of the EG was 13.89and 22.28 respectively. And also the pre and Post SUPT test results of CG was 13.39**,** and 15.00respectively. Thus, from the above we can to summarize that there was a statically significant difference and also shows a gradual improvement between PT and PoT test results on both the EG and CG. Moreover, the above table revealed the WST and SUPT result of EG of p value is 0.000 and the mean value difference was also 7.83 and 8.39. This indicated that there was a statically significance on the mean difference on, WST, SUPT between pre and post test results. In addition, the WST and SUPT result of CG of p value is <0.05 and the mean value difference was 2 and 1.61 and indicated that there was a statically significance on the mean difference on WST and SUPT between pre and post test results. As a result the researcher accepted alternative hypothesis and rejected the null hypothesis. Thus, the output of this study is agreed with the finding of (Marques et.al., 2013) .A, six week combined sprint and plyometric jump training program improve

strength-speed abilities and significant improvement increase7.7CMJ (Counter movement jump) increased in jump height.

Figure 2: **Showing comparative Means of Pre and Post test results of WST and SUPT**



	WST result of EG	WST result of CG	SUPTresult of EG	SUPTresult of CG
pre test	31.78	29.72	13.89	13.39
post test	39.61	31.72	22.28	15
MD	7.83	2	8.39	1.61

4.4. Mean Difference of 60 Meter Speed and 35 Meter Speed Test per Second

Table 4: Means Values and Standard Deviation 60 Meter Speed and 35 Meter Speed Pre and Post tests.

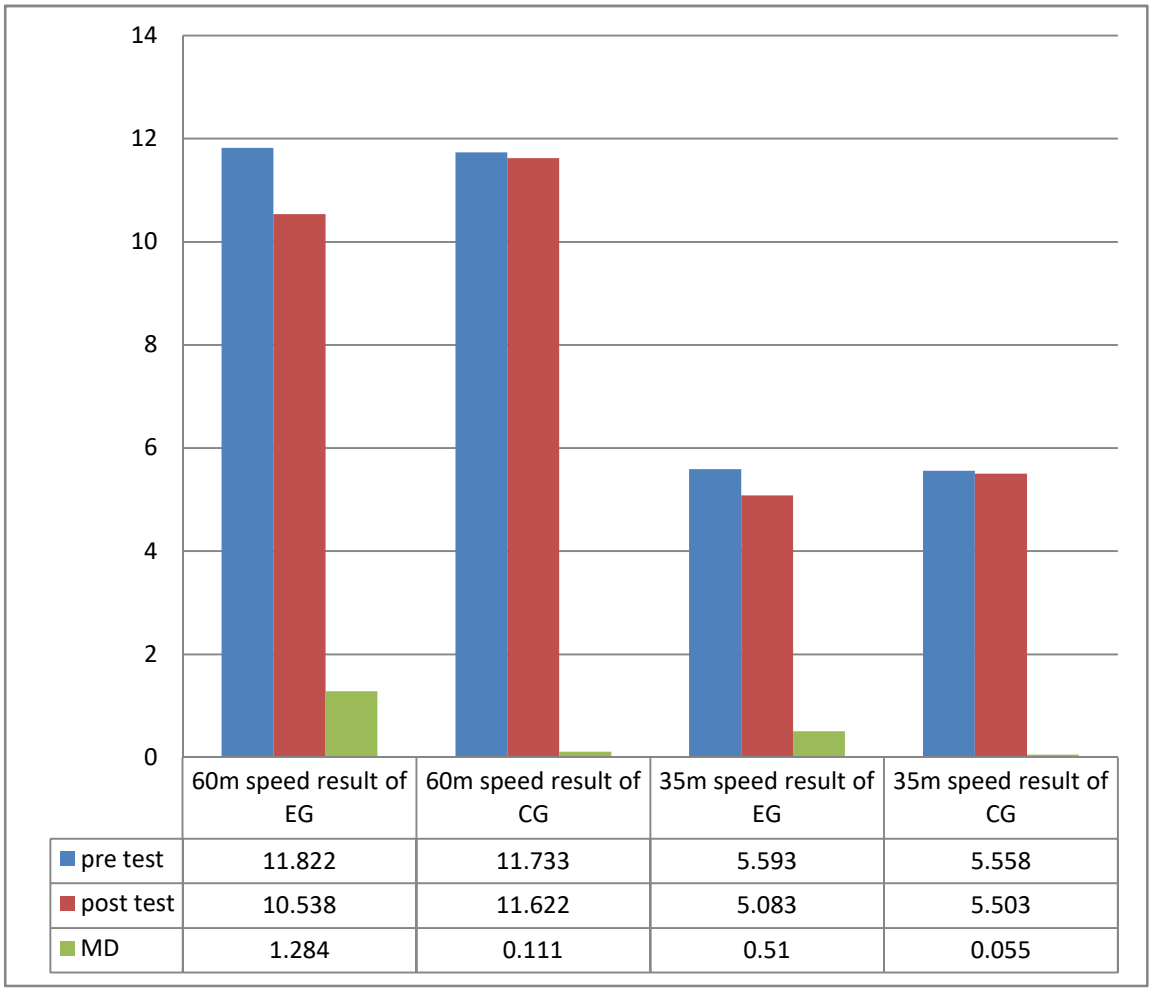
Groups	N	PT(X ,±SD)	PoT(X, ±SD)	X(PoT and PT)	P
60m ST result of EC	18	11.822±.513	10.539 ±.559	-1.283	.000
60m ST result of CG	18	11.733±.5196	11.622 ±.497	-.111	.001
35m ST result of EG	18	5.593 ±.0713	5.083±.0686	-.51	.000
35m ST result of CG	18	5.558 ±.0553	5.5023 ±.0555	-.0561	.000

EG = experimental groups, CG, control groups, 60m speed test, 35m speed test, X=mean value of each tests, X= (MD) mean difference, PT=pre test result, PoT= post test results, p=significance level

Table 4 shows that Pre and Post 60m speed test mean of EG was 11.82and post 60m speed test mean was 10.539while the CG Pre and Post result of 60m speed average mean was 11.733and 11.622respectively. Besides, pre and Post 35m speed test results of the EG was 5.5928and 5.083respectively. And also the pre and Post 35m speed test results of CG were 5.558, and 5.5023respectively. Thus, from the above we can to summarize that there was a statically significant difference and also shows a gradual improvement between PT and PoT test results on both the EG and CG. Moreover, the above table revealed the 60m, 35m speed result of EG p value is 0.000 and the mean difference was also less of 1.28 and .51 ensuing. This indicated that there was a statically significance on the mean difference on 60m and 35m speed test between pre and post test outputs. In addition, the 60m speed result of CG p value is .001and the mean difference was also by less of .111, and it indicated that there was a statically significance on the mean difference of 60m speed test between pre and post test results. Besides, the 35m speed

test of CG p value is 0.000 and mean difference isless .0561. This implies that, there was statistically difference among pre and post test results. Therefore, the result revealed that accepting of the alternative hypothesis and rejecting of the null hypothesis. Thus, the output of this study is similar with the findings of (K.savithri , 2014) plyometric exercise is useful for speed development between badminton players with the measurement of 30m speed decreased in 4.51 pre and 4.20 post test, "p" value of 0.000.

Figure 3: Showing comparative Means of Pre-test and Post-test results of 60M and 35M Speed.



	60m speed result of EG	60m speed result of CG	35m speed result of EG	35m speed result of CG
pre test	11.822	11.733	5.593	5.558
post test	10.538	11.622	5.083	5.503
MD	1.284	0.111	0.51	0.055

5. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary

Plyometric , also known as “Jump training” or” plyos”, are exercises based around having muscle exert maximum force in short interval of time, with the goal of increasing speed, strength and power. Researcher aim was to examine the effect of selected plyometric exercise on, power, strength and speed of short distance female’s trainee with average Age 16-18 years which consists of 36 subjects was simple randomly selected and half of them were selected as Experimental groups and the remaining as control group for this study. And all of them took a pre sergeant jump (SJT) and broad jump (BJT) of power test, wall squat (WST) and sit up test (SUPT) of strength test and 35m dash and 60m dash of speed test. Then the regular ordinal training has been continued besides the selected plyometric exercise training on the EG three day per week, up to 60min a day for three months by the investigator himself and one assistance coach. After three months, post test measurement on the same parameters was taken.

The difference between the tests were analyzed statistically, with paired sample t test at $P<0.05$ Consequently it was observed that selected plyometric exercise . Implemented on short distance female athletes brought about significant improvements between pre and post test results of power, in which duration to complete BJT(Broad jump test) and SJT (Sergeant jump test) was increased by PT and PoT mean difference of 4.11cm at P=0.000 and 3.11 cm at P=0.000. And strength, in which WST (Wall squat test) and SUPT(Sit up test) test result were increased by a PT and PoT mean difference of 7.83 second resist at P=.000 and 8.39 repetition with in 30 second at P=.000 respectively. Speed in which duration of 35m dash and 60m dash speed test result was decreased by a PT and PoT mean difference of 1.28 seconds at P=0.000 and .51 seconds at P=0.000 respectively. As a result the investigator recommended that selected plyometric exercise program helps to improve the performance of power, strength and speed of short distance female athletes. Thus it concludes that selected plyometric exercise. For three months relatively improve power, strength and speed of short distance female athlete’s athletics trainees.

5.2 Conclusions

Based on the finding discussed so, far the following conclusions were drawn:

- The result of the study showed that, 12 week of selected plyometric exercise has a positive effect on power of short distance female athlete's athletics trainees as measured by broad jump and sergeant jump.
- The output of the study showed that three month of selected plyometric exercise has a significant improvement on strength of short distance female athlete's athletics trainees as evaluate by wall squat and sit up test.
- The outcome result of the study shows that selected plyometric exercise has a significant improvement on speed of short distance female athlete's athletics trainees as measured by 60 meter and 35 meter speed per second.

- Moreover, three months of selected plyometric exercise i.e. bounding, squat jump, butt kick, fast skipping, jump in place hoping,High Knee Running and medicine ball were statistically significant improvement and change were observed in short distance female athlete's athletics trainees power, strength and speed.
- To sum up, the findings of this study indicated that the selected plyometric exercises are significant determinant factors on the performance improvement of short distance female athlete's athletics trainees.

5.3 Recommendations

Based on the finding of the study and the conclusion drawn, the following recommendations are made.

- Short distance female athlete's athletics trainees shall give emphasis and practice selected plyometric exercise i.e. bounding, squat jump, butt kick, fast skipping, jump in place hoping,High Knee Running and medicine ball to improve their power, speed, and strength.
- Coaches, physical education teachers or any other athletics trainer shall consider and aware the impact of selected plyometric exercises on the athletic skill performance of power, strength and speed and add it on their regular training 1-2day per week by considering the principals of plyometric, and the safety consideration in plyomtric exercise.
- It is highly expected from sport professionals and related fields to guide and educate on the importance and value of selected plyometric exercise i.e. bounding, squat jump, butt kick, fast skipping, jump in place hoping,high Knee Running and medicine ball to achieve the athletic performance when the program is properly designed, sensibly progressed and supervised by qualified professionals.
- Minster of youth and sport or responsible body should be support the female's athlete to participate in athletics, by giving awareness creation, education and materials support.
- Further research should focus on selected plyometric exercise program on short distance male athletes and other related fields.

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Htt://www.acefitness.org/blog

http://www.topendsports.com/testing/tests/sprint.htm

7. APPENDICES

APPENDIX- I Medical History Check up

The questionnaire prepare for research entitled. Effects of selected plyometric exercise on speed, power and strength of short distance athletics project female athletes in the case of Assosa district Benishangul Gumuz, western Ethiopia. So you are kindly requested to give appropriate information for the following questions regarding to health status.

Thank you!!!

Participant information

Name: _____telephone number _____

Sex: _____ you typical food _____

Age _____time gap b/n meals _____

Emergency Contact information

Name _____ address_____

Relationship _____telephone number _____

Personal health history (answer YES or NO and description if it is necessary)

Is this your first visit to the exercise program? ----------if not please brief description of what lead to the administration ----------

Have you ever been treated for internal organs? If yes, when and give details problems---------

---

Have you ever appeared irregular heart beat on your heart? If yes when and give details--------

---

Have you ever fainted or bad concussion? ----------If yes kindly write when and how you fainted out ----------

Do you have any allergies? If yes kindly list them----------

Are currently undergoing any medical treatment or under observation? ----------

---

Have you fallen sick in the past 6 month? ----------If problem----------

Have you had any injury in the past 5 years? ----------If yes write the problem ----------

Have you ever had major surgery performed on you in the last year? ----------If yes when write the problem ----------

Does your family have a history of any genetic disease? ---------- If yes write the problem----------

Do you have any of the following disease?

Asthma ---------- cancer ----------

Heart disease ---------- stroke ----------

Diabetes---------- skin infection----------

Would you expect that this exercise program service will address satisfactory?

I have read and understand the form and have given accurate information in regard to any my health

Signed ----------date----------

Signed----------date ----------

Thank you for taking your respond

Adapted (THOMAS; 2000) USC, Accessed on January, 21, 2012

APPENDIX- II Information Sheet Form for the Athletes

Researcher's Name: Goitom Abraha

Supervisor's Name: Wegene Waltengus (PhD)

Co-Advisor's Name: Abinet Ayalew (PhD)

Thesis title: Effects of Selected Plyometric Exercise on Power, Strength and Speed, of Short Distance Athletics Project Female Athletes In The Case Of Assosa Wereda Benishangul Gumuz, Western Ethiopia.

1. Purpose of the study:

The purpose of this study is to examine the effects of Selected Plyometric Exercise on Power Strength and Speed, of Short Distance Athletics Project Female Athletes in Assosa District Benishangul Gumuz.

2. Procedure and duration:

You are kindly requested to participate in this research study as described below. This study will be governed by the regulation on human beings. These regulations require that researcher should obtain a signed agreement from you/the players/ to participate in this research project.

Even if taking such skills related test is one component of your regular Athletics training program, the researcher will explain detail about the purpose of the project, the procedure will be used, the potential benefit and the possible risk of participation in this thesis. And you can ask the researcher any question and doubts that you have about the study and you shall expect satisfactory responses regarding your questions. So if you are interested and ready to participate. Please confirm your agreement by your signature with the researcher. You can discontinue at any time from the study if you choose to do so. A basic explanation of the project will be summarized below.

3. Risk and safeguard:

Since subjects are somehow experienced and had regular Athletics training for the last 3 years the expected injury in administering such skill related fitness tests for you may be little. But while in application of the regular Athletics trainings and administering the tests you may experience muscle fatigue, usually happened Athletic related injuries such as muscle soreness and little sprain may exists due to intense b/c the nature of plyometric exercise but not the test only.

But if any unexpected physical injuries occur, appropriate first aids will be provided, but no financial compensation will be given.

4. Confidentiality:

The information obtained from the participants (you) will be kept in confidence, but it will be free to release to their own owners, to the local District, zone as well as regional sport federation offices if it is needed.

And all the collected information will be used only for scientific purpose through grouping without identifying them as an individual.

5. Rights:

Participation in this study will be a fully voluntary based. You have the right to declare to participate or not in the study. And if you decide to participate, you have the right to withdraw from the study at any time and this will not label you for any loss of benefits which you otherwise are entitled.

6. Contact address:

If there is any questions or enquires any time about the study or the procedures, please contact in the following address:

Institutional research ethics review committee (IRERC) at +251256661899

Wegene Waltengus (PhD) (Advisor) +251923670360 Email: wegu4025@gmail.come

Co-adviser: Abinet Ayalew(PhD)+25911827322 Email: amen ab2010@yaho.com

Goitom Abraha (Investigator) +251920434475

Email: mysportab@gmail.com

7. Declaration of informed voluntary consent

We read the participant information sheet we clearly understand the purpose of the research, the procedures, the risk and benefit, issues of confidentiality , the right of the athlete on participating and the contact address for any queries. We informed as our athlete have the right to with draw from the study at any time. Therefore, we declare our voluntary consents for the members to participate in the study with our signature as indicate below.

Name of the trainee parent _____ Name of investigator_____

Signature _____ Signature_____

Date _____ Date _____

APPENDIX- III Description of the training schedule

In Athletics training it needs well design and prepare plan. The purpose of the training plan is to identify the work to be carried out to achieve agreed objectives and to be effective in the training program out comes. Sport fitness training plans are the strategies for achieving peak performance. In sport training plan goals or objective should be specified, participants' fitness level should be assessed before, during and after training, exercise should be selected and specific to the selected physical fitness components needed to develop, it should follow the training principle and also it should be well adjusted to the participant fitness level and to the weather condition. Training plan can be a short terms or it can be a long terms plan. Some fitness components needs short term training and the other need to train for a long period of time. Due to this reason, the researcher will be concentrated on a short term training plan (three mouths). One of the most important rules of training for results comes back to the principle of (android's encyclopaedia of body building)state that , the intensity of the work out and the frequency of the training session play an important in stimulating muscle growth and performance improvement. Change comes from exercise, exercise are physically stressors. Training too often or with too much intensity and not allowing proper rest between sessions could cause either an overuse injury or load to overtraining both of which can significantly limit a client ability to achieve fitness goals. Htt://www.acefitness.org/blog

Planning the session and the training weeks

Based on the above mentioned reason and other the researcher was use the training principle. So, this training session is designed for three mouth, and based on the principle of frequency, intensity, and principle of rest and recovery it was be three days a week, one day split(rest day) in between exercise session days with last consecutive rest days, with 60minuts of each training days. The training session was start with warming up exercise and will continue up to the cooling down.

Exercise intensity

Exercise intensity refers to how hard the body is working during physical activity. The heart rate breathing, temperature and perspiration all measure your level of exercise intensity. Exercise intensity is described as low, moderate, vigorous. The maximum health of benefit the goal is to work hard, but not too hard –described as moderate intensity by Australia's physical activity and secondary behavioral activity.

Measuring exercise intensity

They are various ways to measure exercise intensity to make sure the body is getting the most out of every workout. One coaches my need to experimental to find out which method of measuring exercise suit best. There three different measuring methods:

- Target heart rate method
- Talk test method
- Exercise rating method

Measuring exercise intensity using target heart rate

The human body has an in built system to measure its exercise intensity –the heart. Your heart rate will increase in proportion to the intensity of your exercise. You can track and guide your exercise intensity by calculate your target heart rate (THR) range

The range of exercise intensity

- Low(light)is about 40-54%MaxHR
- Moderate is 55-69%
- High intensity is ≥ 70%

For moderate –intensity physical activity, a person's THR should be 50 to 70 per cent of their maximum heart rate. The maximum heart rate is based on a person's age. An estimate of a person's maximum heart rate can be calculated as 220 beat per minute (bpm) minus your age. Because it is estimate, use it with caution. Keep your heart rate at the lower end of your recommended range if you are just starting regular exercise. Gradually increase the intensity of your workout as your fitness improves. Also, your

heart rate should stay in the lower ranges during warming up and cool down periods. Using a heart rate while you are exercising, or you can take your pulse.

Measuring heart rate by taking pulse

Taking your pulse at regular internal lets you know whether you are exercising within your target heart rate range. Some tips include:

Take your pulse before you warm up.

Take your pulse gain when you have been exercising for about 5-10minutes

Continue taking your pulse at regular intervals.

The radial pulse is located on your inner wrist. To measure it, you should:

Put the first three fingers of one hand against the inner wrist of the other hand just below the thump

Lightly press your finger into the hollow next to the tendon on the thumb –side your artery lies just beneath the skin using a watch with a second hand, count your pulse for 15 seconds. Multiply this figure by four to get your beats per minute. (for example , 31 pulse beats over 15 second equals a pulse rate of 124 beats per minute) you can also take your pulse by pressing your finger lightly against one of your carotid arteries, located on either side of the windpipe

Factors influencing the heart rate

It's not just exercise that affects your heart rate. Your beat per minute could be raised by a number of internal and external factors including Hot weather, Caffeine intake, Time of day, Hormone fluctuations, Stress and anxiety, Cigarette smoking and Medication

Source: www.cardiosmart.org (American college of cardiology) and htt://m.betterhealth.vic.gov.au/bhcv2/bhcartic:nsf/mskpage/exercise intensity

So, the researcher will use the above mentioned mechanism to measure the exercise intensity of the exercise session. But the result can be fluctuated due to the above mention influence factors. The main objective this general training schedule was investigate the effect of selected plyometric

exercise on speed, muscular strength and muscular power in connection in this connection with this training schedule mentioned on the next page.

Depending up on the above basic information, the training plan and their discretions of the selected plyometric exercise with three month as plan follow.

Table 5: plyometric exercise per session guideline

No	PLYOMETRIC PER SESSION		
	Training age	Ground contact	Box height
1	Binger	80-100	20 -40 cm
2	Intermediate	100- 120	40-74cm
3	Advanced	120-140	75cm-1m
	Rest and Recovery		
1	Recovery b/n each activity	30''- 1 minute	
2	Recovery b/n set	3- 5 minute	
3	Rest per session	48-72 hours	

Source:

(Potash and Chu, 2008)

APPENDIX- IV Descriptive Statistics of the Control and Experimental Group

Table 6: Descriptive statistics Paired Samples of control group (CG)

	Participants	Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pre test height	1.5578	18	.01865	.00440
	post test height	1.5583	18	.01948	.0046
Pair 2	Pre test weight	49.50	18	1.855	.437
	Post test weight	49.22	18	1.833	.432
Pair 3	Broad jump before treatment	1.4667	18	.03896	.00918
	broad jump after treatment	1.4811	18	.04874	.0115
Pair 4	sergeant before treatment	26.67	18	1.970	.464
	sergeant after treatment	26.94	18	1.589	.375
Pair 5	wall squat before treatment	29.72	18	2.396	.565
	wall squat after treatment	31.72	18	1.708	.403
Pair 6	sit up before treatment	13.39	18	1.420	.335
	Sit up after treatment	15.00	18	1.328	.313
Pair 7	speed 60m before treatment	11.733	18	.5196	.1225
	speed 60m after treatment	11.622	18	.4971	.11717
Pair 8	speed 35 m before treatment	5.559	18	.0553	.0130
	speed 35mafter treatment	5.5028	18	.0555	.01308

Table 7: Paired Samples Correlations of control group (CG)

		N	Correlation	Sig.
Pair 1	height before & height after	18	.993	.000
Pair 2	weight before & weight after	18	.900	.000
Pair 3	Broad jump before & broad jump after	18	.935	.000
Pair 4	sergeant before & sergeant after	18	.538	.021
Pair 5	wall squat before & wall squat after	18	.540	.021
Pair 6	sit up before &setup after	18	.873	.000
Pair 7	speed 60m before& speed 60m after	18	.974	.000
Pair 8	speed 35m before & speed 35 m after	18	.806	.000

Table 8: Paired sample test of control group (CG)

	Paired difference					T	Df	Sign (2-tailed)
	Mean	Std.deviation	Std.Error Mean	95% confidence interval of confidence				
				Lower	Upper			
Pair 1 height after -height before	. 00056	.00236	.00056	.00173	.00062	1.000	17	.331
Pair 2 weight after -weight before	-.278	.826	.195	.133	.689	1.426	17	.172
Pair 3 broad jump after - Broad jump before	.01444	.01854	.00437	.02366	.00522	3.305	17	.004
Pair 4 sergeant after - sergeant before	.278	1.742	.411	1.144	.589	.676	17	.508
Pair 5 wall squat after- wall squat before	.2.000	2.058	.485	3.023	.977	4.123	17	.001
Pair 6 sit up after -sit up before	.1611	.698	.164	1.958	1.264	9.796	17	.000
Pair7 speed 60m after- speed 60m before	-11111	.11827	.02788	-.05220	-.1699	-3.98	17	.001
Pair 8 speed 60m after - speed 35m before	-.05611	.03449	.00813	-.03896	-.0732	-6.90	17	.000

Table 9: Paired Samples Statistics of experimental group

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	height before	1.559[a]	18	.0231	.00545
	height after experiment	1.559 [a]	18	.0231	.00545
Pair 2	weight before experiment	49.388	18	1.786	.42116
	weight after experiment	48.611	18	2.062	.38678
Pair 3	broad jump before treatment	1.4767	18	.0539	.01271
	broad jump after treatment	1.5178	18	.0524	.01236
Pair 4	sergeant jump before treatment	27.56	18	2.036	.480
	sergeant jump after treatment	30.67	18	2.249	.530
Pair 5	wall squat before treatment	31.78	18	1.396	.329
	wall squat after treatment	39.61	18	2.118	.499
Pair 6	sit up before treatment	13.89	18	1.530	.361
	sit up after treatment	22.28	18	1.364	.321
Pair 7	speed before treatment	11.822	18	.5128	.1208
	speed after treatment	10.538	18	.5585	.1316
Pair 8	speed before treatment	5.593	18	.0713	.0168
	speed after treatment	5.0833	18	.06860	.01617

a. The correlation and t cannot be computed because the standard error of the difference is 0

Table 10: Paired sample correlations of experimental group

Participant		N	Correlation	Sig.
Pair 2	weight before experiment & weight after experiment	18	.874	.000
Pair 3	broad jump before treatment & broad jump after treatment	18	.974	.000
Pair 4	sergeant jump before treatment & sergeant jump after treatment	18	.762	.000
Pair 5	wall squat before treatment & wall squat after treatment	18	.268	.283
Pair 6	sit up before treatment & sit up after treatment	18	.382	.117
Pair 7	speed before treatment & speed after treatment	18	.519	.027
Pair 8	speed before treatment & speed after treatment	18	.197	.435

Table 11: Paired sample tests of experimental group

	Paired difference							
	Mean	Std.deviation	Std.Error Mean	95% confidence interval of confidence		df	T	Sig
				Lower	Upper			
Pair 2 Weight after - Weight before	-.777	1.003	.2364	-.2788	-1.276	17	3.289	.004
Pair 3 Broad jump after -Broad jump before	.0411	.01231	.00290	.04723	.03499	17	14.164	.001
Pair 4 Sergeant after - Sergeant before	3.111	1.491	.351	.3852	.2.370	17	8.854	.000
Pair 5 Wall squat after -Wall squat before	7.8333	2.203	.519	.8.929	6738	17	15.086	.000
Pair 6 Sit up after- Sit up before	8.389	1.614	.380	.9.191	7.586	17	22.053	.000
Pair 7 Speed 60m after -Speed 60m before	-1.28333	.52664	-.12413	-1.0214	-1.5452	17	-10.339	.000
Pair 8 Speed 35 m after -Speed 35m before	-.50944	.08868	-.02090	-.46534	-.55354	17	-24.373	.000

- ✓ The paired samples correlations table is not produced
- ✓ The paired sample test table is not produced

APPENDIX– V Subjects Fitness Assortment Record Sheet

Table 12: Student's fitness test sheet

Name _____age _____ weight _____height ___

No	Major factors to be measure	Types of Test	Fitness level often several weeks of training		
1	Speed	35 m speed test 60m speed test	Seconds	Pre Test	Post Test
2	Muscular strength	Wall squat test	No of times as possible 30sec		
		Sit Ups Test	No of times as possible 30sec		
3	Muscular power	Standing or broad jump	Meter		
		sergeant jump test	Meter		

Ms=muscular strength Cm=centimetre = Sec. second min=minutes rep= repetition

Table 13: standard of sit up per minute value

Age 16-19		
Rate	Female	Male
Excellent	>25	>30
Above average	21-25	26-30
Average	15-20	20-25
Below average	9-14	17-19
Poor	<9	<17

Mackenzie (2000)

Table 14: standard of Wall Squat Test

Age 16-19					
Gender	Excellent	Above average	Average	Below average	Poor
Male	>102 sec	102-76sec	75-58sec	57-30sec	<30sec
Female	>60sec	60-45sec	45-36sec	35-20sec	<20sec

CHO, M. (2013)

Table 15: standard 35M Speed test

Gender	Excellent	Above average	Average	Below average	Poor
Male	<4.80	4.80 - 4.09	5.10 – 5.29	5.30 – 5.60	>5.60
Female	<5.30	5.30-5.60	5.59-5.89	5.90 – 6.20	>6.20

http://www.topendsports.com/testing/tests/sprint.htm

Table 16: 60 m speed test

Rating	Female (sec)	Male
Excellent	4.5 sec	<4.0 sec
Above Average	4.5 - 4.6 sec	4.0 - 4.2 sec
Average	4.7 - 4.8 sec	4.3 - 4.4 sec
Below Average	4.9 - 5.0 sec	4.5 - 4.6 sec
Poor	>5.0 sec	>4.6 sec

DAVIS (2000)

Table 17: standards of Sergeant Jump / VJ

			Age 15-19		
Gender	Excellent	Above average	Average	Below average	Poor
Male	>65cm	50-65cm	40-49cm	30-39cm	<30cm
Female	>58cm	47-58cm	36-40cm	26-35cm	<26cm

(Desalles. 2012, Bui.H and Rouis. M,2014)

Table 18: standard standing long jump/ BJ

Age	Excellent	Above Average	Average	Below Average	Poor
14	>1.91cm	1.91-173cm	1.72-1.60cm	1.59-1.47cm	<1.47cm
15	>1.85cm	1.84-1.73cm	1.72-1.60cm	1.59-150cm	<1.50cm
16	>1.83cm	1.83-1.68cm	1.67-1.58cm	1.57-1.45cm	<1.45cm
>16	>1.91cm	1.91-1.78cm	1.77-1.63cm	1.62-1.50cm	<1.50cm

(Castro, 2010)

APPENDIX-VI Description of some Selected Plyometric Exercises

As with any training program, there is no single regimen of plyometric exercises that will guarantee optimum performance from athletes. The particular exercise is often much less important than how it is executed. In fact, many exercises can be made plyometric. Many coaches will discover a drill that seems especially well suited to their athletes, facilities and environment. The following listing and description of various plyometric exercises is not intended to be all-inclusive. These drills are strongly recommended and should be more than adequate for high school athletes.

1. RHYTHMIC PLYOMETRIC

1.1 Skipping

Skipping is the one plyometric movement that most youngsters probably have done throughout their lives. It incorporates coordinated movement with quickness and bounding. Done properly, skipping develops good running mechanics. Basic running positions and movements are executed and exaggerated in a slower motion. This helps the athlete gain a greater sense of correct body position and action (Collette, 2017).

1.2. High Knee Running.

Many athletes and coaches use high knee running or running in place in their training. The drill reinforces good running form and especially strengthens the hip flexor muscles by stressing a high knee lift action. This drill is especially useful for sprinters and jumpers. Attention must be paid to technique. Athletes should never be allowed to lean backwards from the waist in order to facilitate raising the knees. When good technique deteriorates, the exercise loses effectiveness and should be ended (www.LA84 Foundation org. 2012).

1.3. Butt Kicks.

This exercise is also familiar to many coaches. It strengthens the hamstring muscles and develops quickness and coordination in the recovery phase of the running stride. The drill also requires coordinating leg action with technically correct continuous arm motion. The

exercise is extremely useful in developing coordinated running mechanics (www.LA84 Foundation org. 2012).

1.4. Skipping Kicks

Skipping kicks add some complexity to rhythm plyometric. They are excellent for building coordination and rhythm. Hurdlers especially benefit from this exercise. Skip kicks strengthen the hip flexors, quadriceps and hamstring muscles. Most importantly, skip kicks develop coordination of multiple quick movements (www.LA84 Foundation org. 2012).

1.5. Rhythm Bounds

This bounding exercise of relatively low intensity emphasizes proper rhythm and form rather than power or speed. Coaches should teach this type of bounding before moving to power or speed bounds. The low intensity of rhythm bounds allows for a greater number of repetitions, so younger and weaker athletes can learn and gain strength with a far less chance of injury. Younger athletes should become proficient in these bounds before moving on to more advanced and demanding bounds and jumps. Rhythm bounds can also be used for power-endurance purposes. They are an excellent form of dynamic strength training for distance runners. Bounds develop a wide range of muscles in the legs and hips. They are quite specific to the physical demands of track and field (www.LA84 Foundation org. 2012).

2. POWER PLYOMETRIC DRILLS

2.1. Jumps-in-Places

Jumps-in-place are single-effort jumps that have individuals landing in the same place they started from. These jumps should be maximum effort and should emphasize correct jumping technique and speed of movement. They are valuable for training because they teach optimal jumping and landing technique, and they also teach how to move the body explosively (John. M, 2007).

2.3. Double Leg Hops

The double leg hop is an excellent general plyometric exercise for all athletes. Power and strength are developed in the muscle groups of the legs and hips, and specifically, in the quadriceps, gluteals, hamstrings and gastrocnemius. Slight modifications make the exercise more specific to given events. With beginning and younger athletes, it is best to begin these hop drills by using a small hop between each full hop. This permits the athlete to make any necessary adjustments preparatory to the next full hop. Those with poorer rhythmic and power skills will find this a helpful introduction to power plyometric.

2.4. Single Leg Hops

Single leg hops are identical to double leg hops except they are done on one leg. These jumps develop leg strength with the added elements of isolation and balance. They are physically demanding, however. Only athletes with good basic strength should attempt single leg hops. It is recommended that double leg hops

2.5. Power Bounds

Power bounding is probably the most common plyometric exercise used by track and field athletes. Bounding closely approximates the running motion and is, therefore, specific in training explosive capacity. With power bounds, the athlete should land relatively flat-footed. This allows a safe and efficient leap from the same foot. Arm action should be the same as rhythm bounds except for jumpers who may prefer to use double

arm action. High jumpers may want to accentuate the vertical component of the bound to make it more specific to their event.

2.6. Alternate Leg Bounds

Alternate leg bounds are a foundational move for any athlete but especially for speed demons. Alternate leg bounds, which look like exaggerated sprinting, teach you how to apply horizontal strength quickly into the ground. Imagine a gazelle meeting a sprinter and you get a bound. How to do it: Start by taking a step forward with your right leg and drive off of that leg while driving the left (back) leg into the air. Drive the knee up as forcefully as possible while the opposite arm drives forward, like you would in a sprint. As you land back down on the leg that was driving forward, quickly alternate legs and repeat the same movement on the opposite side (Collette, 2017).

2.11. Medicine ball

Face the rebounder holding a light ply ball or medicine ball over head. Throw the ball multi directional, over head, side to side, back side, 90 sit and throw and repeat for the desire number of repetition (Jason 2007).

APPENDIX-VII Three month training program

Table 19: First Month Training schedule the actual Training time 60 min (Nov 2017)

Day	Types of exercise	Time/sec	Set/Rep	Recovery time	Intensity of exercise
Monday	**Part -1.** General and specific warming-up exercise --General warming-up exercises Joint mobility (ankle, knee, trunk, wrist circles and 4 way necks stretch), knees to chest modified hurdler. modified , lower and upper body dynamic stretch **Part. 2**. Main Part 1.hoping exercise (5 contact) 2, Skipping run (10m) 3 Butt kick (10m) 4, Bound skip (10m) **Part.3**. Cooling down and stretch Stretching exercise • Fed back from the subject	15min 10min 10min 10min 10min 5min	 2x2 2x2 2x2 2x2	30se, each&2min b/n set	Moderate 55-69%
Wednesday	**Part -1.** General and specific warming-up exercise Specific warming-up exercises High knee with extension, heal kick up, bound skip. **Part. 2**. Main Part 1,medicin ball throw multidirectional 2,Squat jump (5m) 3,butt kick (10m) 4,high knee (10m) **Part.3**. Cooling and Stretching exercise(static) • Fed back from the subject	15min 10min 10min 10min 10min 5min	 2x2 2x2 2x2 2x2	30se,each 2minb/n Set	Moderate 55-69%
Friday	**Part -1**. General and specific warming-up exercise General warming-up exercises Ankle bounces, jogging, walking longer stretch, rope jumping, jumping jacks, Calf stretch, Standing hamstring **Part. 2**. Main Part 1.hoping exercise (5 contact) 2, Skipping run (10m) 3 high knee (10m) 4, Bound skip (10m) **Part.3**. Cooling down and stretch Stretching exercise • Fed back from the subject	15min 10min 10min 10min 10min 5min	 2x2 2x2 2x2 2x2	35sec each& 3min b/n Set	Low intensity 40-54.9%

Source, Own

Table 20: Second month Training schedule 60 min (2017)

Day	Types of exercise	Time/sec	Set/Rep	Recovery	Intensity
Monday	**Part -1**. General and specific warming- up exercise General warming-up exercises Ankle bounces, jogging, walking longer stretch, rope jumping, jumping jacks, Calf stretch, Standing hamstring • Dynamic stretching ,leg swim **Part. 2**. Main Part 1.hoping exercise (10 contact) 2, Skipping run (15m) 3 Butt kick (15m) 4, Bound skip (10m) **Part.3**. Cooling down and stretch Stretching exercise • Fed back from the subject	15min 10min 10min 10min 10min 5min	2x10contact 2x3 2x3 3x3	30sec each& 2min b/n Set/Rep	High 70-90% MHR
Wednesday	**Part.1**. General and specific warming-up exercise Specific warming-up exercises, Skipping, jump jack, Side skipping, Controlled leg swing • Active stretching **Part. 2**. Main Part 1,medicin ball throw multidirectional 2,Squat jump (10m) 3,butt kick (15m) 4,high knee (15m) **Part.3**. Cooling and Stretching exercise(static) • Fed back from the subject	15min 10min 10min 10min 10min 5min	2x2 2x2 2x2 2x2	30sec each& 2min b/n Set/Rep	Moderate 55-69%MHR
Friday	**Part.1**. General and specific warming-up exercise Specific warming-up exercises, Skipping, butt kick High knee skips, Side skipping, Controlled leg swing, • Active stretching **Part. 2**. Main Part 1.hoping exercise (10 contact) 2, Skipping run (15m) 3 Butt kick (15m) 4, Bound skip (10m) **Part.3**. Cooling down and stretch Stretching exercise • Fed back from the subject	15min 10min 10min 10min 10min 5 min	3x10contact 2x2 2x2 2x2	30sec each& 2min b/n Set	Moderate 55-69%MHR

Source, Own

Table 21: Third Month the actual Training time for each session 60min (January-2018)

Day	Types of exercise	Time	Set &Rep	Recovery	Intensity
Monday	**Part -1.** General and specific warming- up Joint mobility (ankle, knee, trunk, wrist circles and 4 way necks stretch), knees to chest modified hurdler. modified hurdlers stretch **Part. 2**. Main Part 1.hoping exercise (10 contact) 2, Skipping run (15m) 3 Butt kick (15m) 4, Bound skip (10m) **Part.3**. Cooling down and stretch Stretching exercise • Fed back from the subject	15min 10 min 10min 10min 10min 5 min	 2x3 2x2 2x3 2x2	 30se, each& 2min b/n set	Moderate 55-69%MHR
Wednesday	**Part.1**. General and specific warming- up exercise Specific warming-up exercises, Skipping, butt kick High knee skips, Side skipping, Controlled leg swing • Dynamic stretching, leg swim **Part. 2**. Main Part 1,medicin ball throw multidirectional 2,Squat jump (10m) 3,butt kick (15m) 4,high knee (15m) **Part.3**. Cooling and Stretching exercise(static) • Fed back from the subject	15min 10 min 10min 10min 10min 5 min	 2x2 2x3 2x3 2x3	 30se, each&2min b/n set	High 70-90% MHR
Friday	**Part.1**. General and specific warming- up exercise Specific warming-up exercises, Skipping, butt kick High knee skips, Side skipping, Controlled leg swing • Active stretching **Part. 2**. Main Part 1.hoping exercise (10 contact) 2, Skipping run (10m) 3 Butt kick (15m) 4, Bound skip (10m) **Part.3**. Cooling down and stretch Stretching exercise • Fed back from the subject	15min 10min10 min 10min 10min 5 min	 2x2 2x2 2x2 2x2	 30se, each& 3min b/n set	Low Intensity 40-54.9%

Source, Own

Appendix-VIII Parametric characteristics of participant

Table 22: Lists of Subjects Participated in the Study

No	Serialcode of subjects	Weight (Kg)		Height (m)		No	Serial code of subjects	Weight (Kg)		Height (m)	
		Pre	Post	Pre	Post			pre	post	pre	Post
1	EG-1	49.00	47.00	1.55	1.55	1	CG-1	49	49	1.55	1.55
2	EG-2	50.00	50.00	1.57	1.57	2	CG-2	51	51	1.57	1.57
3	EG-3	51.00	49.00	1.57	1.57	3	CG-3	51	51	1.57	1.57
4	EG-4	50.00	49.00	1.60	1.60	4	CG-4	51	51	1.58	1.59
5	EG-5	47.00	45.00	1.56	1.56	5	CG-5	47	47	1.56	1.56
6	EG-6	46.00	47.00	1.54	1.54	6	CG-6	46	45	1.54	1.54
7	EG-7	48.00	46.00	1.56	1.56	7	CG-7	48	47	1.56	1.56
8	EG-8	51.00	51.00	1.57	1.57	8	CG-8	51	50	1.57	1.57
9	EG-9	52.00	50.00	1.50	1.50	9	CG-9	52	50	1.53	1.53
10	EG-10	49.00	47.00	1.60	1.60	10	CG-10	49	49	1.60	1.60
11	EG-11	47.00	46.00	1.56	1.56	11	CG-11	47	47	1.56	1.56
12	EG-12	48.00	48.00	1.54	1.54	12	CG-12	48	48	1.54	1.54
13	EG-13	48.00	47.00	1.56	1.56	13	CG-13	48	50	1.56	1.56
14	EG 14	51.00	51.00	1.56	1.56	14	CG 14	51	51	1.56	1.56
15	EG 15	52.00	52.00	1.57	1.57	15	CG 15	52	52	1.53	1.53
16	EG 16	49.00	49.00	1.56	1.56	16	CG 16	49	49	1.56	1.56
17	EG17	51.00	51.00	1.57	1.57	17	CG17	51	51	1.57	1.57
18	EG 18	50.00	51.00	1.53	1.53	18	CG 18	50	49	1.53	1.53

Table 23: Pre and post raw data of strength tests (Wall squat and Sit up test)

NO.	Code/Name	pre-WST	post-WST	pre-SUPT	post-SUPT
1	EG1	30	37	12	20
2	EG2	30	38	14	22
3	EG3	31	39	14	23
4	EG4	32	40	18	24
5	EG5	33	37	15	20
6	EG6	32	40	12	22
7	EG7	33	42	14	22
8	EG8	33	42	12	20
9	EG9	34	40	13	21
10	EG10	30	43	14	24
11	EG11	30	38	13	23
12	EG12	30	39	14	24
13	EG13	32	42	13	22
14	EG14	32	40	15	22
15	EG15	32	38	16	23
16	EG16	33	36	13	23
17	EG17	34	43	15	22
18	EG18	31	39	13	24
19	CG1	31	32	12	15
20	CG2	31	31	13	14
21	CG3	30	32	14	16
22	CG4	32	30	11	13
23	CG5	29	31	12	14
24	CG6	28	29	13	14
25	CG7	31	32	12	13
26	CG8	32	32	14	15
27	CG9	27	32	14	16
28	CG10	31	31	15	16
29	CG11	30	32	15	17
30	CG12	27	33	17	18
31	CG13	26	29	12	15
32	CG14	33	34	13	14
33	CG15	33	36	13	15
34	CG16	25	30	14	16
35	CG17	28	32	13	14
36	CG18	31	33	14	15

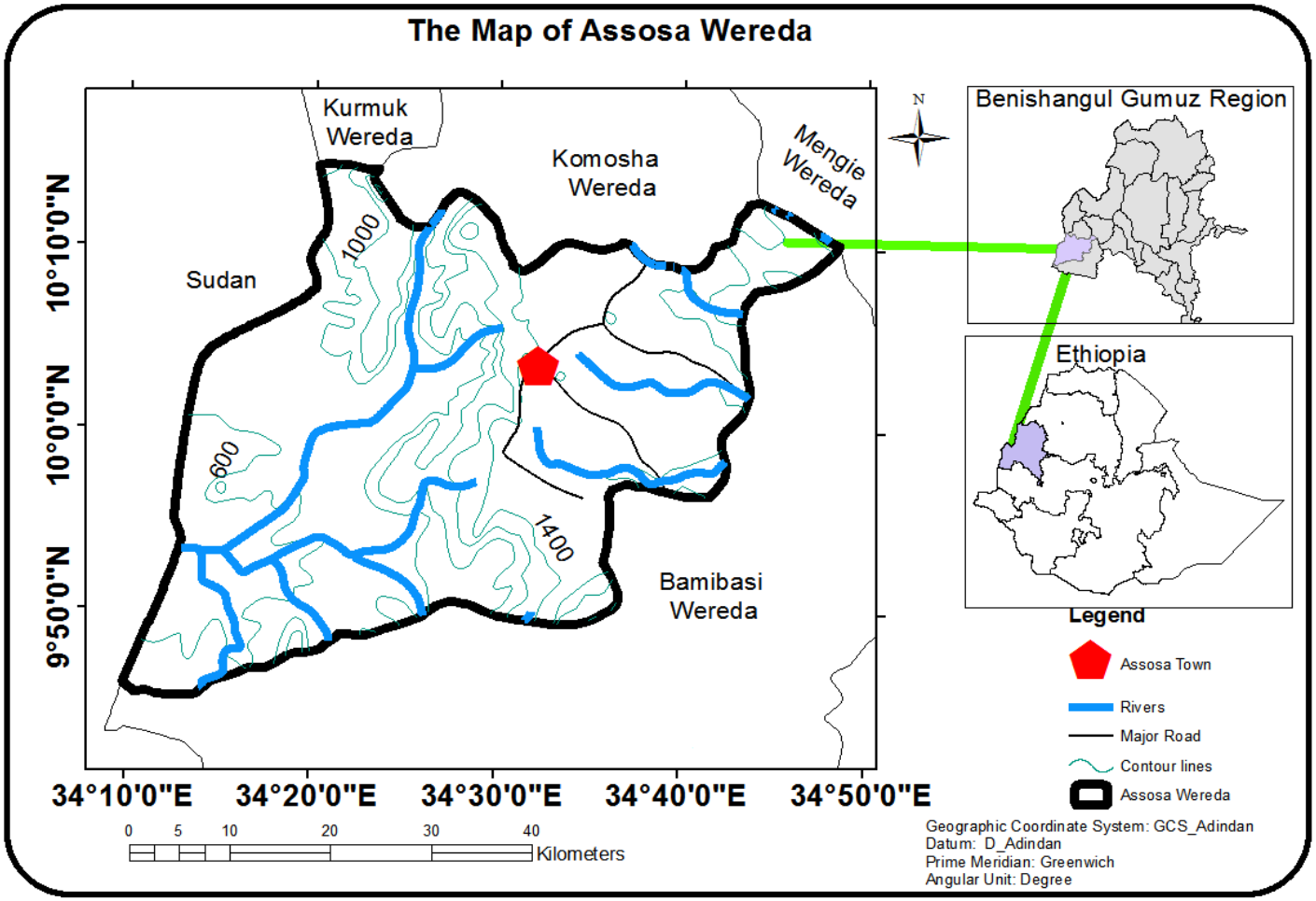
Table 24: Pre and post raw data of power tests in M (Broad jump& Sergeant jump)

NO.	Code/Name	pre-BJT	post-BJT	pre-SJT	post- SJT
1	EG1	1.57	1.60	30	32
2	EG2	1.51	1.55	31	32
3	EG3	1.57	1.62	31	33
4	EG4	1.50	1.55	29	31
5	EG5	1.52	1.55	25	28
6	EG6	1.50	1.55	28	34
7	EG7	1.44	1.49	24	26
8	EG8	1.55	1.57	26	28
9	EG9	1.50	1.54	28	33
10	EG10	1.49	1.53	25	27
11	EG11	1.44	1.49	27	32
12	EG12	1.46	1.50	27	33
13	EG13	1.42	1.45	27	30
14	EG14	1.40	1.44	28	31
15	EG15	1.43	1.45	27	30
16	EG16	1.43	1.50	30	32
17	EG17	1.42	1.47	27	30
18	EG18	1.43	1.47	26	30
19	CG1	1.53	1.54	26	27
20	CG2	1.51	1.53	25	25
21	CG3	1.52	1.55	24	25
22	CG4	1.50	1.53	24	26
23	CG5	1.50	1.54	25	25
24	CG6	1.47	1.50	25	25
25	CG7	1.54	1.56	26	25
26	CG8	1.45	1.47	27	27
27	CG9	1.43	1.44	27	27
28	CG10	1.44	1.46	27	27
29	CG11	1.45	1.48	29	27
30	CG12	1.43	1.47	29	28
31	CG13	1.42	1.43	28	29
32	CG14	1.45	1.43	28	29
33	CG15	1.44	1.44	30	27
34	CG16	1.45	1.43	30	29
35	CG17	1.43	1.42	25	30
36	CG18	1.44	1.44	25	27

Table 25: Pre and post raw data of speed tests (35m &60m)

NO.	Code/Name	pre-35m	post-35m	pre-60m	post-60m
1	EG1	5.60	5.00	11.10	10.10
2	EG2	5.40	5.10	12.50	10.00
3	EG3	5.55	5.10	11.50	10.20
4	EG4	5.62	5.10	12.00	11.30
5	EG5	5.58	5.20	12.25	11.10
6	EG6	5.56	5.00	12.40	11.30
7	EG7	5.62	5.15	12.10	10.00
8	EG8	5.64	5.00	12.25	10.00
9	EG9	5.58	5.00	11.20	10.10
10	EG10	5.55	5.10	11.30	10.00
11	EG11	5.60	5.10	11.20	10.10
12	EG12	5.70	5.20	12.35	11.00
13	EG13	5.54	5.10	11.30	10.00
14	EG14	5.65	5.10	11.50	11.20
15	EG15	5.65	5.15	12.30	11.10
16	EG16	5.65	5.00	12.25	11.00
17	EG17	5.68	5.10	12.10	11.10
18	EG18	5.50	5.00	11.20	10.10
19	CG1	5.60	5.55	11.40	11.35
20	CG2	5.40	5.40	11.20	11.15
21	CG3	5.55	5.50	11.10	11.00
22	CG4	5.62	5.55	11.20	11.15
23	CG5	5.58	5.55	12.25	12.10
24	CG6	5.56	5.50	12.40	12.35
25	CG7	5.62	5.55	12.10	11.55
26	CG8	5.64	5.60	12.25	12.20
27	CG9	5.58	5.50	11.10	11.00
28	CG10	5.55	5.50	11.30	11.25
29	CG11	5.54	5.50	11.20	11.15
30	CG12	5.55	5.50	12.20	12.00
31	CG13	5.54	5.50	11.45	11.40
32	CG14	5.60	5.55	12.20	12.10
33	CG15	5.50	5.50	12.30	12.15
34	CG16	5.58	5.50	12.25	12.20
35	CG17	5.50	5.40	12.10	12.00
36	CG18	5.55	5.40	11.20	11.10

Figure 4: Location of the experimental sit



Source

(BBOARD, 2017)