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THE EFFECT OF PLYOMETRIC TRAINING ON SPEED PERFOREMANCE DURING TEACHING PHYSCIAL EDUCATION PRACTICAL CLASS:AT BETHLEHEM SECONDARYSCHOOL

BY

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Effect of Plyometric Training on Speed Performance during Teaching Physical Education Practical Class at Bethlehem Secondary School

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ACRONYMS

Acronyms used in this particular study are:

GTOS	Golgi tendon organs
HDL	Nigh density Lipoprotein
HV	High Velocity
PC	practical Class
PE	Physical Education
PEPC	Physical Education Practical Class
PT	Plyometric Training
SPSS	Statistical Package for Social Science
SSC	Stretch-Shortening Cycle

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Abstract

Effect of Plyometric Training on Speed Performance during Teaching Physical Education Practical Class at Bethlehem Secondary School

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Addis Ababa University, 2016

The purpose of this study was to examine the effects of plyometric training programs on overall speed performance among high school students during teaching physical education practical class. The study was particularly conducted at Bethlehem secondary school. The study used quasi-experimental design, which was followed by pre-test and post-test non-equivalent comparison group design. From fourteen sections' two intact sections were selected randomly and one was assigned as experimental group and the other as comparison group. Pre-test and post-test was given to the students to measure their speed performance before and after intervention for experimental group. The sample size of the study was 56 students of which 28 were treated under the experimental group and 28 of them were treated as comparison group. The study showed, there is no significant difference between the mean score of the pre-test of experimental and comparison group. However, there is a significant difference between the mean score of the post-test of the experimental group and comparison group, showing plyometric training accounted positive effect on speed performance of students.

Key words: Effect of plyometric training on speed, muscular strength, power out and students speed improvement level

CHAPTER ONE

Introduction

1.1 Background of the Study

The main goal of strength training is to increase the maximum force that a particular muscle group can generate. Muscle strength increases the force apply on the bones. Stronger forces of muscular contraction increase the mechanical stress on bone, and bone must subsequently increase in mass and strength to provide a sufficient support structure for the muscles.

An optimal level of strength, power, and force are necessary to maximize speed performance because speed requires a powerful start and a strong finish. Whenever used Strength training for physical conditioning, it can increase force, muscular strength and power. From those methods plyometric training, involved by light loads and high repetitions could increase speed and velocity. Plyometrichave been extensively explored for improving sprint running speed (Rumpf**et al.; 2014)**

Athletes spend a lot of time and effort to improve athletics performance. Through strength exercise and condition, teachers help students toachieve a high level of athletics performance. This exercise used to develop the athletics strength,power and speed. In addition to improving these physical qualities, strength training also has significant benefits for athletes in terms of increasing muscle mass and decreasing risk of injury. It is a common belief that strength training should be an important part of a training program for these athletes.

Most strength and conditioning coaches will prescribe strength training to increase strength, power and attempt to transfer improvements in these areas to match related outcomes, such as speed and agility.

Although the extent to which qualities such as strength and power are important to sports, performance may vary depending on the activity. The all improvement of all or one of these factors may help for enhancing the athletes performance on his or her respective perform track and field events,(Peason and Gehlsen; 1998).

There is Strong relationship between Physical capacities that can be developed using plyometric training (force production, power, rate of force development) and sport-specific skills such as speed and agility. The amount of research that demonstrates the positive impact of strength training on these physical capacities and playing level, it is reasonable to conclude that strength training has positive benefits for an athlete's performance.

Strength training commonly uses the technique of progressively increasing the force output of the muscle through incremental weight increases and uses a variety of exercises and types of equipment to target specific muscle groups. Strength exercise for athletes involve primarily movements such as the barbell, back squat (lower body) and bench press (upper body) or variations of these exercises (Kawamori&Haff, 2004). This type of training potentially facilitates the development and growth of muscle strength of the body.

One of the most successful methods is the one that involves plyometric exercises (Boumpa, 2005). In plyometric exercises, the sudden lengthening and shortening of muscle length by the contraction and stretching of muscles result in a rapid release of energy stored in the muscles, as a result of which these exercises simultaneously enhance three important abilities, i.e. power,

speed, and endurance (Khorrami, 1997). Success in many sports depends heavily up on the athlete's explosive leg power and muscular strength.

In Jumping, throwing track & field events and other activities the athlete's must be able to use strength as quickly and force fully as possible.

This display comes in the form of speed, strength or power (Yessis& Hat field 1986) Sprinting is a critical factor in most team sports performance, and strength training has been show to improve speed. Speed strength training is a component necessary in many sports, and can be helpful in everyday life as well. Speed strength comes from the neuromuscular system's ability to create a large impulse in the shortest amount of time. The stronger you are, the more speed you will be able to generate. Sprinting will develop both speed and technique. The more you train for a specific speed activity, the better your body will get at performing the activity.

The sprint has three phases: the initial acceleration, maximum running speed, and speed endurance (maintenance). In track and field, a sprinter may possess a good start but lack the ability to maintain maximum speed. The initial acceleration phase occurs between the start and 10 meters (m). The maximum running speed is achieved among untrained sprinters between 10 m and 60 m, but it may take an elite sprinter 80 m to reach top speed due to a higher endurance capacity (Delecluse et al., 1995). The endurance phase is the last 10 to 20 m of the sprint.

In addition, training for the initial acceleration phase is different from training for maximum running speed (Delecluse et al. 1995). Sprinter can improve his/her speed when the plyometrictraining is performed at higher movement velocities (Blazevich& Jenkins, 2002).

Plyometric is a type of training designed to produce fast, powerful movements, and improve the functions of the nervous system, generally for improving performance in sports. Plyometric movements, in which a muscle is loaded and then contracted in rapid sequence, use the strength,

elasticity and innervation of muscle and surrounding tissues to jump higher, run faster, throw farther, or hit harder, depending on the desired training goal.

Plyometric training is used to increase the speed or force of muscular contractions, providing explosiveness for variety of sport-specific activities .Plyometric exercises also used that enable a muscle to reach maximum strength in as short a time as possible.

In addition to plyometric training, many athletes use other training components, such as speed and agility exercises to enhance the athletic performance, but Blazevich and Jenkins,(2002); hypothesized that if athletes wish to improve their HV force production, plyometric training exercises should be performed at high movement speed.

Researchers have studied the impact of plyometric training emphasizing the exact methods that improved the athlete's time in each phase (Young, 2006). Given the context students learn in Ethiopian high schools, how far does plyometric training affect speed performance? is worth investigating.

1.2 Statement of the problem

It is understood that the primary objective in physical education and sports lessons in secondary schools is upgrading physical level for students, so that they can practice practical lessons with a good level of fitness, and through field follow-up to some of the lessons. A weakness has been observe in the fitness and motor performance among students in the sprint run speed, with a lack of diver's frication and combination of modern methods of training by teachers, particularly in the development of effective physical attributes. This is what made people note the weakness of digital achievement in speed during physical education practical session among students. Therefore, the researcher decided to examine the effect of employing plyometric training method

to develop the upgrading capacity to improve digital achievement of speed performance in sprint run with students in physical education and sports classes at the secondary level (High School).

Teachers evaluate each student by utilizing the results of a number of tests in physical education practical class .Strength exercise is one of the exercises that develop speed performance of students during physical education practical class.

Plyometric training is felt to be one of strengthexercise that helps students' to achieve high level of athletics performance or it develops speed. However, most students have a problem of speed, when they preform physical education practical class.

Those who are not muscularly fit have less performance in sprint running. Strength and conditioning professionals spend a lot of time and effort trying to improve athletic performance. Therefore, the researchwas conducted to investigate the effect of plyometric training program on speed performance during teaching physical education practical class at Bethlehem secondary school.

1.3 Significance of the Study

The significance of this study is to potentially inform physical education educators of effective training methods to improve the physical wellbeing as well as performance of their students. The results of the study could help physical education teachers by using these techniques to teach students how to improve their overall performance. The result of this research is very useful for coachesespecially those who train in sprint run athletes. This study would also contribute to the existing literature about effective plyometric training methods to increase speed performance.

1.4 Objective of the Study

1.4.1 General objective

The main purpose of this study is to examine the effects of plyometric training programs on speed performance in high school students during teaching physical education practical class at Bethlehem secondary school.

1.4.2 Specific objective

The specific objectives of this study are:

- To find out whether there is a significant difference between the mean scores of the pre-test for the experimental group and the comparison group.
- To find out whether plyometric training has positive effect on speed performance
- To explore students speed performancelevel before and after plyometric training
- To investigate students speed difference before and after plyometric training programduring sprint run.

1.5 Delimitation of the study

The study was delimited to Bethlehem secondary school, whichis found in Addis Ababa City Administration, Arada sub city. Among the lessons given to the students in physical educationthe focus wasgiven to plyometric training (exercise). Furthermore, the study was delimited to the effect of plyometric training program to speed performance during teaching physical education practical class.

One of thelimitations of the study isgeneralizability. The main and the most problem that could limit this study is food, because almost all students'family are of low economically status. Because of this students may not getsufficient food after training.So, this might have limited the findings and their generalizability. Even when students get a meal, the meal content cannot replace the expended calorie. Therefore, their calorie expenditure and calorie intake might not have been balanced that would limit generalizability.Therefore; this problem challenges and limits theapproach to training and its effect. The other limitation is lack of reference materials and related researches in our context. The fact that this study was conducted only on two intact groups, replication effect might be drawn to issue gaps.

Generally, the school field is not that much suitable for our training. The number of students was reducedfrom 60 to 56 because of dropout, and the researcher involved 56 Bethlehem secondary school students.

1.7 Research Hypothesis

1 There is no significance difference between the mean scores of the pre-test and post-test for the experimental group regarding to speed

2 There is no significance difference between the mean scores of the pre-test and post-test for the comparison group regarding to speed

3 There is no significance difference of the mean scores of the pre-test of the experimental and comparison group regarding to speed

4 There is no significant difference between the mean score of the post-test of the experimental and comparison group regarding to speed

5 There is no significant difference between the mean score of the post-test of the experimental and comparison group, and with respect to sex regarding to speed

6 There is no correlation of plyometric training and improvement of speed performance

1.8 Operational Definitions of term

Power: is the combination of speed and strength.

One repetition maximum (1RM): is the most amount of weight that a participant can lift for one repetition but not two.

High-velocity training (HV): uses the athlete's body weight as the resistance where coordination and speed are emphasized during the movements. Exercises include jumps, skipping, ladder drills, bounding, and hopping.

Plyometric training: is a technique used to develop explosive strength and power, speed and consists of a quick eccentric stretch followed by a powerful concentric contraction

Speed: is the maximum rate at which an individual is able to cover a distance or perform a movement in a chosen period of time.

Strength: is "the force or tension a muscle or, more correctly, a muscle group can exert against a resistance in one maximal effort.

1.9 Ethical consideration

To conduct this study the following points were taken under consideration

- The official letter written from A.A.U; which the researcher submitted to school principals to conduct the study.

- Informed consent was met between researcher and principal of the school;
- Informed consent was met between researcher and homeroom teacher;
- Students in were informed about the confidentiality of the research experimental group;
- The researcher informed the students' who participated in the training and had health problem, in order to prevent injury or accident;
- The rule and regulations of the school were respected during the training;
- Anonymity and confidentiality of participants was considered

1.10 organization of the study

This study is organization in to five chapters. **In chapterone** the researcher discussed the background of the study, statement of the problem, objective of the study, research question, significance of the study, delimitation and limitation of the study. **In chapter two** some of the related literatures were reviewed and discussed. **In chapter three** the methods used to obtain the results of this study were discussed. This includes research design, population of the study, population and sample, sample size, validity and reliability.**In chapter four** the results of this study were discussed; and finally, **in chapter five** summaries of findings, conclusion and recommendation were incorporated.

CHAPTER TWO

Review of Literature

2.1 Strength exercise

Strength exercise is a type of physical exercise specializing in the use of resistance to induce muscular contraction to which builds the strength,anaerobic endurance, and size of skeletal muscles. When properly performed, strength exercise can provide significant functional benefits and improvement in overall health and wellbeing , including increased bone muscle, tendon and ligament strength and toughness improve joints function, reduced potential for injury, increased bone density, increased metabolism, increased fitness, improved cardiac function, and improved lipoprotein, lipid profiles, including elevated HDL(good) cholesterol. Strength training has become an essential method for optimizing athletic performance, especially in sports where explosive strength and speed are key determinants (Baker & Newton,2008; Lopez-Segovia etal., 2010; Marques, 2010). In light of this, numerous authors have studied the strength changes produced in different athletic activities (e.g. jumps, sprints, or maximum repetitions) as a result of power-centered training (Cormie et al.,2010; Turbanski & Schmidtbleicher, 2010). Strength training has been show to improve strength, power and speed. The relative influence that strength and power have on performance depends on the requirements of them particular sport, a large body of evidence supports a positive benefit.

Athletics is one of the most popular sports in now days. Strength exercise programs have helped many athletes become stronger and faster. These programs have also succeeded in providing athletes with the ability to enhance theirperformance. It is a commonly accept fact that many sprint run skill can be enhancethrough proper strength exercise and conditioning.

2.2 Definition of Plyometric Training

Plyometric training is defined as a quick, powerful movement involving an eccentric contraction, followed immediately by an explosive concentric contraction. This is accomplished through the stretch-shortening cycle or an eccentric-concentric coupling phase.

The eccentric concentric coupling phase is also referred to as the integrated performance paradigm, which states that in order to move with precision, forces must be loaded (eccentrically), stabilized (isometrically), and then unloaded/accelerated (concentrically). Plyometric exercise stimulates the body's proprioceptive and elastic properties to generate maximum force output in a minimum amount of time.

Plyometric is a system of hopping, skipping, jumping, or running that works on developing explosive power and maximally recruiting fast-twitch muscle fiber by eccentrically loading a muscle and quickly producing a concentric force. Plyometric are exercises that enable a muscle to reach maximum strength in as short a time as possible.

Plyometric is a type of training designed to produce fast, powerful movements, and improve the functions of the nervous system, generally for improving performance in sports. Plyometric movements, in which a muscle is loaded and then contracted in rapid sequence, use the strength, elasticity and innervation of muscle and surrounding tissues to jump higher, run faster, throw farther, or hit harder, depending on the desired training goal. Plyometric is used to increase the speed or force of muscular contractions, providing explosiveness for a variety of sport-specific activities.

Plyometric are a type of exercise that typically include hops, jumps, and bounding exercises that make use of the muscles' cycle of lengthening and shortening to increase muscle power.

It is an exercise that enable a muscle to reach maximal strength in ashort time as possible by eliciting the stretch –shorten cycle of muscle fiber .This sequence of events begin by having the muscle stretch and there for store elastic energy prior to tiring.

Plyometric trainings are vital components in aiding an athlete's maximal speed and should be included in any conditioning program for sprinters.plyometric training involves where the active muscles are stretched prior to its shorting.

Plyometric training is popular among individuals involved in dynamic sports, and plyometric exercises such as jumping, hopping, skipping and bounding are executed with the goal of increasing dynamic muscular performance, especially speed.

Jumping, bounding, and hopping exercises that exploit the stretch-shortening cycle have been shown to enhance the performance of the concentric phase of movement (Gehri et al., 1998) and increase power output and speed performance (Adams et al., 1992; Paul et al., 2003).

Plyometric exercises evoke the elastic properties of the muscle fibers and connective tissue in a way that allows the muscle to store energy during the deceleration phase and release that energy during the acceleration period (Asmussen, 1974; Bosco et al., 1982;) Benefits from the plyometric training include improved measures of muscular strength and power explosive capacities of the athletes, (Bobbert, 1990; Matavulj et al., 2001); and, plyometric training can improve muscular strength, vertical jump, and speed (Harrison & Gaffney, 2001;)

Plyometric training can act as the bridge between strength, power, speed and skill. Plyometric training utilizes the stretch reflex mechanism in the muscle to improve the reaction time of the nervous system in that muscle.

The goal of plyometric training is to develop the power and speed that is specific to a sport.Plyometric work by quickly stretching the muscle (eccentric) followed by a very quick muscle contraction (concentric).

The quick eccentric phase activates and fires the muscle spindle, located in the muscle fiber, and a tremendous amount of force is generated through elastic energy that is stored in the tendons and muscle. Each time specific and correct plyometric action is practiced the nerve synapse and the muscle it innervates, becomes better at transmitting the same signal in the future. These synapses over time can increase the receptor sites for greater excitation of the muscle. Simply put the body learns to create to a faster and greater muscle contraction.

2.3 Physiological Principles of Plyometric Training

Plyometric training utilizes the elastic and proprioceptive properties of a muscle to generate maximum force production by stimulating mechanoreceptors to facilitate an increase in muscle recruitment in a minimal amount of time. Muscle spindles and Golgi tendon organs (GTOs) provide the proprioceptive basis for plyometric training. The central nervous system then uses this sensory information to influence muscle ton, motor execution, and kinesthetic awareness. Stimulation of these receptors can cause facilitation, inhibition, and modulation of both agonist and antagonist muscle activity. This enhances neuromuscular efficiency and functional strength.

The concept of plyometric is based on the three-component model of muscle. Muscle is modeled with a contractile element and two elastic elements that are named according to their relationship to the contractile element—one in line with (the series elastic element) and one in parallel (the parallel elastic element).

When a muscle contracts, tension is not directly transmitted to the endsof the tendon and the load is not overcome, leading to movement. This would only happen if the connection between the contractile element and its insertion were rigid and inelastic.

In reality, the contractile element develops tension, stretching the series elastic element; the degree of stretch is dependent on the load to be moved. After sufficient tension has been generated, the tension at the ends of the muscle is sufficient to overcome the load and the load is moved. When a load is applied to a joint (eccentric phase), the elastic elements stretch and store potentialenergy (amortization phase) prior to the contractile element contracting (concentric phase).

An eccentric contraction immediately preceding a concentric contraction significantly increases the force generated concentrically as a result of the storage of elastic potential energy.During the loading of the muscle, the load is transferred to the series elastic components and stored as elastic potential energy. The elastic elements then contribute to the overall force production by converting the stored elastic potential energy to kinetic energy, which enhances the contraction. The muscle's ability to use the stored elastic potential energy is affected bythe variables of time, magnitude of stretch, and velocity of stretch. Increased force generationduring the concentric contraction is most effective when the preceding eccentric contraction is ofshort range and is performed immediately. A simple example of the use of the energy stored in the elastic element is the basic vertical or countermovement, jump.

The initial squat (the countermovement) is the eccentric phase stretches the elastic elements and stores elastic energy (amortization phase). When the jump isperformed (the concentric phase), the stored energy is "added" to the tension produced leadingto a higher jump.

The amount of stored energy used is inversely proportional to the time spentin the amortization phase. When doing a vertical jump, the longer one waits at the end of the countermovement before performing the jump, the lower the eventual jump height due to the inability to recover the stored elastic energy.

The improved muscular performance that occurs with the pre-stretch in a muscle is the result of the combined effects of both the storage of elastic potential energy and the proprioceptive properties of the muscle. The percentage that each component contributes is unknown at this time, but the degree of muscular performance, as stated earlier, is dependent upon the time in transition from the eccentric to the concentric contraction.

Training that enhances neuromuscular efficiency decreases the time between the eccentric and concentric contraction, thereby, improving performance. This can be accomplishing through integrated training.

2.4Plyometric Training Methods for speed

Plyometric exercise is a popular form of training commonly used to improve athletic performance which involves stretch of the muscle-tendon unit immediately followed by shortening of the muscle unit. This process of muscle lengthening followed by rapid shortening during the stretch-shortening cycle (SSC) is integral to plyometric exercise.

The SSC process significantly enhances the ability of the muscle-tendon unit to produce maximal force in the shortest amount of time. These benefits have prompted the use of plyometric exercise as a bridge between pure strength and sports related power and speed.Plyometric have been extensively explored for improving sprint runningspeed performance.

Since sprint running involves both eccentric and concentric muscle actions, the ability to generate maximal force during running is also dependent upon the behavior of the stretch-shortening cycle and the stiffness of the lower body. It is often stated that such plyometric are the key to bridging the qualities of strength and power or other related high-velocity expressions of strength.

Alternatively, other physiological adaptations might occur that cause an improved ability to store and release elastic energy during high-velocity eccentric and concentric muscle actions.

Many coaches and athletes make use of plyometric exercises to enhance speed and power. Plyometric can also be used to improve agility and coordination for better athletic performance. Many sports performances come about by applying force to the ground, whether you are jumping high, running fast, swinging a golf club or delivering a karate kick, force must be applied to the floor to bring about the performance. For this reason, all track and field athletes pay particular attention in training to their lower body. In your pursuit for speed and power, here are some of the top plyometric exercises to help you improve the power of your lower extremities:

The speed of the sprint, whether or not the athlete is accelerating may affect the degree to which elastic energy storage and/or stiffness are important for sprint running performance. In respect of velocity, Cavagna (2006) found that the increase in stretching velocity of the hip extensors and knee flexors in the terminal swing phase of sprint running increases with increasing speed.

This implies that the elastic elements of the muscle-tendon units contribute more to force production at faster running speeds. Thus, it might be expected that training methods that help improve elastic energy storage might help improve sprint running performance to a greater degree at faster speeds than at slower speeds.

Additionally, Roberts (2002) found that several studies reported that muscles during constant speed running change length only slightly but contract more or less isometrically, while the tendon in series undergoes large changes in length. This is in contrast to acceleration running, whereby the muscles shorten considerably while undergoing concentric contractions. This implies that the elastic elements of the muscle-tendon units contribute more to force production at constant-speed sprint running than during accelerating sprint running.

Thus, it might be expected that training methods that help improve elastic energy storage might help improve speed performance to a greater degree during maximum speed sprint running than during accelerating sprint running.

Plyometric training has become a popular way for students to increase overall performance in sprints run. Many types of strength training methods are used by strength and conditioning teacher and students to increase speed, strength, and power. Plyometric exercises are suitable for improving various measures and components of muscle power such as vertical jumping ability, speed and acceleration (Fatouros et al., 2000).

Increased power increases speed by either increasing the number of muscle units involved in the contraction or the strength of each involved muscle unit.

Both can result in increase of force against the ground, which can produce a longer stride or, more importantly, if more force can be created in less time, less ground contact time and greater stride frequency. It is less ground contact time, and therefore greater stride frequency, which separates good and great sprinter.

2.4.1 Three Phases of plyometric Exercise

There are three distinct phases involved in plyometric training including the eccentric, or loading, phase; the amortization, or transition, phase; and the concentric, or unloading, phase.

1. The Eccentric Phase

The first stage of a plyometric movement can be classified as the eccentric phase, but it has also been called the deceleration, loading, yielding, countermovement, or cocking phase. This phase increases muscle spindle activity by pre-stretching the muscle prior to activation.

Potential energy is stored in the elastic components of the muscle during this loading phase. A slower eccentric phase prevents taking optimum advantage of the myotatic stretch reflex.

2. The Amortization Phase

This phase involves dynamic stabilization and is the time between the end of the eccentric contraction (the loading or deceleration phase) and the initiation of the concentric contraction (the unloading or force production phase). The amortization phase, sometimes referred to as the transition phase, is also referred to as the electromechanical delay between the eccentric and concentric contraction during which the muscle must switch from overcoming force to imparting force in the intended direction .

A prolonged amortization phase results in less-than-optimum neuromuscular efficiency from a loss of elastic potential energy. A rapid switch from an eccentric contraction to a concentric contraction leads to a more powerful response.

3. The Concentric Phase

The concentric phase (or unloading phase) occurs immediately after the amortization phase and involves a concentric contraction, resulting in enhanced muscular performance following theeccentric phase of muscle contraction. This occur secondary to enhanced summation and reutilization of elastic potential energy, muscle potentiation, and contribution of the myotatic stretch reflex.

The key to plyometric exercise is to keep the amortization phase (the landing and pre-stretch phase) as short as possible. This phase is significant. If the loading phase is too long the Golgi Tendon Organ will take over and cancel out the function of the Muscle Spindle.

The shorter the amortization phase, the greater the muscle spindle action and elastic response from the muscle and the nervous system. The amortization phase should be between .003 to .005 seconds. The athlete must always react as if the ground is hot like a frying pan. As soon as ground contact time increases, or fatigue is noticed, it is time to stop the exercise. Plyometric are effective for improving sprinting speed in athletes. No single plyometric exercise has been shown to be more effective than any other is, although a variety appears to be better than one exercise alone.

Plyometric and weight training can enhance of strength performances. The researchers found that applied training for strength development led to an increase in maximal isometric force along with an increase in concentric force produced in leg extensions and calf extensions. Concluded that strength training in young athletes resulted in an increase in maximal isometric muscle contraction and increased performance of the vertical jump of the participants.

Adolescent participation in plyometric training programs can be appropriate when the programs are designed well and competently supervised. Plyometric training not only provides improvement in sport performance but may provide the adolescents with a gain in self-confidence in their physical abilities so they will continue to participate in other activities as they get older (Ignjatovic et al., 2007). Plyometric help athletes become durable from strengthening some tissues and prepare the nervous system for similar contractions later. Plyometric help deceleration or agility by overloading the eccentric actions of sport movement.

Plyometric are specific to jumping, but are not always appropriate to jumping sports if other elements are not included, such as running and maximal strength, increasing your vertical are available, but the improvements of speed is the most captivating.

2.5 Explosive Plyometric Training

Explosive plyometric is a form of explosive training used to increase speed, quickness and power.Explosive plyometric training is a method of converting increase in strength in to sped and explosive power.it is a method that relies on bringing about a forced involuntary stretch that accumulates energy and then returns it in the muscle contraction after the stretch .although plyometric training is the key to success for many athletes, it is not for everyone.

Youngsters especially shouldbeaware of doing explosive plyometric orvery intense type of explosive plyometric training because it can be very stressful to the joints and nervous system.Most important in youth(pre- and early post puberty) is development of strength and effective technique.

One of the most interesting and undervalued forms of training for runners, proven to enhance economy, is strength work. This includes a special type of training known as plyometric.

Plyometric invokes specific neural adaptations, such as an increased activation of motor units, with less muscle hypertrophy than typical heavy-resistance strength training (Hakkinen, 1994; Sale, 1991). Strength training and plyometric have both been shown to improve running performance. They do so by taking advantage of something known as the stretch-shortening cycle (SSC).

The stretch-shortening cycle is an eccentric-concentric coupling phenomenon in which muscle-tendon complexes are rapidly and forcibly lengthened, or stretch loaded, and immediately shortened in a reactive or elastic manner. The stretch-shortening reflex involves three distinct phases. Phase one is the eccentric phase, which involves preloading the agonist muscle group. Phase two is the time between the eccentric and concentric phases and is termed the amortization or transition phase. Phase three is the concentric phase and is the body's response to the eccentric and amortization phase.

During running, the eccentric phase begins at foot touchdown and continues until the movement ends. The amortization phase is the transition from eccentric to concentric phases during touchdown; it is quick and without movement.

The concentric phase follows the amortization phase and comprises the entire push-off, until the athlete's foot leave the surface (Baechle&Earle, 2008).

A second popular training technique is high-velocity (HV) training which can include plyometric exercises. Plyometric exercises use the student's body weight as the resistance and include exercises such as bounding,hopping, skipping, and jumping.

Some teacher and students perceive plyometric training as the only strength-training method to result in an improvement in sprint performance because coordination and speed are specifically related (Delecluse et al., 1995).

Plyometric training is considered as one of the development methods of the explosive power of the legs and the working muscles on the joints of the lower parts (legs), as well as the improvement and development of speed. Plyometric training is effective and efficient way to improve the strength and speed of movement. The study of Caruso J. F, et al. (2010) and Kotzamanidis (2005), where it is clear that the use of plyometric training is an effective factor in the sprint run competitionwhere performance requires to work on the integration of maximum force of muscles with the speed performance to achieve a high degree recipe performance capability especially if the explosive power of the legs is one of the qualities of desired development.

2.6 Proposed Mechanism by which Plyometric training enhances Performance

2.6.1 Training Enhances speed performance

There are three proposed mechanisms by which plyometric training improves speed performance; enhanced muscle spindle activity, desensitization of the GTO, and enhanced intramuscular and inter muscular neuromuscular efficiency.

2.6.2 Enhanced muscle Spindle Activity

The speed of a muscular contraction is regulated by the neuromuscular system. The human movement system will only move within a set speed range regardless of how strong a muscle is. The faster the eccentric loading, the greater the concentric force production.

2.6.3 Desensitization of the Golgi Tendon Organ

Desensitizing the GTO increases the stimulation threshold for muscular inhibition. This promotes increased force production with a greater load applied to the musculoskeletal system

2.6.4. Enhanced Neuromuscular Efficiency

Plyometric training may promote better neuromuscular control of the contracting agonists and synergists, thus enabling the central nervous system to become more reflexive. These neural adaptations lead to enhanced neuromuscular efficiency e en in the absence of morphological adaptations, such as muscle hypertrophy. Exploiting the stretch reflex, inhibiting the TO, and enhancing the ability of the nervous system to react with maximum speed to the lengthening muscle optimizes the force produced by the concentric contraction.

In the end, plyometric training has wide-ranging effects beyond power output. There is moderate Evidence that when plyometric exercises are incorporated into an integrated training program, there are documented improvements in jumping ability, running economy, power output, and rate of force development, but not strength. When used in an isolated training program, there is moderate evidence that plyometric have little positive benefits on performance. There is no evidence that youth athletes, when properly instructed and following directions, cannot use plyometric in an integrated training program or that plyometric should be reserved solely for athletes.

2.7 Effects of plyometric Training on speed

Plyometric exercises are a vital component in aiding an athlete's maximal speed and should be included in any conditioning program for sprinters. Plyometric training is an effective mode of

training as it enhances motor learning and neuromuscular efficiency promoting the excitability, sensitivity, and reactivity of the neuromuscular system to increase the rate of force production (power), motor-unit recruitment, firing frequency (rate coding), and synchronization. Plyometric training provides the opportunity to train specific movement patterns in a biomechanically correct manner at a more functionally appropriate speed. This provides functional strengthening of the muscle, tendon, and ligaments specific to the demands of everyday activities and sports. The ultimate goal of plyometric training is to improve the reaction time of the muscle action spectrum (eccentric deceleration, isometric stabilization, and concentric acceleration).

The speed of muscular exertion is limited by neuromuscular coordination. This means that the body will move most effectively and efficiently within a range of speed that the nervous system has been programmed to allow. Plyometric training improves both neuromuscular efficient and the range of speeds set by the central nervous system.

Optimum reactive performance of any activity depends on the speed at which muscular forces can be generated (Wilkerson et.al,2004).Speed strength, also known as power, is crucial for the performance in sports where changes of direction, accelerations, and jumps are importance. Hence, strength and power in leg muscles are important for professional soccer players.

Maximal strength is an important quality for power performance, because power is the product of force (strength) and velocity (speed).

Thus, an increase in 1RM is usually related to improved power abilities. Research results showed that heavy strength training on leg extensor muscles improved power, jumping height and sprint performance in professional soccer players. Plyometric training (PT) is a widely used method to improve muscles' ability to generate explosive power.

Plyometric is a type of exercise training designed to produce fast, powerful movements, and improve the functions of the nervous system, generally for the purpose of improving performance in a specific sport.

PT, in which a muscle is loaded and then contracted in rapid sequence, use the strength, elasticity and innervations of muscle and surrounding tissues to jump higher, run faster, throw farther, or hit harder, depending on the desired training goal. Plyometric training has been shown to increase power, jumping height and sprint performance.

Sprint performance is determined by the ability to attain maximum running speed as fast as possible and maintaining this speed for the required time or distance. By improving specific kinematics such as step length, and step rate as well as increasing explosive strength, sprint performance can be improved. This kinematics can be trained by improving optimal motor neuron excitability and fast twitch fiber recruitment. Sprint running is an important quality for many athletes.

It can be subdivided into accelerating sprint running and constant-speed sprintrunning. Track athletes appear to accelerate for longer distances (50 – 60m) than team sports athletes (20 – 30m) but may not necessarily accelerate maximally.

Many training methods can increase sprinting speed in athletes, including conventional sprint running training, resisted sprinting, resistance training, ballistic training, plyometric, and a combination. Comparisons of these training methods have not yet identified which is best and training status may affect the selection of the best method.

"The benefits of plyometric for sprint performance are expected to be the greatest at the velocity of muscle action that most closely approximates the velocity of muscle action employed in

training. Therefore, it has been suggested that the greatest effects of plyometric on sprinting performance occur in the acceleration phase, since the velocity of muscle action in bounding plyometric exercises most closely approximates the velocities of muscle action in the acceleration phase of the sprint"(GoranMarkovic&PavleMikulic,2010).

Resisted sprinting is effective for improving sprinting speed in athletes and sled towing is the most common type resisted sprinting method. Contrary to popular belief, the weight of the sled appears to have little influence on outcomes and both heavy and light sled loads can be used successfully. Plyometric are effective for improving sprinting speed in athletes. Plyometric training (PT) has positive effects on peak power, jumping and speed performances (Ozbar et al. 2014). No single plyometric exercise has been shown to be more effective than any other is, although a variety appears to be better than one exercise alone.

Sprint running is described in three phases: an acceleration phase, a maximum speed phase, and a maintenance phase (Delecluse et al., 1995; Button, &Glaister, 2007).

The ability to developmaximal sprint speed in a short time may be of greatest significance when sprint efforts are of short duration.

The athlete's ability to accelerate is dependent on factors such as running technique (kinematics) and the force production of the lower limb musculature (Cronin et al., 2008). Understanding the athlete's abilities allows coaches to design training exercises that use applied forces as resistance to improve force production while running different distances. Coaches and athletes use weighted vests, sleds, parachutes, tires and bungee cords regularly to improve leg strength and force production; however, the use of these objects may change sprint kinematics (Cronin, Ogden, Lawton, & Brughelli, 2007).

"The benefits of plyometric for sprint performance are expected to be the greatest at the velocity of muscle action that most closely approximates the velocity of muscle action employed in training. Therefore, it has been suggested that the greatest effects of plyometric on speed occur in the acceleration phase, since the velocity of muscle action in bounding. Plyometric exercises most closely approximate the velocities of muscle action in the acceleration phase of the sprint."

Delecluse and colleagues (1995) found that training with heavy weights and low repetitions allowed the participants to increase sprint speed over short distances; however, a study performed by Faigenbaum, et al., (2007) researched the effects of plyometric exercise was more beneficial in improving strength and sprint times(Speed).

Faigenbaum, et al., (2007) hypothesized that six weeks of training the early pubertal boys with a plyometric training program would lead to greater improvements in fitness performance. Plyometric training, that includes movement specific plyometric exercises, would improve maximum running speed.

The results found by Delecluse, et al., (1995), showed that plyometric training increased the participants' strength levels, but the effect on sprint performance was only significant when compared to the passive training group. In addition, plyometric training was more efficient in improving initial acceleration and final sprint time.

Plyometric training enhancing hip, thigh power and speed by increase the explosive capacities of the athlete (Bosco, 1982). O'Shea (1985) believes that the dynamic nature of this training is highly conductive to enhancing neuromuscular efficiency (e.g. facilitating the stretch reflex). This turn allows for excellent transfer of power to other biomechanically similar movements that require a powerful thrust from the hips and thighs, such as running.

Training programs that have utilized plyometric exercise have been shown to positively affect performance in power related movements such as running speed (Cluter 1983; Rimmer&Sletver,2000). Improved muscle performance dueto plyometric training program also be due in part to increased motor unit functioning.

The speed of sprint and whether or not the athlete is accelerating may affect the degree to which elastic energy storage and/or stiffness are important for speed performance. In respect of speed, Cavagna (2006) found that the increase in stretching velocity of the hip extensors and knee flexors in the terminal swing phase of sprint running increases with increasing speed. This implies that the elastic elements of the muscle-tendon units contribute more to force production at faster running speeds. Thus, it might be expected that plyometric training methods that help improve elastic energy storage might help improve speed performance to a greater degree at faster speeds than at slower speeds.

2.8 Plyometric training Program Design

Plyometric exercises are specialized and very intense training techniques, which are used to develop muscular power, referring to the relationship between strength and speed.

Plyometric is a mixture of intensity, speed and strength to develop explosive power to enhance athletic performance. Plyometric training is mainly short, explosive, actions that improve reaction increasing strength, power, speed, quickness, agility and weight-loss if performed quickly in circuits.

A systematic and progressive plyometric training program is a vital component of any integrated training program. As plyometric- training is one of the more advanced training tools, the athlete

needs proper levels of flexibility, core strength, and balance before progressing into plyometric training.

Sports Performance Professionals must follow very specific program guideline , proper exercise selection criteria, and detailed program variables for the best outcome and lowest risk of injury.

Guidelines to Follow:

1. Plyometric Exercises should be performed at 100% effort. Plyometric training is an Alactic Energy System exercise.

2. Each set should last no longer then 6 to 8 seconds.

3. Full recovery should occur between sets.

4. Plyometric exercises should be progressive in intensity. Start with easy exercises and develop in intensity and complexity.

5. The skill and speed of performing a plyometric exercise is of great importance. Stop before fatigue breaks down technique.

2.8.1 Lower Body Plyometric Exercise

These are appropriate for virtually any athlete and any sport. Direction of movement varies by sport, but many sports require athletes to produce maximal vertical or lateral movement in a short amount of time. There are a wide variety of lower body drills with various intensity levels and directional movements.

2.8.2 Drills to developing explosive leg strength

1 Jump to Box

The focus of this exercise is to increase a runner's ability to produce as much force as possible. Producing more force increases running speed.

2 Standing Long Jump

The focus of this exercise is to increase a runner's ability to produce as much force as possible, this time in a (mostly) horizontal direction.

3 Single-Leg Push Off

The focus of this exercise is to increase a runner's ability to produce as much force as possible, this time with just one leg at a time because at no time when running are both feet on the ground.

4 Two-Foot Ankle Hop

The focus of this exercise is to decrease the amount of time a runner's feet are in contact with the ground. The less time on the ground contact, the faster the runner.

5 Bounding

The focus of this exercise is to combine all of the previous characteristics into a running-specific exercise. Maximal force is produced in a minimal amount of time in a horizontal direction off one foot at a time. So get out there and run, but make sure you add plyometric training to improve your running speed and efficiency.

2.8.3 Upper Body Plyometric Exercise

Drills include medicine ball throws, catches, and several types of push-ups. Trunk Plyometric Exercises for the trunk may be performed "plyometrically" provided that movement modifications are made. Specifically, the exercise movements must be shorter and quicker to allow stimulation and use of the stretch reflex. The slide shows a plyometric sit-up. The relatively small range of motion and quick movement in this exercise may increase abdominal muscle activity through use of the stretch reflex.

- **Intensity**

Plyometric intensity refers to the amount of stress placed on muscles, connective tissues, and joints. Primarily the type of plyometric drill controls it. Generally, as intensity increases, volume should decrease.

- **Frequency**

Forty-eight to 72 hours between plyometric sessions is a typical recovery time guideline for prescribing plyometric. Using these typical recovery times, athletes commonly perform two to four plyometric sessions per week. For this study, students were preform three plyometric sessions per week.

- **Recovery**

Recovery for depth jumps may consist of 5 to 10 seconds of rest between repetitions and 2 to 3minutes between sets. The time between sets is determined by a proper work-to-rest ratio (i.e., 1:5 to 1:10) and is specific to the volume and type of drill being performed.

Drills should not be thought of as cardiorespiratory conditioning exercises but as power training. Furthermore, drills for a given body area should not be performed two days in succession.

- **Volume**

For lower body drills, plyometric volume is expressed as contacts per workout (or in distance for bounding drills). For upper body drills, plyometric volume is expressed as the number of throws or catches per workout. Recommended lower body volumes vary for athletes with different levels of experience.

- **Program Length**

Currently, most programs range from 6 to 10 weeks; however, For this study the researcher used 8 weeks plyometric training length. Speed performance improves as quickly as eight weeks after the start of a plyometric training program.

- **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).

2.9 Implementation of plyometric training

Plyometric training was implemented by dividing the exercise in to three-exercise part.

1.Plyometric Stabilization Exercise

Exercises in the stabilization level of plyometric training involve little joint motion. They was designed to establish optimum landing mechanics, postural alignment, and reactive

neuromuscular efficiency. Upon landing, the athlete should hold the landing position (or stabilize) for 3–5 seconds before repeating.

2. Plyometric-Strength Exercise

In the strength level of plyometric training, exercises are more dynamic, requiring eccentric and concentric movement throughout the full range of motion. The specificity, speed, and neural demand are also progressed within this level.

Exercises in this level are designed to improve dynamic joint stabilization, eccentric strength, rate of force production, and neuromuscular efficiency of the entire human movement system. These exercises are performed in a more repetitive fashion by spending a shorter amount of time on the ground.

3. Plyometric Power Exercises

In the power level of plyometric training, exercises involve the entire spectrum of muscle actions and contraction velocities important for integrated, functional movement. These exercises are designed to improve the rate of force production, eccentric strength, reactive strength, reactive joint stabilization, dynamic neuromuscular efficiency, and optimum force production. These exercises are performed as fast and as explosively as possible.

CHAPTER THREE

Research Design andMethodology

This chapter mainly focuses on the methods of the study, research site, population, sample and sampling method, data collection instrument, reliability and validity,and method of data analyses.

3.1 Methodological Approach

In educational research, there are two main types of methodological approaches: quantitative and qualitative (Best & khan, 1993).Quantitative research is categorized to in three; Experimental, quasi-experimental and non- experimental designs. For the purpose of this study, the researcher used quasi-experimental design. The main distinction between experimental and quasi-experimental research lies in the assignment of students to groups. In traditional experimental research, students are assigned (allocated) to groups through randomization to minimize bias.But the quasi-experimental are often used precisely since such random assignment is not always possible or practical. Quasi-experimental is used mainly when it is impossible to conduct true experiment research because of research ethics. Quasi-experimental design looks a bit like an experimental design, but it lacks the key ingredients of random assignment. Quasi- experimental research involves the use of intact groups of subjects in an experiment rather than assigning subjects at random to experimental treatments(Trochim,2006). Due to this, the method preferred for this study was quantitative as the purpose of the research was to examine the effect of plyometric training on speed performance.

3.2 Research design

This study examined the effect of plyometric training program on speed performance amonghigh school students during teaching physical education practical class. The research design used for this study was, thus quantitative and quasi-experimental. Under different forms of quasi-experimental deign the researcher focused on pre-test and post-test with 100m sprint runand analyzed to examined the effects of plyometric trainingprogram on speed performance among high school students during teaching physical education practical class.

Therefore, in order to see the significance of difference between pre-test and post-test and to achieve the intended objective; the researcher selected quantitative methods since the goal of quantitative methods is to determine whether the predictive generalization of a theory is true. Before applying experimental interventions for the experimental group and comparison groups, a pre-test was administered and post-test wasconducted at the end of the intervention.

3.3Populationand Sample

3.3.1 Population of the study

The total number of grade nine students is 560. There were 14 sections each containing 38-42 students whose age lay between 14 and 19.Since the number of sections was large it was not possible to include all of them in this experimental study. Because, it was too difficult to control and addressed by the researcher to give treatment for all of those sections. So, the researcher used systematic sampling to select the participant of the study.But, the whole grade nine students at Bethlehem secondary school constitutes the population for the study.

3.3.2 Target population of the study

The target population for this particular research was Bethlehem secondary school. From this school the study was conducted on grade nine students. From among the grade nine students, two intact classes were used to set the target population for the study.

3.3.3 Sample size

The participant of the study were grade nine students .There were 14 sections in the school with mixed abilities in each class and their average age lies between 14 to 19 years. After discussion with the school participial and homeroom teachers of all grades, two intake classes were selected by using systematic sampling methods. The researcher has used such sampling methods, because the researcher has been selected the sample by regular intervals. That is to select two sections from the list of 14 sections, arrange all sections in specific order and select the seventh one after selecting the first randomly.

Again, out of two sections, one class was assigned to be experimental group and the other class was assigned to comparison group by lottery method. Before treatment was administered, pre-test has given to both groups. For the experimental group plyometric training was given whereas for comparison group not treatment of plyometric was given.

Moreover, from the total number of grade nine students,56 sample size were selected for this particular study. As a result the researcher divided them equally between experimental and comparison groups; such as28 and 28 respectively.

The total number of male and female students in both group was 18,10 and 18,10 respectively. This was helpful for the researcher to analyze at the end of the study

3.4 Data collection procedures and instrument

3.4.1 Data collection procedures

Theparticipants of the study were grade nine students with average age between 14 to 19 years. There were 14 sections in the school with mixed ability in each class. After discussion with the school principal and homeroom teachers of all grades, two intact classes were identified randomly for this study from the fourteen sections.

Again, out of the two selected sections, one class was assigned to be the experimental group and the other class was assigned to comparison group by lottery method. Before treatment was administered pre-test was given to both groups. For the experimental group plyometric training was givenwhereas for comparison groupno treatment of plyometric training was given.

The sample studied consisted of 56 students. Of the 56 in the total sample, 28 students of the treatment group underwent the plyometric training for 8 weeks.

3.5 Data Collection Instruments

Research instruments are the basic tools to gather data to seek possible solution for the observed problems. The researcher developed pre-test and post-test for both the experimental and comparison groups that enable the researcher to compare the students' improvement of speed. Pre- test and post-test prepared by the researcher should address the effect of plyometric training to speed.Speed test was conducted for this purpose. To this end, the researcher used stopwatch to measure speed.

3.6 Validity and Reliability of instrument

Reliability and validity are critically important in conducting research. To this effect, the reliability and validity were addressed as follows.

A) Reliability of Instruments

According to Temesegn (2008) the basic idea of reliability is summed up by the word consistency.Likewise, as Trochin (2006) asserted, does the instrument measure consistently over a time? perhaps the best way to look at reliability is the extent to which the measurements resulting from a test are the result of characteristics of those being measured.For this study, the reliability of the instrument was checked by using SPSS software through the calculation of Cronbachaplha.To this effect, the reliability of pre-test and post-test was checked using coefficient of alpha cronbach, where the coefficient of alpha cronbach of the pre-test was .64 and the post-test was .67 both of which are meaningfully ensuring acceptable reliability.

B) Validity ofInstrument

Temechegn (2008) states that validity looks at whether the instrument measures what it was intended to measure or to elicit accurate information.Pre- test and post-test prepared by the researcher should address the effect of plyometric training to speed.Speed test was ensured for face validity, by using stopwatch as a tool for measuring time. Therefore, the researcher used stopwatch to measure speed of the participants. In order to control measurement error, the researcher used three times successive records with in two-days interval and took the average of this three recorded speed at pre-test, and also the same procedure was used to record the post-test of speed.

3.7 Method of data Analysis

The researcher used descriptive data analysis method. Descriptive statistical analysis is concerned with numerical description of pre-test and post –test of speed. Inferential statistical analysis is also computed forthe correlation between variables and to measure difference of valuesby using t-test. The data scores that were obtainedfrom pre-test and post-test were presented in the tabular form for the purpose of interpretation. To interpret data the mean score, standard deviation and mean difference were computed for each of the groups of interest. The significance of different between the mean scores and the mean difference of both the experimental group and comparison groups on the variable of the pre-test and post-test scores was tested at $\alpha = .05$ levels.

There are wide varieties of effect size measures around but for this particular study, the researcher used Cohen's d in conjunction with the t-test. The formula for this effect size is as follows:

D= (Mean for group A-Mean for group B)/pooled standard deviation

Where: pooled standard deviation=$\frac{\sqrt{(n_{A-1})SD_a^2+(n_B-1)SD_b^2}}{n_{a+}nb_{-2}}$

There are some guidelines for determining whether our effect size is strong. Cohen (1988) suggests the following:

0-.20 =weak effect

0.21-0.51=modest effect

0 .51-1.00=moderate effect

>1.00 =strong effect

The researcher found the mean scores of the students' results in both groups on the pre-test and the post-test, and used t-test and ANOVA to compute and analyze the results. The data analysiswas carried out using the statistical package for social sciences (SPSS) version 20.0.

CHAPTER FOUR

Analysis and Interpretation of the Data

4.1 Introduction

This chapter presents the major finding of the study. The data are organized in tabular form and they are analyzed to check the research hypotheses with identified effect of plyometric training on speed during teaching physical education practical class. The data were analyzed using the statistical package for social science (SPSS) version 20.0. This chapter includes different descriptive and inferential statistics such as mean score, standard deviation, t-test and ANOVA test.

4.2 Background and characteristics of participants of the experimental group

Table 4.1 Frequency table showing age of participants in theexperimental group

Category	Frequency	Percent
14-15	4	14.3
16-17	22	78.6
18-19	2	7.1
Total	28	100.0

As the above table shows in this study, 28 students participated in experimental group. Majority, 22 (78.6%) of them were between 16-17 years of age and 4 (14.3%) of the group were between 14-15 years age. The rest of the students, 2 (7.1%) participants were between 18-19 years age. This shows that each of the expected age groups are included in the study.

Table 4.2 Frequency table showing sex of participants of the experimental group

Category	Frequency	Percent
M	18	64.3
F	10	35.7
Total	28	100.0

As shown in the above table, 28 students participated in the experimental group of this study. Among these 18 (64.3%) participants were male and the remaining 10 (35.7%) of them were female participants.

4.3 Backgrounds and characteristics of participate of the comparison group

Table 4.3 Frequency table showing age of participant of comparison group

	Frequency	Percent
14-15	3	10.7
16-17	22	78.6
18-19	3	10.7
Total	28	100.0

As the above table shows in this study, 28 students participated in comparison group. Majority, 22 (78.6%) of them were between 16-17 years of age and 3 (10.7%) of the group were between 14-15 years age. The rest of the students, 3 (10.7%) participants were between 18-19 years age.

Table 4.4 Frequency table showing sex of participants of the comparison group

	Frequency	Percent
M	18	64.3
F	10	35.7
Total	28	100.0

As shown in the above table 28 students were participated in the comparison group of this study. Among these 18 (64.3%) participants were male and the remaining 10 (35.7%) of them were female participants.

4.4 General Description of the Data

The mean and standard deviation of the students' improvement of both groups are provided in table 4.5 below. For all statistical analyses, the 5% level of the significant was used throughout the paper.

The overall mean of pre-test experimental ($M_{pre.exp}$) and the mean of comparison ($M_{pre.compa}$)groups were $M_{pre.exp}$ =17.3700 and $M_{pre.compa}$=17.2589 , respectively where as the standard deviation of experimental group ($SD_{pre.exp}$) =0.73613 and the standard deviation of comparison group ($SD_{pre.comp}$) = 0.58401.

Similarly, the overall mean of post-test experimental ($M_{pos.exp}$) =16.0086 and the mean of comparison group ($M_{pos.comp}$) = 17.2889 where as the standard deviation of experimental ($SD_{pos.exp}$) and the standard deviation of comparison group ($SD_{pos.compa}$) were $SD_{pos.exp}$ =0.46052 and $SD_{pos.compa}$ =0.5677.

experimental and comparison groups

Category	SEX	N	Mean	Std. Deviation	Std. Error
Pre- test of experiment of group	Male	18	17.1522	.68668	.16185
	Female	10	17.7620	.68511	.21665
Total		28	17.3700	.73613	.13911
Pre-test of comparison group	Male	18	17.2783	.56681	.13360
	Female	10	17.2240	.564526	.20405
Total		28	17.2589	.58401	.11048
post -test of experiment group	Male	18	15.8756	.43881	.10343
	Female	10	16.2480	.41646	.13170
Total		28	16.0086	.46052	.08703
Post-test of comparison group	Male	18	17.3872	.55596	.13104
	Female	10	17.1120	.57370	.18142
Total		28	17.2889	.56777	.10730

4.5 Analysis of Data and Interpretation

At the very beginning it was useful to check difference between the mean scores of pre-test of experimental and comparison group. This helps the researcher to identify where students in both groups were equal in their speed of 100meter sprint run or not before intervention. Here, in order to test the following hypothesis, independent sample test was used.In order to test and compare mean score difference of pre-test of experimental group with the pre-test of comparison group, independent sample test was used.

H_0: There is no significant difference between the mean score of the pretest for experimental and comparison groups.

Table 4.6showing the mean score of the pre-test of the Experimental group and comparison group

	N	Mean(time in second)	Std. Deviation	Std. Error	T	df	Sign(2-tailed)
pretest of experiment group	28	17.3700	.73613	.13911	.625	54	.534
per test of comparison group	28	17.2589	.58461	.11048			

Table 4.6 shows the independent t-test of the mean scores of the pre-test of experimental group and comparison group. As we observe from the table of the independent samples t- test and the results given above, the mean of experimental group(M=17.3700) is greater than the mean of comparison group (M=17.2589), but, based on this descriptive statistics one cannot generalize that there is a significant difference between those two groups. According to result provided in table 4.6 there is no significant difference between the experimental group and comparison group on the mean score of pre-test. So far we need to find the value of independent t-test at $p< 0.05$ significance level.

In the table of independent t-test shown above the independent t test between experimental and comparison group on the pre-test is at $p< 0.05$. According to the speed test results given in table 4.6the value of $t(54) =.625$ with significance (2-tailed) of .534.

Thus, the result showed that there is no significance difference between the experimental and comparison group on the mean of the pre-test. So, the null hypothesis is accepted. This shows that both groups were almost similar in their speed at the beginning of the treatment given to students.

This result is supported by RadomirKostic (2008) who declared that the result of pre-test of speed does not provide significant difference between experimental group and comparison group.

As described above, the pre-test of the experimental group and pre-test of the comparison group were almost similar or there was no significant difference between experimental and comparison groups. Before given the intervention, students speed performance was almost similar. Even though, there was an individual difference of muscular strength, power and speed performance between students of experimental group and comparison group, this difference was not significantto depict difference between pre-test of the experimental group and pre-test of the comparison group. Therefore, at pre-test of the experimental group and the pre-test of comparison group students' speed performance was ensured to be similar.

In order to test and compare the mean score of the pre-test and the post- test of the experimental group, paired sample statistics was used.

H_0: There is no significance difference between the mean score of the pre- test and post -test for experimental group.

Table 4.7 Table showing Paired sample test of the mean scores of the pre-test and pots-test of experimental group

	N	Mean	Std. Deviation	Std. Error	T	Df	Sign(2-tailed)
Pre- test of experiment group	28	17.3700	.73613	.13911	13.517	27	.000
post-test of experiment group	28	16.0086	.46052	.08703			

Table 4.7 shows the paired sample test of the mean score of the pre-test and post- test for the experimental group. The paired t-value between the pre-test and post-test of the experimental group shows a value of t (27) =13.517 with sig (2-tailed) = .000. Thus result showed that there is significant difference between the mean scores of pre-test (M=17.3700) and that of post-test mean (M=16.0086) of the experimental group. Therefore, we evidence to reject the null hypothesis and accept the alternative one at $p < .05$. Here, the effect size of plyometric training on speed improvement of students d =2.217 implies plyometric training has very strong effect. This shows that the training induced a significant improvement in speed. This result is supported by Chilly et.al (2010), who reported that plyometric training induced a significant increase in thigh muscle volume and a significantly increase in running speed.

Bosco (1982) stated that plyometric training enhancing hip, thigh power and speedby increasing the explosive capacities of the athlete's. Equally, Ozbar et al. (2014) supported this by stating plyometric training (PT) has positive effects on peak power, jumping and speed performances.

Cavagna (2006) found that the increase in stretching velocity of the hip extensors and knee flexors in the terminal swing phase of sprint running increases with increasing speed.

This implies that the elastic elements of the muscle-tendon units contribute more to force production at faster running speeds.

Thus, plyometric training methods that help improve elastic energy storage might help improve sprint-running performance to a greater degree at faster speeds than at slower speeds. Similarly, this result goes with result of other studies such as Chimera,et.al., (2004)andDelecluse, et.al.,(1995).

Therefore, the researcher decided that the experimental group achieved the best results on the post-test as compared to the pre-test of experimental group in a test for the 100m run speed test. This is due to the effect of plyometric training. Plyometric-training increases the muscle strength, explosive power of leg, power, interaction of nerve system and activation of motor units, the combination of this increase the speed performance of student. AccordingtoZatsiorsky, (1995) plyometric training is much focused activity, which requires a high resolution of interaction with the nervous system. By Matavulj,etal., (2001) the importance of plyometric exercise through improving each component of muscle strength and speed at the same time and that show the explosive form. Therefore, the plyometric exercises are factors, which led to increase the explosive power of the legs, especially in running speed, where research results have shown that plyometric training is impressive and effective way to improve the strength and movement of speed.

In order to test the hypothesis and compare the mean difference or mean gain of the pre- test and post –test of experimental group and pre-test and post-test of comparison group, paired sample test was used.

Table 4.8Mean difference of the pre-test and post- test of experimental group and pre-test &posttest of comparison group

	Paired Differences			T	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean			
pretest of experiment group - posttest of experiment group	1.36143	.53255	.10064	13.527	27	.000
per test of comparison group - posttest of comparison group	-.03000	.49574	.09369	-.320	27	.751

Here the result was analyzed to determine the change of improvement in speed as a consequence of plyometric training and assess whether plyometric training has effect on mean difference of pre-test and post-test of experimental group and pre-test and post- test of the comparison group.

The mean difference of the pre-test and post-test or mean gain of experimental group was 1.36143 whereas that of comparison group was -.03000.

These indicated that there is high significant difference between experimental and comparison group. In the above table the mean difference of pre- test and post- test of experimental and comparison group shown that the t- value between experimental and comparison group on at $p<.05$.The result shows that a value of $t(27)=13.527$ with significance level at 2-tailedfor experimental group.

For comparison group result shows that a value of t(27)=-.0320 with sign (2-tailed)=.751.This result showed that there is no significance improvement of speed in pre-test to post-test in the comparison group. However, when we see the experimental group there is significant difference between pre-test and post-test of the mean score of the experimental group. That means, highly improvement of speed of 100m run form pre-test to post-test.

There for we have confidence to reject the null hypothesis at $p<.05$.Thus the result showed that there is a significant mean difference or improvement of speed in pre –test to post-test of experimental group.

According to Delecuse,et.al.,(1995) and Faigenbaum, et.al., (2007) who investigated the only training groups to significantly improve the overall time or speed in 100m run when compared to the other testing groups. Similarly, this result was supported by other studies such as Collegues (2007); Edwards (2012) who found same finding.

Training programs that have utilized plyometric exercise have been shown to positively affect performance in power related movements such as running speed Cluter,(1983); Rimmer&Sletver,(2000). Therefore, the experimental group achieved the best results compared to the comparison group in a test for the 100m run speed test.

As shown in the above table the mean gain of experimental groups is $M_{pre} - M_{post}=1.361443$. This improvement of speed comes by plyometric training. Plyometric training used to increase hip, high power and speed by increasing explosive capacities of athletes. So, students become muscularly fit,increase activation of motor units and become powerful. Therefore there is significant improvement of speed from pre-test to post tests of experimental group.

In order to test the hypothesis and compare the mean score differences of the pre- test and post - test of the experimental group with respect to sex independent sample test was used.

H_0: There is no significance difference between male and female students of experimental group of the mean score of pre-test and as well as the post-test.

Table 4.9 showing independent sample test of the mean score of the pre-test and post-test for male and female students of the experimental group.

	SEX	N	Mean	Std. Deviation	Std. Error Mean	T	df	Sign(2-taied)
pre -test of experiment group	M	18	17.1522	.68668	.16185	-2.253	26	.033
	F	10	17.7620	.68511	.21665			
Post- test of experiment group	M	18	15.8756	.43881	.10343	-2.190	26	.038
	F	10	16.2480	.41646	.13170			

Table 4.9 showed the independent sample test of the mean score of the pre-test and post-test for male and female students of the experimental and comparison groups. For male students the mean score of the pre-test was17.1522 and for female students the mean score of pre-test was 17.7620 on the experimental group. Equally, the post-test of male students mean score was 15.8756 and for female students the mean score of the post-test was16.2480.

As presented in table 4.9 the independent sample test of mean scores of the pre-test and post-test for male and female students of the experimental group is $p< .05$.

The result showed that a value of t (26) =-2.253 with sign (2 tailed) =.033 for pre-test of both male and female students of experimental group. Thus, result showed that there is significant difference between male and female students in pre-test of the mean score of the experimental group. In the same manner the post-test value of t (26) =-2.190 with sign (2-tailed) =.038 for both male and female students which implies that there is also significant difference between mean score of the post-test 15.8756 for male and 16.2480 for female students respectively of the experimental group.

This shows that the speed of male students' is faster than the speed of female students' in both pre-test and post-test of experimental group. One would declare that plyometric training did not bring any difference to equate female students with those of males in their speed, but was found to enhance the speed irrespective of sex.

But, the higher effect size on females as presented below might show that the training is more effective on females than males. Should, training time be changed to bring about significant change on females requires further study.

The effect size of plyometric training to speed for female students improvement effect size d=2.75 and for male students d=2.27 which implies that both the effect size are very strong effect. Thus, result showed plyometric training is important for improvement of speed performance.

In order to test the correlation coefficient of pre-test and post-test of experimental group, Pearson correlation was used.

Table 4.10 showing Correlation of pre-test and post-test of experimental group

	N	Correlation	Sig.
pretest of experiment group & post-test of experiment group	28	.694	.000

From the above table, the correlation coefficient of pre-test and post-test of experimental group is r=.694. This result showed high relationship between pre-test and post-test score of speed and direct or positive relationship between plyometric training and improvement of speed. According to Ozbar,et.al., (2014) plyometric training has positive effects on peak power and speed performance.

Paule,et.al., (2003) also stated that plyometric training increase power out andspeed performance. Therefore, the relationship between plyometric training and speed performance is direct or positive.

Therefore plyometric training has a positive effect on speed improvement during teaching physical education practical session.

In order to test the second hypothesis and compare the mean score of the pre-test and the post-test of the comparison group, paired sample statistics was used.

H_0: There is no significant difference between the mean score of the pre-test and the post-test for the comparison group.

Table 4.11 showing paired sample test of mean scores of the pre-test and post -test of the comparison group.

	Mean	N	Std. Deviation	Std. Error	t	df	Sign(2-tailed)
Per- test of comparison group	17.2589	28	.58461	.11048	-.320	27	.751
post-test of comparison group	17.2889	28	.56777	.10730			

The table 4.11 showed the paired sample test of mean scores of the pre-test and post-test of the comparison group. As can be observed from the table above, even though there is a few difference, the mean scores of the pre-test (M=17.2589) and post-test of the mean score (M=17.2889), which is not statistically significant different from pre- test to post-test of the comparison group.

Since the paired test t value between pre-test and post-test of comparison groups showed that a value of t(27) =-.320 with sign (2-tailed)=.751> 0.05. Therefore the result showed that there is no significance improvement of speed between the mean scores of the pre-test and post-test of the comparison group. According to Cronin (2012) the students in comparison group did not gain improvement of speed scores from the pre-test to the post-test, during 100m run which is in agreement with this study.

As the shown in the above, there is no significance difference of speed between pre-test and post-test of the comparison group.

This is so due to lack of plyometric training. If, students did not do plyometric exercise properly, they could not develop muscular strength, explosive power of leg, activation of motor unit, power output and the combination of this decrease speed performance. So, students need to do plyometric training if they need to significantly improve their speed performance.

In order to test and compare to the mean score difference or mean gain of the pre-test and the post-test of comparison group, paired sample test was use.

H_0: There is no mean score change pre-test and post-test of or mean gain score of the comparison group.

Table 4.12 showing Mean score difference of the pre-test and the post-test comparison group

	Paired Differences			T	df	Sig. (2-tailed)
	Mean difference	Std. Deviation	Std. Error Mean			
Pre-test of comparison group- Post -test of comparison group	-.0300	.48324	.09132	-.320	27	.751

Table 4.12 shows the paired sample test of the mean score difference of pre-test and post- test of the comparison group. The result showed that a value of t (27) =-.320with sig (2-tailed) =.751. Thus, the result has showed that there is no significance improvements of speed in 100m run the pre-test and post-test of the comparison group. Therefore, there is no improvement of speed from pre-test to post test.

The results show that the mean gain of the comparison group were-0.0300. This indicated that there is no significance difference between pre-test and post-test of the comparison group.

Since there is no improvement of speed performance from pre-test to post-test of the comparison group, rather, it implies that the speed performances of the students' were slightly declined. This occurred because of different factors.

- The first factor for the decline in speed performance was the training method that they used. i.e, they did not use properly.
- The students' did not do plyometric training properly.
- Calorie intake and calorie expenditure was not balanced. This is because of the fact that calorie intake is greater than calorie expenditure which in turn led to unnecessary accumulation of fat. So; this goes to increase of body weight. Any unnecessary body fat will slow an athlete down.

  The main cause of excess body fat is poor nutrition and unbalanced calorie intake and calorie expenditure; this must be attended to for an athlete to perform to their maximum.

Therefore, as the researcher mentioned the students speed performance become slightly declined; or, there is no improvement of speed performance between pre-test and post-test of the comparison group.

In order to test and compare the mean score difference of pre-test and post -test of the comparison group with respect to sex; independent sample test was used.

H_0: there is no significance difference between mean score of pre-test and post-test of male and female students of comparison group.

Table 4.13 showing independent sample tests of mean score of the pre-test and post-test for male and female students of the comparison group.

	SEX	N	Mean	Std. Deviation	Std. Error	t	Df	Sign(2-tailed)
Per- test of comparison group	M	18	17.2783	.56681	.13360	.231	26	.819
	F	10	17.2240	.64526	.20405			
Post-test of comparison group	M	18	17.3872	.55596	.13104	1.241	26	.226
	F	10	17.1120	.57370	.18142			

The table 4.13 showed the independent sample test of the mean score of pre-test and post-test for male and female students of comparison group. For male students of pre-test mean score were 17.2783 and for female students of the mean score of pre-test were 17.2240.

For male student the mean score of post-test were17.3872 and for female students the mean score of post-test were 17.1120.

From the above table 4.13one can see the independent sample test of mean scores of the pre-test and post-test for male and female students of the comparison group at $p < .05$.

The result showed that a value of t (26)=.231 with significance (2-tailed)=.819 for pre-test of both male and female student. Thus, the result shows that there is no significance difference between mean score of pre-test of male and female students of comparison group.

When we saw the mean score of the post-test of both male and female students, the value of t(26)=1.241 with significance (2-tailed)= .226. This implies that there is no significant difference between the mean score of post-test of male and female students of comparison group. Therefore the speed performance did not show to vary between sexes.

The other test employed was to find out whether there is a mean score difference between the post-tests of comparison group and experimental group. This might lays a base for researcher to see whether both groups are the same or not after intervention.

H_0: There is no significance difference between the mean of the post-test of the experimental group and pots-test of the comparison group..

Table 4.14 showing independent sample test of mean sore of post-test of experimental and comparison group.

	Group	N	Mean	Std. Deviation	Std. Error Mean	T	df	Sign(2-tailed)
post test	Experimental	28	16.0086	.46052	.08703	-9.267	54	.000
	Comparison	28	17.2889	.56777	.10730			

As shown in the table 4.14, the descriptive statistics presents difference in the mean scores between those of experimental and comparison groups.

However, we cannot generalize that there is a significance difference of improvement in speed between the two groups. So, we need to find the value of independent t-test at $p<.05$.

Accordingly, an independent samples t-test was performed from which the mean score of experimental group ($M_{pos.test.exp}$)=16.0086 is less than the mean score of comparison group post-test=17.2889.That means the experimental group has shown significant improvement in their speed than the comparison group.

The above tables 4.14 showed the independent test t value the mean score of the post-test of experimental group and post-test of the comparison groups. The result showed that the value of t (54) =-9.267 with significance (2-tailed) =.000.

Thus, the result showed that there is significantdifference between the post-test of the experimental group and post -test of the comparison group.

Therefore, the experimental group had shown significant improvement of speed than comparison group. This implies that plyometric training has an effect of speed improvement of the students in 100m run.

This result is supported by Adams,et.al.,(1992) and Ionnis, et.al., (2000) who concluded that after treatment the post-test of experimental group shown a significant improvement of speed than the post-test of comparison group. According to the studies of Delecuse, et.al., (1995) and Faigenbaum, et.al., (2007) which investigated the only training groups to significantly improve the overall time or speed in 100m run when compared to the other testing groups used in their study.

Hence, plyometric training method in the physical education and sports classes at the secondary schools on the experimental sample had a positive impact in improving the ability to upgrade and forward speed performance. The students have an important physical attributes for practitioners of the 100m run speed.

The plyometric exercises elaborate to improving the movement energy and elastic energy that have a significant impact on the ability of the explosive development by prolongation and dereliction of muscle fibers cycle. Therefore, the experimental group achieved the best results compared to the comparison group in a test for the 100m run speed test.

Thus, plyometric are especially useful for track and field athletes. Plyometric raise the force and speed of muscle contractions, leading to higher explosive power that is needed in sports activities. Since plyometric training can boost running speed, performance can improve a lot.

Even if someone is involved in an activity that does not involve running, plyometric can still help because it is better at throwing farther or punching harder. Plyometric training can help one to achieve almost all athletic goals. In addition, through plyometric training, the strength of arm and leg muscles would be enhanced by a higher rate of force development, thereby guaranteeing a rise in muscular power and force.

CHAPTER FIVE

Summary, conclusion and Recommendation

5.1 Introduction

The purpose of this study was to investigate the effect of using the plyometric training on speed performance among grade nine students. This chapter presents the summary of finding, conclusion and recommendations of the study.

5.2 Summery of the findings

The findings of the study are summarized as follows:

- There is no significant difference between the mean score of the pre-test of the experimental group and the pre-test of the comparison. This helped the researcher to know the background ability of the students speed performance. In this case both students of the experimental and comparison groups had almost equal speed performance background ability.

- There is a significant difference between the mean score of the pre-test and post-test of the experimental group. This implies that, plyometric training had strong effect on the improvement of students speed performance. With respect to sex, the mean score of female and male students and their improvement level showed a significant difference between female students and male students and the effect size of both male and female students has strong effect on the improvement of speed performance.

- There is no significant difference between the mean scores of the pre-test and post-test of the comparison group. As well as with respect to sex and improvement level there is no significance difference between them at $p<.05$.

- There is a significance difference between the post-test of the experimental and the post-test of the comparison group.

- Plyometric training has a strong effect on the students' improvement of speed performance. Additionally there is a significant difference between the mean gain score of the experimental group and the comparison group.

5.3 Conclusion

Physical strength is one of the great influential for speed performance. Plyometric exercise one of the strength exercises that used to students and athletes to improve speed performance. It helps for students and Athletes to improve their speed performance. It also helps teachers not only in teaching physical education but also to training short distance or sprint runner athletes.The training groups improved speed performance from pre-test to post-test with in eight weeks of plyometric training.

There is no significant difference of pre-test and post-test was observed between comparison groups. I could be suggested that plyometric training can help students and athletes improve their speed performance. Based on the information from this study it may be important for peoples involved in sprinting, coaching, teachers and other sports to understand that a shorter amount of time for training can used improvement of speed performance.

Generally, it is good and fruitful if more research is done on this issue and applicable in our country in order to improve the speed performance of the sprint run athletes and students.

5.4 Recommendations

The findings from this study have generated new ideas that could be of interest to individuals involved in athletics, training, physical education, and in sports, which require sprinting. This study could also provide information to coaches and athletes about training programs that will improve speed performance in the 100 m sprint.

Based on the results of the findings the researcher forwards some suggestions and recommendations as follows.

- Teachers and coaches use plyometric training to improve students speed performance.
- The study only focused on the students speed performance. This means there is a need to consider the effect on other attributes like athletes.
- The school principal should be fulfill necessary equipment's for the training session
- The length of the current study was only eight weeks of plyometric training. The researcher recommends studying the case at extended length of training week.
- In this study, there was nutritional factor during the training session. Therefore, the researcher recommends further studies by controlling this nutritional factor.

References

Adams, K., O'Shea, J.P., O'Shea, K.L., &Climstein, M. (1992). The effect of six weeks of squat, plyometric and squat-plyometric training on power production

Adams, T.M., Worley, D., &Throgmartin.D. (1984). An investigation of selected plyometric trainingexercises on muscular leg strength and power

Alcaraz, P. E., Palao, J. M., Elvira, J. L. L., &Linthorne, N. P. (2008).Effects of three types of resisted sprint training devices on the kinematics of sprinting at maximum velocity;*Journal of Strength and Conditioning Research*

Blazevich, A. J., & Jenkins, D. G. (2002). Effect of the movement speed of resistance training exercises on sprint and strength performance in concurrently training elite junior sprinters*Journal of Sport Sciences*

Brandon Leigh (2010); Anatomy for strength and fitness training for speed

Chelly, M. S., Ghenem, M. A., Abid, K., Hermassi, S., Tabka, Z., & Shepard, R. J. (2010). Effects of in-season short-term plyometric training program on leg power, jump- and sprint performance of soccer players. *Journal of Strength and Conditioning Research, 24,* 2670-2676.

Chimera, N. J., Swanik, K. A., Swanik, C. B., & Straub, S. J. (2004). Effects of plyometric training on muscle-activation strategies and performance in female athletes; *Journal of Athletic Training*

Chimera et al., (2004) in a pre-test to post -test control group design with 20 healthy Division I female Athletes, found that a 6-week plyometric training program improved

Conroy, T.R. (1998). Plyometric training and its effects on speed, strength, and power of intercollegiate athletes ;*New Studies in Sport Magazine*

Cronin, J., & Hansen, K. (2005). Strength and power predictors of sports speed. *Journal of Strength and Conditioning Research*

Cronin, J., Hansen, K., Kawamori, N., & McNair, P. (2008). Effects of weighted vests and sled towing on sprint kinematics;*Sports Biomechanics*

Cronin, J. B., Ogden, T., Lawton, T., &Brughelli, M. (2007). Does increasing maximal strength improve sprint running performance? Strength and Conditioning Journal, 29(3), 86-96.

Delecluse, C., Van Coppenolle, H., Willems, (1995). Influence of high-resistance and high-velocity training on sprint performance; *Medicine and Science in Sports and Exercise*

Gambetta, V. (1986).*Principles of plyometric training*

G., Sanders, R., Button, C., &Glaister, M. (2007). The effect of periodized resistance training on accelerative sprint performance; *Sports Biomechanics*

Green berg, &Jerrolds (1995). Physical fitness and wellness

Hewett TE, Stroupe AL, Nance TA et al(1996). Plyometric training in female athletes decreased impact forces and increased hamstring torques

Kawamori & Haff, (2004) .Weight and plyometric training: effects on eccentric concentric force production *Canadian Journal of Applied Physiology*

Kotzamanidis, C(2006). Effect of plyometric training on running performance and verticalJumping in prebubertal boys

Khorrami, 1997, C. Effect of plyometric training on running performance and jumping , *Journal of Strength and conditioning research*

Lachance, P.F. (1995). Plyometric exercise

Luebbers PE, Potteiger JA, Hulver MW et al (2003). Effects of plyometric training and recovery on vertical jump performance and anaerobic power

Markovic G, Jukic I, Milanovic D et a(2007) Effects of plyometric training on muscle function and sprint athletic performance

Michael Yessis, (2009). **E**xplosive plyometric training

O'Shea, J.P.(1985).The Effects of Plyometric, Weight and Plyometric-Weight Training on Anaerobic Power and Muscular Strength

Paul E. L., Jeffrey A. P., Mathew W. H., John P. T.& Michael (2003). Effects of Plyometric Training and Recovery on Vertical Jump Performance and Anaerobic Power

Peason &Gehlsen,(1998) .Effects of a plyometric intervention program on sprint performance *Journal of Strength and conditioning research*

Rimmer, E., &Sleivert, G. (2000). Effects of a plyometric intervention program on sprintperformance.

Rumpfet **al.; (2014).** Effect of Different Training Methods on Running Sprint Times in Male Youth

Smirniotou, A., Katsikas, C., Paradisis, &G., Argeitaki, P. (2008). Strength-power parameters as predictors of sprinting performance;Journal of Sports Medicine and Physical Fitness

Verkhoshanski, T., &Tatyan, V. (1983). Speed-strength preparation of future champions

Yessis & Hatfied ,1986;The effects of plyometric training drills on the physical strength gains of collegiate football players Natl Strength Cond Assoc

Wilkerson et al.,(2004). In a quasi-experimental design with 19 female basketball players, demonstrated that a 6-week plyometric training program improved

Young, W. (2006). Transfer of strength and power training to sports performance;*International Journal of Sports Physiology and Performance*

Young, W., McLean, B., &Ardagna, J.(1995). Relationship between strength qualities and sprinting performance;*Journal of Sports Medicine and Physical Fitness*

Young, W. (2006). Transfer of strength and power training to sports performance; International Journal of Sports Physiology and Performance, 1, 74-83

Young, W., McLean, B., &Ardagna, J. (1995). Relationship between strength qualities and sprinting performance; Journal of Sports Medicine and Physical Fitness, 35, 13-19

APPEDEX A

Experimental Group Pre- Test and post Test of 100 meter Run in second

No	Student code	Six	Pre-Test	Post-Test	Change
1	E01	M	17.34	16.20	1.14
2	E02	M	16 .56	16.25	.31
3	E03	M	17.22	16.10	1.12
4	E04	F	17 .48	16.12	1.36
5	E05	M	18.12	16.08	2.04
6	E06	M	16.54	15.40	1.14
7	E07	F	18.10	16.58	1.52
8	E08	M	17.20	16.18	1.02
9	E9	M	16 .34	15.30	1.04
10	E10	F	17.46	16.28	1.18
11	E 11	M	16.34	15.16	1.18
12	E12	F	17.56	17.06	.50
13	E13	M	16.42	15.22	1.20
14	E14	F	17 .58	16.08	1.50
15	E15	M	16.48	15.40	1.08
16	E16	M	18.58	16.40	2.18
17	E17	M	17.12	16.10	1.02
18	E18	F	19.10	16.38	2.72
19	E19	F	18.20	16.20	2.00
20	E20	M	17.42	16.06	1.36
21	E21	F	18.24	16.20	2.04
22	E22	M	17.40	16.10	1.30
23	E23	M	18.26	16.07	2.19
24	E24	F	17.36	16.18	1.18
25	E25	M	17.42	16.14	1.28
26	E26	M	16.54	15.38	1.16
27	E27	F	17 .48	16.12	1.36
28	E28	M	16 .50	15.30	1.20

APPENDEX B

Comparison Group pre-test and post-test of 100-meter run in second

No	Student Code	Six	Pre-Test	Post-Test	Change
1	C01	M	17.46	17.50	-0.04
2	C02	M	16.58	17.02	-0.44
3	C03	M	17 .24	17.20	0.04
4	C04	M	18.24	18.30	-0.06
5	CO5	F	17.54	17.55	-0.01
6	C06	M	17.40	17.30	0.1
7	C07	M	16.58	16.59	-0.01
8	C08	M	17.36	17.40	-0.04
9	C09	M	16 .48	16.54	-0.06
10	C10	F	17.49	17.46	0.03
11	C11	M	17.37	17.39	-0.02
12	C12	M	16.59	17.34	-0.75
13	C13	M	16.52	17.01	-0.49
14	C14	M	18.10	16.53	1.57
15	C15	M	17.47	18.08	-0.61
16	C16	M	18.14	17.49	0.65
17	C17	F	17.35	18.20	-0.85
18	C18	F	18.22	17.37	0.85
19	C19	F	17.44	18.21	-0.77
20	C20	F	17 .35	17.45	-0.1
21	C21	M	16 .58	16.58	0
22	C22	M	17.24	17.25	-0.01
23	C23	F	18.13	18.12	0.11
24	C24	M	16.46	16.48	-0.02
25	C25	F	17.50	17.50	0
26	C26	F	16 .56	16.47	0.09
27	C27	F	17.38	17.36	0.02
28	C 28	M	16.48	16.50	-0.02

Declaration

I declare that the effect of plyometric training on speed performance during teaching physical education practical class in Bethlehem secondary school is my own work and that all the sources that I have used or quoted for reference are acknowledged.

ErmiasTilahun signature_____

Date 22/10/2016

This thesis has been submitted for the examiners with my approval as a university adviser

Kassa Michael (PHD) signature_____

Date _____

September 2016

Addis Ababa University