JIMMA UNIVERSITY

SPORT ACADEMY

DEPARTMENT OF SPORT SCIENCE

THE EFFECT OF EIGHT WEEKS PLYOMETRIC EXERCISE ON THE LOWER BODY PERFORMANCE OF SPRINT HURDLE AND TAEKWONDO: IN CASE OF ADDIS ABABA SPORT CLUBS

BY: MOTUMA GETACHEW

A THESIS SUBMITTED TO JIMMA UNIVERSITY SPORT ACADEMY DEPARTMENT OF SPORT SCIENCE IN PARTIAL FULFILMNT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN SPORT SCIENCE (ATHLETICS COACHING)

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JIMMA, ETHIOPIA

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APPROVAL SHEET

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Acknowledgments

First I would like to express my special thanks to almighty Holy Trinity our creator. I would like to forward my gratitude to Jimma University for giving me this golden opportunity to pursue my study. And my sincere appreciation to Dr. Asim Khan (PhD), Behailua.Z (MSc.) my thesis advisor and co advisor, for their constructive suggestions, critical comments and advice. Without their proper guidance, the study would never have seen in the light of today. I would like to appreciate Mr. Getahun Tadesse (MSc.), global master Geremwu, master Mohamed, Dr. Tefera Tadesse(PhD), Mr. Hailu Muleta (ass professor) Mr Mohamedamin Kediri, Mr Sagni Gobena (MSc.) Mr. Habetamu chairperson of oromia world taekwondo federation, Commercial Bank athletics club, Ethiopia and Oromia world taekwondo federation for their various types of contributions in advice, editing and moral support for the success of this thesis. My heartfelt thanks go to my parents, my sisters, my class mates for their material, financial and moral support in order to make this thesis successful. Eventually, I would like to thank my all friends, participant athletes in this study for their valuable encouragement and support during my study.

Acronyms and Abbreviation

SSC: Stretch Shortening Cycle

CMJ: Counter Movement Jump

ROM: Range of Motion

OAU: Organization of African Union

ECE: Economic Commission for Africa

SPSS: Statistical Package for Social Science

Abstract

The purpose of this study was to find out the effect of eight weeks plyometric exercise on the lower body performance of taekwondo and hurdling clubs. A quasi-experimental design was employed. The study subjects were selected from three Addis Ababa area (Commercial Bank of Ethiopia, Gere world taekwondo club, and Best world taekwondo club) using purposive sampling technique. Thus, the subjects in the study were athletes (n=40), coaches (n=4), and administrative staff of oromia world taekwondo federation (n=1). Data collection instruments such as Standardized fitness test, semi-structured interview and observation. The data gathered through Standardized fitness test were analyzed by using STATA version 14, then Independent sample t-test was used. The result of this study shows that there was statistically significant was observed between pre- test and post- test due to eight weeks plyometric training at P<0.05. The findings of this study show that eight weeks plyometric exercise had effect on the improvement of lower body power performance, leg explosive power, leg strength and flexibility of taekwondo and hurdlers. The researcher recommends to incorporate eight weeks plyometric exercise in to their annual training plan in order to improve power, flexibility and strength.

Keywords hurdle, taekwondo, plyometric, performance, power, explosive, strength, flexibility.

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CHAPTER ONE

INTRODUCTION

1.1. Background of the Study

Plyometric is a training method used by athletes in many types of sports like running, jumping and throwing events. This type of training which involves repeated rapid stretching and contracting of muscles to increase power is referred to as "explosive-reactive" power training (Bal, 2011). So, Plyometric is a training techniques used by athletes in all types of sports to increase strength and explosiveness (Chu, 1998). In general, the term plyometric refers to types of jumping or throwing drills that are designed to help increase an individual's explosiveness. Also practical way to increase athletic performance. (MSCA`s). There are many examples of plyometric activities in the lower extremities, such as running, jumping and kicking. Strength training is utilized for various purposes, such as the improvement of power and strength endurance, increasing muscle mass, and/or the prevention of injuries (Zatsiorsky, 2006). Plyometric in Athletics produces an explosive reaction that increases both speed and power of the limb during athletic activities (Kraemer WJ, 2000;11). This explosive reaction facilitates has the production of maximal force in the shortest amount of time (Bobbert MF G. K., 1996) (Rassier DE, 2005). Explosive power is a necessary physical component in various sports. And it's the ability of the muscles to overcome resistance with a very rapid contraction. Explosive power is important for some explosive sports such as: Sprint, hurdles, athletic throwing and jumping numbers (Evi Susianti, 2018). On this study hop to know the improvement of performance of Hurdling and Taekwondo athletes by plyometric or explosive exercise. Because Taekwondo was a so called "**explosive**" sport, and developed well training programs for explosive strength of lower extremity was key point to improve the Taekwondo performance (chenfu huang, 1999).

Hurdling probably originated in England in the early 19th century, where such races were held at Eton College about 1837. In those days hurdlers merely ran at and jumped over each hurdle in turn, landing on both feet and checking their forward motion (Britannica, 2021). Experimentation with numbers of steps between hurdles led to a conventional step pattern for hurdlers 3 steps between each high hurdle, 7 between each low hurdle, and usually 15 between each intermediate hurdle. Further refinements were made by A.C.M. Chrome of

Oxford University about 1885, when he went over the hurdle with one leg extended straight ahead at the same time giving a forward lunge of the trunk, the basis of modern hurdling technique. Britannica, the Editors of Encyclopedia (Britannica, 2021).

Hurdling, sport in athletics (track and field) in which a runner races over a series of obstacles called hurdles, which are set a fixed distance apart. Runners must remain in assigned lanes throughout a race, and, although they may knock hurdles down while running over them, a runner who trails a foot or leg alongside a hurdle or knocks it down with a hand is disqualified. The first hurdler to complete the course is the winner (Britannica,2021).

On the other hand, Taekwondo is martial arts that existed in Korea over the last 2,000 years and incorporates the abrupt linear movements of Karate and the circular patterns of Kung-fu with native kicking techniques (Smith, 2013). Additionally, over fifty typically Chinese circular hand movements can be identified in modern Taekwondo (Smith, 2013).

"Taekwondo is an empty-hand combat form that entails the use of the whole body. Tae means "to Kick" or "Smash with the feet," Kwon implies "punching" or "destroying with the hand or fist," and Do means "way" or "method." Taekwondo thus, is the technique of unarmed combat for self-defense that involves the skillful application of techniques that include punching, jumping kicks, blocks, dodges, parrying actions with hands and feet. It is more than a mere physical fighting skill, representing as it does a way of thinking and a pattern of life requiring strict discipline. It is a system of training both the mind and the body in which great emphasis is placed on the development of the trainee's moral character (Smith, 2013)."

The present study was tried to found the effect of plyometric exercise for sprint hurdling and taekwondo athletes for enhancing their lower body performance and their relation on lower body extremity in the aspects of lower body power performance, leg explosive power, flexibility, and strength. Therefore, this study is aimed to examine the effect of eight week plyometric exercise on Commercial bank athletics club, Gere world taekwondo club and Best world taekwondo club.

1.2. Statement of problem

It is not a secret that now a days Ethiopia do not have a big part in hurdling sport as it has in long running sport. (Some coaches from commercial bank athletics club and Trunesh Dibabaa academy before two years ago from their coaching experience stated the reason behind is that the attention given for the hurdling sport is very low and also there is no any best model athletes in the country by this sport that initiates the beginner's athlete to join hurdling). Though, the plyometric exercise has great role on the improvements of athlete's performances (power, flexibility, strength and core muscles) (JM, 2007), in present study area plyometric exercise was less both in hurdler and taekwondo athletes. In other hand, there are many world taekwondo athletes train for so long times and it is known that taekwondo is a sport which 90% of its performance is based on explosive lower body extremity. Taekwondo and Sprint hurdling sport has the same relation in physical fitness (power, flexibility and strength) and core muscle (hip, pelvic, abdominal muscle and lumbar muscle) (Liu aijie, 2007). in which plyometric exercise might use for their improvements.Camelia branet, (2017) identified the effect of plyometric training on lower body strength in preadolescent athletes while factors that affect hurdle performance in some selected first division athletics clubs in Addis Ababa, Ethiopia was reported by Endris, (2012).

However, there is no any reports on the present study area until this thesis was reported. Therefore, the present study was aimed to assess the effect of eight week plyometric exercise on lower body performance of sprint hurdle and taekwondo athlete in the case of Addis Ababa sport clubs.

1.3. Research Questions

Depending on the statement of the problem the following research question was rise which answered at the end of this thesis work.

1. What is effect of eight weeks plyometric exercise on lower body power performance of sprint hurdle and taekwondo in Addis Ababa sport clubs?
2. What is effect of eight weeks plyometric exercise on hip and trunk flexibility performance of sprint hurdle and taekwondo in Addis Ababa sport clubs?
3. What is effect of eight weeks plyometric exercise on explosive leg power performance of sprint hurdle and taekwondo in Addis Ababa sport clubs?
4. What is the relationship between hurdling and world taekwondo performer on lower extremity strength in Addis Ababa sport clubs?

1.4. Objectives of the study

1.4.1. General objective

The general objective of the study was to assess the effect of eight weeks plyometric training on the lower body performance of sprint hurdle and taekwondo: in case of Addis Ababa sport clubs.

1.4.2. Specific objective

1. To assess the impact of eight weeks plyometric exercise on lower body power performance of sprint hurdle and taekwondo in Addis Ababa sport clubs.
2. To find-out the influence of eight weeks plyometric exercise on hip and trunk flexibility performance of sprint hurdle and taekwondo in Addis Ababa sport clubs.
3. To find-out the influence of eight weeks plyometric exercise on explosive leg power performance of sprint hurdle and taekwondo in Addis Ababa sport clubs.
4. To identify the relationship between hurdling and world taekwondo on lower extremity strength in Addis Ababa sport clubs.

1.5. Significance of the study

The present studies have several significance both for the community and academics. Academically it might contribute new findings and it became baseline for further investigation. It clearly found outs the effect of eight week plyometric exercise on the performance of hurdling event in commercial bank club and world taekwondo club in Addis Ababa. It may also create awareness about training system, it may also help to participate in worldwide competition, provide useful information for clubs, personnel's, in the training especially in the area of hurdler and taekwondo and give feedback about the problem of this event for those clubs. It can also provide useful information for all taekwondo athletes and athletics federation to improve the performances of hurdler and taekwondo athletes.

1.6. Delimitation

The delimitation of this research was only delimited the effect of eight weak plyometric exercise on the lower body performance of sprint hurdling in commercial bank Club (n= 20), Best and Gere world taekwondo clubs (n =20) in case of Addis Ababa area. The training was focused on plyometric exercises that used for lower body extremity. This research was conducted "between" October, 2020 to July, 2021.

1.7. Limitation of the Study

During conducting this study, the researcher facing the following limitations. This includes lack of cooperation with athletics federation, coaches and athletes to get reliable information, financial problems and shortage of time.

1.8. Operational Definition of Terms

Hurdling is technical and energy demands an exciting and challenging event with powerful movement.

Taekwondo (TKD) is a type of martial art incorporates the abrupt linear movements of Karate and the circular patterns of Kung-Fu above 90% of lower body explosively move on it.

Explosive Strength: defined as the ability of rapid physical fitness change to apply force rapidly.

plyometric exercise: is a quick, powerful movement preceded by a prestretch, or countermovement, and involving the stretch-shortening cycle (SSC).

1.9. Organization of the Study

The final research paper organized into five chapters. The first chapter deals with introduction, background of the study, statement of the problem, significance, scope, limitation of the study and operational definition of terms. The second chapter deal with review of related literature pertinent to the research; the third chapter covers research methodology, which includes research design, study area, research method, population of the study, sample size, sampling technique, data collecting instrument, procedure of data collection, study variable, methods of data analysis While the fourth chapter deals on research results and discussions, the fifth and the last chapter summarize the research and highlight the way forward. References and appendix, which include questionnaire, checklists, glossary and photo pictures during data collection other related materials, was a part of the document.

CHAPTER TWO

LITERATURE REVIEWS

2.1. Theoretical literature

2.1.1Plyometric exercise

Plyometric are one parts of exercise it can apply in mainstream media and health clubs or

In recreation center used to enhance athletic performance. In other case some peoples and study can say the use of plyometric and speed training has commonly been available to only high-level athletes, with the training provided by a team of strength and conditioning professionals (Aura, 1989). But the truth has Although not typically emphasized in the design of programs for personal training clients, plyometric and speed training are fast becoming important components of a well-balanced plan to improve not only sport performance, but function during job and activities of daily living. Exercises designed to train clients to jump higher and run faster are becoming popular,and arguably essential, program components(Davideh.Potach, 2017).

A practical definition of plyometric exercise is a quick, powerful movement preceded by a prestretch, or countermovement, and involving the stretch-shortening cycle (SSC) (Wilk, 1993),

The purpose of plyometric exercise is to use the stretch reflex and natural elastic components of both muscle and tendon to increase the power of subsequent movements; speed training exercises are designed to use these same mechanical and neurophysiological components, in concert with technique and muscular strength, to produce larger ground forces, thereby allowing clients to run faster (Davideh.Potach, 2017).

In general, the term plyometric refers to types of jumping or throwing drills that are designed to help increase an individual’s explosiveness. Also practical way to increase athletic performance. (MSCA`s).

2.1.2. Examples of Plyometric in Athletics

This rapid deceleration-acceleration produces an explosive reaction that increases both speed and power of the limb during athletic activities (Kraemer WJ, 2000;11).This explosive reaction facilitates the production of maximal force in the shortest amount of time (Bobbert MF G. K., 1996) (Rassier DE, 2005). Plyometric training is often considered the missing link between strength and return to performance (Couco A, 2012). An example of the SSC is illustrated during the overhead pitching motion. When the pitcher goes into the late cocking

position, the muscle spindle and the PEC and SEC of the shoulder internal rotator muscles are pre-stretched, in order to enhance the acceleration phase of the pitching motion. The necessity of plyometric for the shoulder complex can be illustrated in the context of the incredible demands placed on the shoulder with different sporting activities. For example, overhead throwing produces angular velocities that exceed 5000-7000 degrees per second (Pappas AM, 1985), which makes the SSC necessary to help generate the forces required. With a short amortization phase, the time from the cessation of the eccentric pre stretch to the onset of the concentric muscle action, the SSC permits stretching (eccentric lengthening) to contribute to the maximal explosive shortening (concentric contraction) (George Davies,2015).

2.1.3. Explosive power

Explosive power is a necessary physical component in various sports. Explosive power is the ability of the muscles to overcome resistance with a very rapid contraction. Explosive power is important for some explosive sports such as: Sprint, hurdles, athletic throwing and jumping numbers (Evi Susianti, 2018). Explosive power is the result of (force x velocity), where force is equivalent with strength, and velocity with speed (Harsono, 1988). Explosive power is the primary ability to achieve goals. (Bompa, 2018) Explosive power is equal with strength times speed, it means that the power of explosive power is a blend elements of strength and speed. The explosive power must have both strength and speed elements. Strength is one of very important elements and must be possessed by an athlete, because every sports requires muscle strength beside to the other elements. From some opinions of the experts, it can be concluded that strength is the effort done by using maximum power in overcoming a barrier. It is known that the element of strength plays a role in almost all sports. Biomotoric elements such as agility, co-ordination, flexibility, speed and so on are the combination of strength Explosive power is influenced by several large maximal levels of strength, if it does not have a maximum of strength, then explosive power will not reach the high standards. Strength remains the basic for the formation of explosive power (Evi Susianti, 2018). Therefore, before explosive power training, people must have a good level of muscle strength. Athletes who learn strength training can help to prevent injury and improve appearance, and helps recovering faster from the injury(Harsono, 1988) .

2.1.4. Explosive leg power (strength) performance.

There are many examples of plyometric activities in the lower extremities, such as running, jumping and kicking Strength training is utilized for various purposes, such as the improvement of power and strength endurance, increasing muscle mass, and/or the prevention of injuries (Zatsiorsky, 2006). To improve neuromuscular coordination (motor unit recruitment, rate coding, synchronization and the entire coordination pattern), the maximal effort method is applied. Conversely, to stimulate muscle hypertrophy, the methods of repeated and submaximal efforts are appropriate. By varying the intensity, training load, and type of exercise, adaptation in the desired direction can be implemented (Erika zemková1, 2017).

Commonly, heavy resistance is employed to enhance muscular strength, or more specifically; the maximal force generated by an athlete in a given motion. A typical example would be a weightlifter that exerts the greatest effort on a barbell in order to accelerate it maximally in the desired direction (Erika zemková1, 2017).

Another example is aerobic gymnasts or rock & roll performers, for whom explosive strength should be maintained for the prescribed period of the performance (Zemková, 2009). Although the height of a jump in aerobics is about 3-times lower than in a maximal jump (Kyselovičová, 2010), the exercise must be maintained throughout an entire 1:45 minute routine that consists of about 182 jumps out of 352 other elements (e.g. balance, flexibility, strength) (Erika zemková1, 2017).

Muscle hypertrophy is primarily the goal of bodybuilders, though some competitive athletes also employ the same training methods. For instance, shot-putters can utilize about 50% of F-max during throws. Since these maximal forces should be exerted in minimal time, explosive strength is a critical ability for these athletes (Erika zemková1, 2017).

Explosive strength can be a limiting factor in the performance of most combat sports however, for example tae-kwon-do and/or karate (Zemková, 2004). The production of maximal force in the shortest possible time is essential for techniques such as punching and kicking. This ability is also important in the take-off movement required for sprinting and long and high jumping, as well as for sports such as basketball and volleyball (Erika zemková1, 2017).To improve explosive strength, a plyometric exercise using a pre-stretch or countermovement is usually preferred. Increases in the pre-stretch intensity (e.g., jumping from an elevated dropping height) have a considerable influence on the process of storage and subsequent recoil of elastic energy, due to the activation of the stretch-shortening cycle (Ishikawa, 2004).

The ability to use the potentiating effect of the stretch-shortening cycle to improve vertical jumping performance is more enhanced in explosive than in endurance athletes. It has been established that sprinters are more proficient in countermovement and drop rebound jumps than endurance athletes, but there are no differences in pre-stretch augmentation between the groups (Harrison, 2004). The average vertical leg stiffness during drop jumps is also significantly higher for sprinters than for endurance runners (Erika zemková1, 2017).

2.1.5. The Stretch-Shortening Cycle

Vertical jump is an integral part of preparation exercises in most of sports, movement that exploration of maximum speed and power (force). Vertical jump is also uses for assessing the explosive power of lower extremity and forecasting and monitoring athletes (Mahdi Cheraghi,2017). Ability of producing high power by lower extremity is very important in most of sports, such as soccer, ice hockey, volleyball, basketball and run and field (Jiménez-Reyes P, 2011). Counter movement jump (CMJ) is a kind of vertical jumps and most useable test for assessing the neuromuscular coordination of athletes (Claudino JG, 2017). Vertical jump preceded by a countermovement it is a pre stretch will increase vertical displacement above a squat jump (one with no pre stretch) (Bobbert MF, 1996). The stretch shortening cycle (SSC), which describes an eccentric phase or stretch followed by an isometric transitional period (amortization phase), leading into an explosive concentric action. The SSC is synonymous with plyometric (WJ, 2004) and is often referred to as the reversible action of muscles (WJ Z. V., 2006). The SSC is therefore essential to many sporting movements, with performance dependent on its efficient use within a movement skill (Anthony N. Turner, 2010).

2.1.6. Plyometric vs hurdling

Hurdles races are SPRINT event, NOT JUMPING events. Hurdling is in essence a sprint or... but over barriers in which the athlete’s skill is measured in terms of time. The technical component of hurdling is clearly much greater than sprinting. Because it is a sprint, optimum speed (horizontal velocity) is the primary consideration in running to, over and between each barrier (Rautenbach). Therefore it’s more complex than sprint on other way Sprint running is an explosive movement so it can be apply plyometric exercise and is commonly used as a testing exercise in many individual and team sports.

Sprint running represents a multidimensional movement skill consisting of 3 different phases: (a) initial starting phase, (b) acceleration phase, and (c) maximum running speed phase (Delecluse, 1995).similarly hurdles consists of three phases without sprinting between stride these are Take-of, Hurdle clearance and landing. These changes in the lean of the body, the involvement of leg muscles and their respective regimes of muscle action, as well as force and power produced, differ among these 3 particular sprint phases (Delecluse c. , 1997) the force and power also used for hurdle phase.

The effects of sprint hurdle and plyometric training on muscle function and performance that included measurements of 4 specific motor qualities: muscle strength, muscle power, SSC muscle function, and athletic movement performance. In general For “Special Endurance” type hurdlers, the most effective strength training is based on running strength exercises (jumps, skips, uphill runs) and basic leg strength exercises with low/medium weight. The appropriate means for a “Technical” type of hurdler are: classic weight lifting, dynamic leg strength and short jumps. For the “Rhythm” type of hurdler, the training program should emphasize leg strength training on machines and special running exercises (jumps and running drills). Sometimes we must take advantage of other exercises, like explosive starts, sprinting with resistance and isometric strength (Iskra, 2012).

2.1.7. Plyometric vs Taekwondo (TKD)

Taekwondo (TKD) requires both aerobic and anaerobic physical fitness to be developed (Bouhlel E, 2006). The anaerobic metabolic pathway provides the short, quick, all-out bursts of maximal power during combats therefor best and appropriate method to perform maximal power training is exercise that related with plyometric training, while the aerobic system contributes to the TKD athletes’ ability to sustain effort for the total duration of the combat, to recover during the brief periods of rest or reduced effort during the combat, and also for an effective recovery between combats (Monoem Haddad1 2014).in other way many maximal power training is correlated with strength training. Strength, or the ability to express force, is a basic physical characteristic that determines performance efficiency in sports. Each sport varies in its strength requirements, in the interest of specific, we should examine its relationship to speed and force (Dick, 1997).

These characteristics showed Taekwondo was a so called "**explosive**" sport, and developed well training programs for explosive strength of lower extremity was key point to improve the Taekwondo performance (chenfu huang, 1999). The human body, considered in relation

to the sagittal plane, is two-sided. Asymmetry can be discussed in terms of morphological and functional aspects. Functional asymmetry is associated with the dominance of one of the cerebral hemispheres and, as a result, the dominance of one of the upper or lower limbs.

The expression of functional asymmetry is the selection and dominant use of one of the limbs is called lateralization (Janusz Iskra, 2019).

The dominant role of a selected lower limb is often determined by the specificity of a given discipline. Such phenomena can be observed in activities such as martial arts, football, and selected athletic competitions such as jumps or hurdles (Hoffman, Ratamess, Klatt, Faigenbaum, & Kang, 2007). This study shows that applying eight weeks plyometric exercise on hurdle and taekwondo athletes based on their core muscle and lower extremity strength.

2.1.8. Flexibility

Flexibility is traits of the musculoskeletal system that determines the range of movements that can be achieved without joint injure (G.P. Fife, 2013). Flexibility is a person's ability to make movements with the broadest possible range of motion in the joints, factors are the shape of the joints, muscle elasticity, and ligaments, flexibility is not only needed by athletes but it is important for everyone to facilitate daily activities (Ng, 2011). Flexibility (stretching) is classified in to Dynamic and static stretching dynamic stretching involves a controlled movement through the active (with a muscle contraction) joint ROM (IM, 2010). Studies have reported that dynamic stretching can provide either similar acute increases (Beedle BB, 2007) (Behm DG, 2011). Or less improvement (Bandy WD, 1998) in flexibility as static stretching.

2.1.9. The Linkage of Flexibility to HURDLER

Flexibility (joint range of motion) is promoted as an important component of physical fitness (Pollock, 1998). It is widely conjectured that increasing flexibility will promote better performances and reduce the incidence of injury (Shellock, 1985) (Smith, 1994). Consequently, stretching exercises designed to enhance flexibility are regularly included in both the training programs, and the pre-event warm-up activities of many athletes (Holcomb, 2000).

According to (Silvey) male or female hurdler must spend a lot of time on flexibility. The hurdler should be one of the most flexible athletes on the entire track and field team. Be prepared to stretch twice a day. Another important component to hurdling is Dorsi-Flexion

(heel up-toe toe). Dorsi-Flexion will allow the athlete to gain 2-3 inches in additional "lead leg" clearance and 2-3 inches in "trail leg" clearance.

Hurdling is state of mind. For a hurdler to enter the world of the "elite" athlete, will need to have the right state of mind. A highly aggressive nature and the "mind set" of a western "Gunslinger" are characteristics that can benefit the hurdler. Hurdler will need the toughness and tenacity of a NFL of a linebacker and like the "Ninja Warrior" attack hurdles with "No Fear". This Ninja Warrior is type of martial art the same with other combat sports like taekwondo or karate.

If we need or working as a great hurdler must spend a lot of time on flexibility. The hurdler is one of the most flexible athletes on a track and field team. Flexibility is so important that I consider it a waste of time to work with hurdlers who are not willing to work on improving their flexibility. Good flexibility decreases the following:

1. Technical errors in hurdling
2. Unwanted contact with the hurdle
3. Balance problems
4. Get to the ground quicker
5. Physical injuries

Working on flexibility means that the athlete must devote another 15-20 minutes a day in his/her workout to flexibility.

When they do it is not important except that it follows an activity that warms up their muscles such as, in the morning after a jog, after practice or at home in and after a warm shower. The athlete must be very flexible in their hip rotations, hurdle splits, lower back and hamstrings to be great (Silvey).

2.1.10. The Linkage of Flexibility to Taekwondo

Taekwondo is a modern martial sport rooted in traditional Korean martial arts (Lee Kyung-Hoon, 2009). Taekwondo has many advantages, it not only teaches physical aspects such as fighting skills, but also strongly emphasizes teaching aspects of mental discipline and ethics (Turner, 2009). Thus, Taekwondo will form a strong mental and ethical attitude for people who earnestly study Taekwondo properly (H.B. Kim, 2016). This is in line with what is needed by a sports athlete, especially in the taekwondo martial arts branch to achieve the best performance (C.A. Bridge, 2013). One aspect that needs to be fostered to achieve a good achievement is by fostering physical conditions.

Physical condition is the most important factor in achieving high achievement, athletes who have good physical condition will be better prepared in facing the training process (C.A. Bridge J. F., 2014). In fostering this physical condition, there are four components that need attention, namely: flexibility, speed, strength and endurance. The four components are interrelated and one cannot be marginalized (Haff, 2009).

In the kyorugi taekwondo especially the dollyo chagi kick, flexibility is needed to support the kicking motion, when kicking towards the upper target (H.-J. Kwon and J. Lee, 2018). Thus, flexibility is an important motoric component that must be trained and improved, especially for young athletes (M. Kazemi, 2013). The development of one's flexibility is influenced by age. The development of flexibility at each age level is different. So small children have more flexible or flexible muscles. As they enter adolescence, their flexibility tends to reach the peak of their development. Flexibility plays a very large role in learning movement skills and in optimizing other physical abilities (F. Tornello, 2014).

To develop speed in taekwondo sports athletes must be fast must have a large amplitude of leg movements to be able to produce strong and fast kicks (F. Tornello L. C., 2013). In other words, without speed the kick speed does not develop optimally. Taekwondo athletes when kicking strongly and directed without being supported by the ability to flex the joints of the body, shoulders, legs and hands, because flexibility is needed to optimize the use of leg power, shoulders, abdominal muscles and waist rounds to kick on (D.R. Mailapalli, 2015).

2.1.11. Speed

Speed is the highest rate at which a movement or a series of movements can be executed or the ability to cover a given distance in the shortest possible time during an all-out effort of very short duration. Speed is a critical ability in Taekwondo sport and can be developed through sport specific straining. There are two periods for optimal development of speed based on chronological age. The first period of optimal speed training occurs between the ages of 7 and 9 years and 6 and 8 years for boys and girls respectively. This period may provide better opportunity to develop speed agility, the ability to move quickly and precisely (less than 5-6 seconds) in response to a given stimulus. The second period for speed adaptation occurs between the ages of 13 and 16 and 11 to 13 for males and females respectively. This period may enhance the ability to develop maximal speed which requires maximal effort for a very short duration (extended 20 seconds) and may be multi-directional in nature (Canada, 2008).

2.1.12. Power

Power is a physical component as a result of the multiplication of strength and speed. In PON DIY Taekwondo athletes, the leg power could be maintained in the performance of the competition period, even increased well although the improvement was not significant. Stopping the loading exercise will reduce the performance of the strength, power, and speed of an athlete and worse, it could decrease the skill (Shepherd, 2009). Several studies show that certain strength training programs can increase the athlete's maximum strength and power production, reduce the injury, and contribute to fasten the recovery of injuries by minimizing the number of training sessions and competitions. The opinions of these experts strengthen the fact that power is very necessary for Taekwondo sport (Devi Tirtawirya, 2018).

2.1.13. Special Endurance on sprint hurdles

Speed, both maximal and technical (medium and high intensity; “elements of speed”) are necessary for all the types of 400m hurdlers. The means used to develop this bio-motor ability are much the same as they are for 400m runners and other sprinters.

“Special Endurance” type of hurdler we choose of all runs with maximal (100%) or submaximal 90-95%) intensity. Strength is a very important part of training for the 400m hurdles. In particular, we must develop special leg strength and additional strength of trunk and upper part of body. “Special Endurance” type hurdlers, the most effective strength training is based on running strength exercises (jumps, skips, uphill runs) and basic leg strength exercises with low/medium weight. The appropriate means for a “Technical” type of hurdler are: classic weight lifting, dynamic leg strength and short jumps. For the “Rhythm” type of hurdler, the training programme should emphasize leg strength training on machines and special running exercises (jumps and running drills). Sometimes in long-term periodization we must take advantage of other exercises, like explosive starts, sprinting with resistance and isometric strength (Iskra J. , 2012).

2.1.14. Hurdles movement

Hurdles movement is a hip rotation frequency and the most rapid severe track and field events, the hurdles is speed sports, Hurdlers are crucial to the absolute speed requirement. Absolute speed is greatly supported by the **core muscle strength**, thus generating a powerful source of power. Core muscle strength is related to the waist hip flexion, stretching hip to exercise of power, attack down the conduction knee joint after the bar, produce bend flexion, waste of work, involving the onset of excessive torque speed hurdler body loss, lack of core

muscle strength hip flexion and hip fatigue, stress transfer lower limb muscles, deep knee bends, joint muscle (Wen Bo, 2019).

2.1.15. Plyometric exercises and core stability exercises

Plyometric exercises and core stability exercises are among those various exercises which are used by athletes to improve their performance (Heydar Sadeghi, 2013). Existing information shows that regular plyometric exercise can increase strength and power of adult persons (Fleck, 2004). Coaches and athletes claim that plyometric exercises create relational bridge between strength and power and raise competitive performance of athletes directly. These exercises include a rapid stretching of muscles (eccentric contraction) that immediately followed by a concentric contraction and shortening of this muscle and connective tissues (Baechle, 2000). On the other hand, core stability is a concept in the health and fitness professions which became popular in the early 1990s. Professionals such as physicians, physical therapists bio mechanists and chiropractors use the concept to educate patients on the recovery from of prevention of injuries (Waldhelm, 2011). Researchers at description of core stability area remark that the abdominals act as the front of the house, the para spinals serve as the back the house, the diaphragm servers as the roof and the musculature of the hip girdle and pelvic floor create the 2 basements of the house (Richardson, 1999). For many strength and conditioning professionals, core stability is considered as a key component in training to improve sport performance (Heydar Sadeghi, 2013). It is believed that a strong core allows an athlete the full transfer of forces generated with the lower extremities through the torso, and to the upper extremities and sometimes an implement (Cissik, 2002). And a weak core is believed to interrupt the transfer of energy, resulting in reduced sport performance and risk of injuries to a weak or underdeveloped muscle group. Therefore, training the core has become popular among strength coaches and personal trainers as a means to improve performance and reduce the chance for injury (Nesser, 2008).

2.1.16. Lumbar core muscle strength

size effect stretching hip flexible rotation speed, affect the coordination of two arms swinging, losses run speed, strong back, strong core muscle strength can make folding the ground movements back and strong core muscle strength can be prompted to run smoothly and shaking, stable control center of gravity acceleration and strong core muscle strength can automatically control the hurdler run bar speed rhythm, strong core muscle strength can cross bar or column leg down quickly, quickly completed across from the bare (Wen Bo, 2019).

2.1.17. Core Muscle Strength

Core muscle strength is applied to track and field training, to explore and study the mechanism of core muscle strength training for hurdlers' fast attack speed technical function, so that the attack speed will not be lost and the fast hurdle technique will be improved (Wen Bo, 2019). It is believed that core balance training can enhance the control ability of hurdlers under the unsteady state, maintain the balance function, coordinate the strength performance of each muscle group, improve the hurdlers' skill and prevent sports injury. The core control ability of hurdler's body is the main factor of the movement function of upper and lower limbs. Strengthening the core muscle strength is beneficial to control the center of gravity, determine the fulcrum for the movement of upper and lower limbs, and optimize the transmission and control of the generated force. The core parts include spine, hip joint, upper and lower limbs, which play a pivotal role in maintaining balance I physical movement of hurdlers. Core balance depends on the control and contraction of the trunk core muscle group. The core part of hurdler's body generates the source of speed and power, transmission and control for hurdler (Chen, 2007).

2.1.18. Body Core

Body core shows core muscle group speed and physical quality of hurdlers are all controlled by the nervous system. The central nervous system functions hurdlers' muscles drives muscle strength and controls muscle group, so that core balance reflects dynamic sense. Hurdler core body balance depends on the core muscle strength, the coordination between the trunk of each joint muscles to complete the hurdler body, for the onset of muscle contraction parts to determine the power protection, increase the efficiency of the onset of muscle and association each muscle contraction, speed up the transmission power, improve the efficiency of hurdler body movement. Core balance is the timer of physical movement of hurdlers, which plays a regulating role in training to stabilize the body movement of hurdlers, balance and coordinate the physical function of hurdlers. Core muscle strength training can assist hurdler core stability, strong core muscle strength can be stable hurdler core parts of the body, control hurdler body movement center of gravity, passing the powers of their lower limbs, speed, balance the stability and fixation of further smaller muscle groups, complete the speed of the neural control muscle strong ability, as a hurdle sports power source, the core muscle strength

support to control the hurdler rotating body gravity balance, power drag, improve the core power conversion is hurdler hurdles speed engine (deng, 2007).

2.1.19. Core Muscle strength for hurdle

Core muscle strength training for hurdle athletes run hurdles, increase muscle strength as the core torso motion together, build support for onset of muscle contraction, the muscle contraction force, coordinate various hurdles joint muscle into the state, make the different movement joints, muscle contraction joint movement, makes the muscle rotation of each joint, coordination between muscle movement, strengthen the core parts of the lumbar spine and hip muscles, enhance the overall strength of the core muscles passing ability. Resistance strength training can improve the coordination of multiple muscle groups, the rapid recruitment of synergistic fast muscle and nerve impulse frequency (xing, 1986). Increase the muscle contraction strength of upper and lower limbs, rapidly transfer strength, improve signal transmission, improve the efficiency of hurdlers' special hurdling exercise, and create conditions for hurdlers' fast running muscle contraction work. During Hurdles During hurdles, hip rotation, accompanied by weak muscle strength and muscle tension disorder of lumbar segments, affects the balance of lumbar spine, and strengthens core muscle strength training measures of hurdlers .the trunk muscles of hurdlers from the middle to the legs, directly behind and on both sides, can regulate the core muscles of the hurdler's body to maintain the balance and stability of the trunk.

The control of trunk core muscle group will effectively control the ability of balanced movement over hurdles. In sports, hurdlers lack the support of large muscle groups in their lumbar vertebrae, while hurdlers are in the unsupported condition when hurdling, which is the weak part in sports. Core muscle strength training is needed to protect the movement center to enhance balance. At present, the hurdle project mainly focuses on the training of lower limbs and legs, but the training of core muscle strength is not enough, and there are not enough methods to train hurdle. After 1.6 run-up hurdles through hurdler body back muscles to integration, the hurdler body hurdles with core muscle strength exercise on practice, to improve motor function and its mechanism is through the hurdler body core muscle strength training of the nervous system control of the waist muscle, strengthen the hurdles small muscles and big muscles strength coordination function, enhance the speed signal input, upward lower limb muscle signals, to promote coordinated movement, all joints, muscles training can enhance the body of the contralateral limb speed sensitivity, through the training

can accelerate the brain function for the hurdler leg control ability, The adjustment response of core motor muscle group is closely related to the physical balance and control ability of hurdlers, and the nervous system should have fine ability to control and control multiple muscles (Liu aijie, 2007).

2.1.20. Core Muscles Strength of Taekwondo

In relation to fitness, although power, strength, muscle endurance, agility, and flexibility have been reported as very important fitness factors in Taekwondo games factors that directly affect athletic performance have not yet been established (Seong-Deok Yoon, 2014). If vertical jump motions are made frequently in sport activities, the possibility of injuries developing in the jumper's knees or anterior cruciate ligaments will increase because of excessive increases in stretching in the knee region and landing motions (Seong-Deok Yoon, 2014). The rate of injuries due to kicks including high level jumps is actually exhibiting an increasing trend. In general, the causes of occurrences of sport injuries are attributed to excessive training, incorrect training methods, Proprioceptive senses play an important role in maintaining joint stability. It is known that although flexibility, muscle endurance, and muscle strength are needed to perform in high-level sports agilely and accurately, proprioceptive senses act as a very important factor for continuous and precise performance of sports techniques (Brill PW, 2002).

Core stabilization exercises are known to strengthen the deep muscles of the human body such the local spinal muscle group, the abdominal muscle group, the hip muscles, and the pelvic muscle (JM, 2007).

The trunk muscles such as the spinal, pelvic, and abdominal muscles are called the core muscles. These core muscles generate all the power and motility of the human body. In the case of Taekwondo players, strengthening these core muscles would improve spinal movement and stability, and greatly help to improve athletic performance.

Fitness factors such as the ability to turn quickly, quickness, agility, and balance are required in Taekwondo games because attacks and defensive maneuvers are made in response to the movements of opponents, and at least 90% of attacks are made with foot techniques (Phys, 2015).

Since stability in sport situations is completely different from the stability on a stable surface, motions required become much easier to perform when the center of gravity of the body is

effectively arranged to maintain the balance of a relatively heavy weight on a small and narrow base of support (Akuthota V, 2004).

Aktuthota and Nadler (Kim SY, 2001) advised that although diverse terms are used for lumbar stabilization exercises such as core strengthening, dynamic stabilization, trunk stabilization, muscular fusion, and neutral spine control, their purpose, which is to improve the functional stability around the abdomen and pelvis, is the same.

Hodges and Richardson (Chung EJ, 2013).reported the importance of trunk muscles in performing upper and lower extremity movements while maintaining spinal stability in standing positions or sitting positions. In the present study, the core muscles of the Taekwondo players were strengthened by the eight weeks of exercise centering on trunk muscles, and measurement of the foot pressure in standing positions indicated that balance was significantly improved.

Muscular strength is the basic ability for athletes to control the more skill. Furthermore, how to improve the muscular strength is the problem which athletes and coaches often concerned about. Generally, there are three main classifications of strength, namely maximum strength, explosive strength (power) and enduring strength respectively. The kicking was the main offensive weapon for Taekwondo. The previous researches indicated that the range of movement time of Taekwondo kick were 0.22-0.31 seconds (Cho, 1996) and the maximum velocity of kick reached 22.4 ml sec (Sung, 1987). These characteristics showed Taekwondo was a so called "explosive" sport, and developed well training programs for explosive strength of lower extremity was key point to improve the Taekwondo performance. Plyometric, which developed by Veroshanski at 1991, was effective method of training power ability. Some researchers showed that combining plyometric with weight training could have more effectiveness, but there were few information’s about how to apply on Taekwondo sport. The purpose of this study was to investigate the effect on three different training methods by combining the typical plyometric training method (drop jump) and traditional weight training.

2.1.21. Sport-specific plyometric

Plyometric exercises are a great way to enhance sport specific power. In Part one we looked at why this was so and provided typical examples of plyometric drills (ranked by intensity). In Part Two we show you how with a bit of tweaking and specific thinking, you can make

your plyometric drills even more specific to your sport. A reminder on how plyometric exercises work Plyometric drills work on improving the natural recoil of muscles and tendons. As indicated in Part One this is the result of an eccentric (muscle lengthening) contraction priming an immediate subsequent concentric (muscle shortening) one. The action is akin to a pogo stick – which would no doubt be banned from children's use under current health and safety regulations! On landing on a pogo stick a spring mechanism compresses and 'fires' the child and stick higher into the air, as they bounce down the road. A similar reaction occurs naturally

In our muscles if we were to jump, for example, up and down on the spot. Our muscles don't have in-built springs like the pogo stick, but they are able to create greater 'spring' due to the Eccentric/concentric response (which is also known as the stretch, shortening cycle).Making your plyometric more specific although a series of bounds or hops will improve the speed and power capacity.

2.2. Empirical literature

Aktuthota and Nadler (Kim SY, 2001) advised that although diverse terms are used for lumbar stabilization exercises such as core strengthening, dynamic stabilization, trunk stabilization, muscular fusion, and neutral spine control, their purpose, which is to improve the functional stability around the abdomen and pelvis, is the same. They suggested that lumbar stabilization exercises should be effective when the roles of different muscles are well understood and exercise programs that fit the characteristics of these muscles are applied. Trunk stabilization exercises have been mainly used to restore the ability to control muscles and movements in low back pain patients, musculoskeletal system disease patients, and normal persons.

Whether the core has sufficient power or not, power will be lost at the hip muscles if the trunk is unstable because the level of core stability is insufficient, and so the body will supplement the power with power from other muscles, eventually leading to the loss of body balance.

In a study on changes in loads on muscles and spinal stability made while healthy adults were performing seven core stabilization exercises, (Kavcic et) reported that abdominal curl, side bridging, and bridging exercises with leg lifts were very closely related to the activity of the muscle rectus abdomens.

(Choi et al). Reported that the muscle activity of individual abdominal muscles was significantly increased through lumbar stabilization exercises performed by 20 healthy adults in crawling positions in four different environments setups using slings.

Trunk stability exercises improve body balance and stability. In particular, these exercises activate the abdominal muscles and the multi fidus muscles, which are small muscles on the spine, simultaneously and in harmony, thereby improving any imbalance of those muscles necessary to maintain posture.

In a study conducted by (Kim et al). The rate of weight bearing increased more in their experimental group that performed exercise to improve lower trunk stability five times per week for three weeks than in their control group which received general exercise treatment intended to improve balance with weight loads or weight shift, gait, and muscle strength; the experimental group showed significant differences in the ability to control balance and gait ability, and exercise to improve lower trunk stability showed significant positive correlations with balance ability and gait ability.

CHAPTER THREE

RESEARCH METODOLOGY

3.1. Research Design

A quasi-experimental design aims to establish a cause-and-effect relationship between an independent and dependent variable in which repeated measures design is a research design that involves multiple measures of the same variable taken on the same or matched subjects either under different conditions or over two or more time periods. For instance, repeated measurements are collected in a longitudinal study in which change over time is assessed. In this case subjects was selected without random selection and both experimental group of taekwondo sport and sprint hurdlers. Eight weeks plyometric intervention tests was given and subjects was tested two time by repeating the design. This helped to formulate cause-effect relationship between plyometric exercise and lower body performance of sprint hurdlers and taekwondo athletes.

3.2. Study Area

Addis Ababa is the capital and largest city of Ethiopia. Three site for the study area that were purposively selected were Commercial Bank of Ethiopia located at CMC Mikael in own new academy, Best World Taekwondo Clubs at Burayu Special Zone of Oromia and GERE World Taekwondo Clubs located at Lege-tafo and Sandafaa Special Zone of Oromia. In general, two private taekwondo sport clubs and one Commercial Bank of Ethiopia athletics club were used to collect data from taekwondo and hurdler athletes.

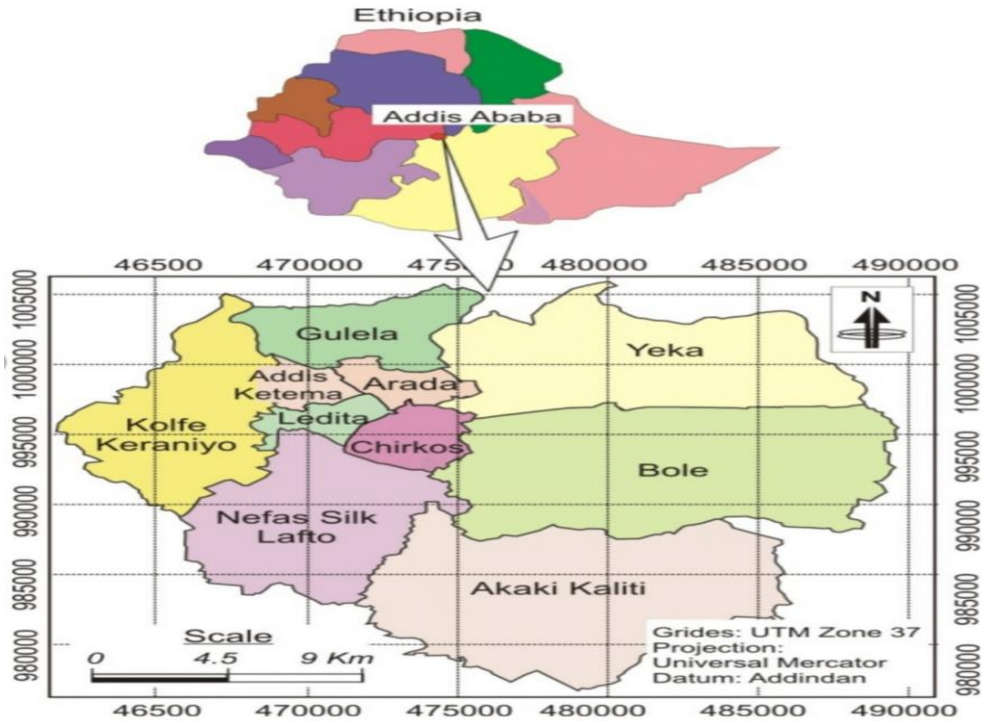

Figure 3.1 map of Addis Ababa city (Mesele Berhanu, 2017).

3.3. Research Method

In order to attain objectives of the study, valuable information's were gathered from different Sources. Besides, triangulation of various data gathering tools (dominantly standardized fitness tests additionally observation, semi structured interview) was used to obtain relevant information. Intensive review of related Literatures was made to support the study with empirical knowledge in the area.

3.4. Population of the Study

Table 3.1. Population of The study

Name of clubs	Total population		Sampled population		Sampling technique	
	Athletes	Coaches	Athletes	Coaches	Athletes	Coaches
CBE athletics club	**20**	**2**	**20**	**1**	Convenience	Purposive
Best world taekwondo club	**70**	**1**	**10**	**1**	Purposive	Convenience
Gere world taekwondo club	**100**	**1**	**10**	**1**	Purposive	Convenience
Total population and sample population of the study	**190**	**4**	**40**	**3**		

3.5. Sample and Sampling Techniques

The sampled population of the study from Commercial Bank of Ethiopia sprinters (N = 20), Best World Taekwondo Clubs athletes (N = 10) and Gere World Taekwondo Clubs athletes (N = 10) the total sample of the study (N = 40). Was selected using purposive sampling technique for taekwondo athletes and Convenience sampling technique for hurdlers. The sampling focuses on specific cases (critical case). Purposive sampling technique was used to access a particular subset of athletes from the total population based on athletes age, training age, weight, height, performance of athletes similarity and most gold medalist in country level and the athletes seniority level.

3.6. Data Collecting Instrument

In present study observation, Interview and dominantly standardized fitness tests were used as instruments of data collections. Additionally, multi-method approach was implemented to maintain the validity of the study and to acquire information from different sources. The use of different tools helped to see the situation in-depth. The detail of each data collection instruments is discussed as follows:

Observation

In order to obtain information about training availability of eight week plyometric during competition, pre and post-test principles of training and style of coaching applied by the coaches, observation has been used by the researcher (Kumer, 1999). Pointed out

“observation is one way of collecting primary data since purposeful, systematically planned recorded, is subjected to be checked, and it controls, the validity and reliability of what to be observation” the main advantage of this method lies on.

Interview

Interview guide was prepared and conducted in order to gained information about on lower body power performance of the athletes with strength, flexibility relation between taekwondo and hurdling on lower extremity, qualification level of the coaches, and number of athletes Information related with criteria of selection of athletes and like Elimination of bias.

Standardized fitness tests

Standardized fitness tests was used to collect relevant information from athletes. These tests includes Vertical Jump Test (Sargent Jump, Vertical Leap) and the purpose of the test was to measure the development of the athletes lower body power performance and tools used to measures wall, meter tape measure, chalk and assistant. On the other hand, Standing Long Jump Test (Broad Jump) was to measure the explosive power of the legs. While Tools are tape meter used to measure distance jumped, non-slip floor for takeoff, and soft landing area preferred and also commercial Long Jump Landing Mats are also available. Moreover, the flexibility test is measured by modified Sit & Reach Test method that was used to measure the development of the athlete's hip and trunk flexibility. Tools are 'Sit & reach’ Yard stick and Assistant. Finally, Squat test are other standardized fitness tests that was used to measure the development of the athlete’s leg strength. The tools used to measure are chair and assistant.

3.7. Procedure of Data Collection

The procedure of the data collection was started from developing the research design. Based on the research questions the instrument of data collection including standardized fitness tests (Vertical Jump Test (Sargent Jump, Vertical Leap), Standing Long Jump Test (Broad Jump), flexibility test and Squat Test). Data collection of standardized fitness tests was been strictly followed during two week familiarization of the test. Then the final test was given to the subjects of the study during pretest, and post-test. Eight week plyometric exercise protocol was given to three sport clubs athletes. In addition to this, observation checklist and semi-structured interview data was collected regarding the effect of Eight week plyometric exercise on the performance of sprint hurdler and teakwood athletes.

3.8. Study Variable

3.8.1. Dependent Variable

Four dependent tests such as lower body power, explosive leg power, flexibility of hip and trunk muscle and strength of leg power were measured by Vertical Jump Test, Standing Long Jump Test, sit and rich test and Squat Test respectively.

3.8.2. Independent Variable

Eight weeks plyometric exercise was stipulated as the independent variable of the study. This plyometric test was given with the precautions longitudinally.

3.9. Methods of Data Analysis

The data was entered into STATA version 14, was used to analyze the effect of eight weeks plyometric exercise on lower body power performance of sprint hurdle and taekwondo in Addis Ababa sport clubs, effect of eight weeks plyometric exercise on hip and trunk flexibility performance of sprint hurdle and taekwondo in Addis Ababa sport clubs, effect of eight weeks plyometric exercise on explosive leg power performance of sprint hurdle and taekwondo in Addis Ababa sport clubs and the relationship between hurdling and world taekwondo performer on lower extremity strength in Addis Ababa sport clubs.

CHAPTER FOUR
RESULT AND DISCUSSION

4.1 Descriptive summary of the participants

A total of 40 participants 20 from hurdling 20 from taekwondo were included in the study. All the subjects completed the training program, and none reported any training-related injury. Descriptive statistics data was calculated for all variables and presented as group means values and standard deviations.

Table 4.1. Status of Participant Athletes

STATUS OF PARTICIPANT ATHLETES							
	Gender		Age	Training age	Marital status	Weight	Height
	M	F					
Taekwondo	10	10	18-25	3-5	NO	53-68	1.6 -1.79
Hurdling	12	8	18-25	3-5	NO	55-70	1.6 -1.9

4.2. The impact of eight weeks plyometric training on lower body power performance of sprint hurdle and taekwondo

Table 4.2. Two sample vertical independent t-test of pre and post hurdling athletes

S.n	**Variable**	**Obs**	**Mean**	**Std. Err**	**Std. Dev**	**[95%Conf.Interval]**	
1	Pre-test of vertical jump hurdles	20	44.15	1.888	8.443	40.198	48.101
2	post-test of vertical jump hurdles	20	48.5	1.968	8.804	44.379	52.620
Diff		20	-4.35	0.405	1.814	-5.199	-3.5
mean(diff) = mean (pre H vertical - post H vertical)						t = -10.721	
Ho: mean(diff) = 0						degrees of freedom = 19	
Ha: mean (diff) < 0			Ha: mean (diff)! = 0			Ha: mean(diff) > 0	
Pr(T<t) = 0.0000			Pr {ITI > ItI} = **0.0000**			Pr(T>t) = 1.0000	

This output provides useful descriptive statistics for the two pre and post-test that were compared, including the mean and standard deviation, as well as the actual results from the independent t-test. It was revealed that the group means are significantly different as the *p*-value in the Pr (|T| > |t|) row (under Ha: diff! = 0) is less than 0.05 (i.e., based on a 2-tailed significance level). Looking at the Mean column, the result showed that post-test of vertical

jumping of hurdling athletes had taken higher (cm) of jumping than hurdle athletes during pretesting of vertical jumping test method.

An independent t-test was run on a sample of 20 athletes to determine their differences on vertical jumping between pre-test and post-test evaluation of hurdle athletes in commercial bank. The results showed that the pre-test of commercial bank hurdlers had statistically significantly lower vertical jump (44.15 ± 8.443 cm) as compared to post-test after eight week plyometric exercise hurdle athletes (48.5 ± 8.804 cm), t (19) = -10.721, p = 0.00.

This result implies that the post-test of hurdle athletes after eight week plyometric exercise had higher vertical jumping value that were significantly different from pre-test of commercial bank hurdling athletes because, the eight week plyometric exercise is effective on increment of vertical jumping for hurdlers of commercial bank athletes.

Table 4.2. Two sample vertical independent t-test of pre and post taekwondo athletes

S.n	**Variable**	**Obs**	**Mean**	**Std. Err**	**Std. Dev**	**[95%Conf.Interval]**	
1	Pre-test of taekwondo vertical jump	20	45	0.931	4.167	43.049	46.950
2	post-test of taekwondo vertical jump	20	49.15	0.880	3.937	47.30727	50.992
Diff		20	-4.15	0.166	0.745	-4.498	-3.801
mean(diff) = mean (pre T vertical - post T vertical)						t = -24.9066	
Ho: mean(diff) = 0						degrees of freedom = 19	
Ha: mean (diff) < 0			Ha: mean (diff)! = 0			Ha: mean(diff) > 0	
Pr(T<t) = 0.0001			Pr {ITI > ItI} = **0.0000**			Pr(T>t) = 1.0000	

This output provides useful descriptive statistics for the two pre and post-test that were compared, including the mean and standard deviation, as well as the actual results from the independent t-test. It is revealed that the group means are significantly different as the p-value in the Pr (|T| > |t|) row (under Ha: diff! = 0) is less than 0.05 (i.e., based on a 2-tailed significance level). Looking at the Mean column, the result showed that post-test of taekwondo vertical jumping had taken higher length (cm) than pre-test of taekwondo vertical jumping test method.

An independent t-test was run on a sample of 20 athletes to determine their differences on vertical jump between taekwondo athletes before eight week plyometric exercise during pre-test and after eight week plyometric exercise during post-test. The results showed that the pre-test of taekwondo athletes had statistically significantly lower strength (45 ±4.167 cm) as compared to post test of Taekwondo athletes (49.15 ± 3.937 cm), $t(19) = -24.90$, $p = 0.00$.

This result implies that the post test of taekwondo athletes have higher vertical jumping that were significantly different from pre-test of taekwondo vertical jumping because, the eight week plyometric exercise showed improvement on lower body power performance.

Lower-body plyometric exercises are jumping-type exercises that use an individual's body weight or a relatively low external load as resistance. In various sports training regimens, lower-body plyometric training is used to improve athletic lower body performance in tasks that require high power generation such as jumping and sprint running (Kurokawa, 2014). On present study Vertical jump test has indispensable for knowing lower body power performance and leg elastic strength. The finding showed that the pre-test of commercial bank hurdlers had lower vertical jump as compared to post-test after eight week plyometric exercise ($P = 0.0 < 0.05$). In case of taekwondo athletes the pre-test of taekwondo athletes had lower vertical jump as compared to post test of Taekwondo athletes ($P = 0.0 < 0.05$). And lower body performance on vertical jumping test the taekwondo athletes had better improvement than hurdlers. Generally, in the current study plyometric exercise had improved the vertical jump of sprint hurdler and taekwondo athletes. In agreement to this finding the study conducted that Vertical jump performance, acceleration, leg strength muscle power, increased joint awareness and overall proprioception enhanced by plyometric exercise (Taekwondo Players, 2015).

4.3. The influence of eight weeks plyometric training on explosive leg power performance of sprint hurdle and taekwondoTable

4.3. Two sample long jump independent t-test of pre and post hurdle athletes

S.n	Variable	Obs	Mean	Std. Err	Std. Dev	[95%Conf.Interval]	
1	Pre-test of hurdle long jump	20	250.05	2.282	10.205	254.273	254.826
2	post-test of hurdle long jump	20	256.05	2.665	11.918	250.472	261.628

Diff	20	-6	2.127	9.514	-10.452	-1.540
mean(diff) = mean (pre H long jump - post H long jump)						t = -2.8202
Ho: mean(diff) = 0						degrees of freedom = 19
Ha: mean (diff) < 0			Ha: mean (diff)! = 0			Ha: mean(diff) > 0
Pr(T<t) = 0.0055			Pr {ITI > ItI} = **0.0109**			Pr(T>t) = 0.9945

This output provides useful descriptive statistics for the pre and post-test that were compared, including the mean and standard deviation, as well as the actual results from the independent t-test. It is revealed that the group means are significantly different as the *p*-value in the Pr (|T| > |t|) row (under Ha: diff! = 0) is less than 0.05 (i.e., based on a 2-tailed significance level). Looking at the Mean column, showed that post-test of long jump hurdling athletes had taken slightly higher than pre-test long jump hurdling athletes.

An independent t-test was run on a sample of 20 athletes to determine their differences on pre and post-test long jump hurdling athletes in commercial bank Club. The results showed that the pre-test of long jump had significantly lower jumping length (250.05 ±10.205 cm) as compared to post-test of long jump in commercial bank Club(256.05 ± 11.918 cm), $t(19) = -2.8202$, $p = 0.0109$. This result implies that there was significant change of long jumps for commercial bank athletes after eight week plyometric exercise had been given.

Table 4.4. Two sample long jump independent t-test of pre and post taekwondo athletes

S.n	**Variable**	**Obs**	**Mean**	**Std. Err**	**Std. Dev**	**[95%Conf.Interval]**	
1	Pre-test of taekwondo long jump	20	250.3	1.166	7.455	246.810	253.789
2	post-test of taekwondo long jump	20	258.05	1.606	7.185	254.6872	261.412
Diff			-7.75	1.295	5.793	-10.461	-5.038
mean(diff) = mean (pre T log jump - post T log jump)							t = -5.9823
Ho: mean(diff) = 0							degrees of freedom = 19
Ha: mean (diff) < 0			Ha: mean (diff)! = 0				Ha: mean(diff) > 0
Pr(T<t) = 0.0000			Pr {ITI > ItI} = **0.0000**				Pr(T>t) = 1.0000

This output provides useful descriptive statistics for the pre and post-test that were compared, including the mean and standard deviation, as well as the actual results from the independent t-test. It is revealed that the group means are significantly different as the *p*-value in the Pr (|T| > |t|) row (under Ha: diff! = 0) is less than 0.05 (i.e., based on a 2-tailed significance level). Looking at the Mean column, the result showed that post-test of taekwondo long jump athletes had taken higher than pre-test long jump taekwondo athletes.

An independent t-test was run on a sample of 20 athletes to determine their differences on pre and post-test long jump taekwondo athletes in Baste and Gere world Taekwondo Clubs. The results showed that the pre-test of long jump had significantly lower jumping length (250.3 ±7.455 cm) as compared to post-test of long jump in Gere and Baste world Taekwondo clubs (258.05 ±7.185 cm), $t(19) = -5.9823$, $p = 0.00$. This result implies that long jump improvements in Gere and baste world taekwondo Clubs were observed after eight week plyometric exercise had been given.

Plyometric training is a specific strategy used to develop explosive power (Brown, 2007) also it's a method to increase performance of athletes in explosive power sports. Using plyometric exercise in athletics training is essential, as it has become an important part in physical preparation programs utilized to develop leg explosive power with the combination of strength (said el-ashker, 2019). Plyometric training as a direct means to develop leg explosive power because it involves a stretch-shortening cycle (said el-ashker, 2019). Fatouros and coworkers (Fatouros, 2000) noted that plyometric training leads to fast decelerations immediately followed by fast accelerations. The muscle-tendon system is stretched in the initial eccentric phase of the movement and the stored elastic energy is partially retained during the shortening phase of the contraction (Donald, 1998).In this study there is significant change before eight week plyometric exercise (pre-test) and after eight week plyometric exercise the (post-test) value from the collected data of standing long jump test because plyometric training muscles are able to produce more force they are stretched during the contraction of lower extremity. On the current study long jump test has indispensable for knowing leg explosive power. The researcher tested the hurdle and taekwondo athletes' lower leg explosive power. On finding the standing long jump test of taekwondo athletes the pre-test of long jump had lower length as compared to post-test of standing long jump ($p=0.0 < 0.05$). In case of hurdling athletes the pre-test of long jump had lower jumping length as compared to post-test of long jump ($p=0.01 < 0.05$). In agreement to this finding the study conducted that standing long jump performance was significantly increased implementation of plyometric method in the training micro cycles is recommended for Karate coaches for increasing neuromuscular explosiveness power performance of young competitive Karate athletes (Nikolaos,2020).

4.3. The influence of eight weeks plyometric training on hip and trunk flexibility performance of sprint hurdle and taekwondo

Table 4.5. Two sample flexibility independent t-test of pre and post hurdle athletes

S.n	Variable	Obs	Mean	Std. Err	Std. Dev	[95%Conf.Interval]	
1	Pre-test of hurdle flexibility	20	39.95	0.889	3.979	38.087	41.812
2	post-test of hurdle flexibility	20	44.2	0.958	4.287	42.193	46.206
Diff		20	-4.25	0.951	4.253	-6.240	-2.259
mean(diff) = mean (pre H flex - post H flex)					t = -4.46		
Ho: mean(diff) = 0					degrees of freedom = 19		
Ha: mean (diff) < 0		Ha: mean (diff)! = 0			Ha: mean(diff) > 0		
Pr(T<t) = 0.0001		Pr {ITI > ItI} = **0.0003**			Pr(T>t) = 0.9999		

This output provides useful descriptive statistics for the two pre and post-test that were compared, including the mean and standard deviation, as well as the actual results from the independent t-test. It is revealed that the group means are significantly different as the *p*-value in the Pr (|T| > |t|) row (under Ha: diff! = 0) is less than 0.05 (i.e., based on a 2-tailed significance level). Looking at the Mean column, the result showed that flexibility of hurdle athletes after eight week plyometric training post-test had taken higher flexibility than pre-test of hurdles athletes during this test can apply by standard sit and reach test method.

An independent t-test was run on a sample of 20 athletes to determine their differences on flexibility between pre and post-test Hurdling athletes in commercial bank. The results showed that the pre-test of commercial bank hurdlers had significantly lower flexibility (39.95 ± 3.979 cm) as compared to post test of hurdle athletes after eight week plyometric exercise (44.2 ± 4.287 cm), t (19) =-4.46, p = 0.0003.This result implies that post flexibility test after eight weak plyometric exercise had higher flexibility because, the eight week plyometric exercise is effective to increase flexibility performance of the hurdle athletes.

Table 4.6. Two sample flexibility independent t-test of pre and post Taekwondo athletes

S.n	Variable	Obs	Mean	Std. Err	Std. Dev	[95%Conf.Interval]	
1	Pre-test of taekwondo flexibility	20	48.35	1.129	5.050	45.986	50.713
2	post-test of taekwondo flexibility	20	52.2	1.082	4.840	49.934	54.465
Diff			-3.85	1.564		-7.016	-0.683
mean(diff) = mean (pre T flex - post T flex)						t = -2.4613	
Ho: mean(diff) = 0						degrees of freedom = 38	
Ha: mean (diff) < 0			Ha: mean (diff)! = 0			Ha: mean(diff) > 0	
Pr(T<t) = 0.0092			Pr {ITI > ItI} = **0.0185**			Pr(T>t) = 0.9908	

This output provides useful descriptive statistics for the two pre and post taekwondo flexibility test that were compared, including the mean and standard deviation, as well as the actual results from the independent t-test. We can see that the group means are significantly different as the *p*-value in the Pr (|T| > |t|) row (under Ha: diff! = 0) is less than 0.05 (i.e., based on a 2-tailed significance level). Looking at the Mean column, the result showed that post-test flexibility on taekwondo athletes had taken higher flexibility than pre-test taekwondo athletes by standard sit and reach test method.

An independent t-test was run on a sample of 20 athletes to determine their differences on flexibility between pre and post-test taekwondo athletes in Baste and Gere world Taekwondo Clubs. The results showed that the pre-test of taekwondo athletes had statistically significantly lower flexibility (48.35 ±5.050 cm) as compared to post-test flexibility of taekwondo athletes(52.2 ± 4.840 cm), $t(38) = -2.4613$, $p = 0.0185$.This result implies that post-test after eight week plyometric exercise have higher flexibility significantly different from pre-test flexibility taekwondo athletes.

The flexibility test apply by standard sit and rich test method. The objective of this test is to monitor the development of the athlete's hip and trunk flexibility (Mackenzie, 2005). Strengthen the core parts of the lumbar spine and hip muscles, enhance the overall strength of the core muscles passing ability of hurdles. The trunk muscles of hurdlers can regulate the

core muscles of the hurdler's body to maintain the balance and stability of the trunk (Liu aijie, 2007). This trunk muscle also call as core muscle its indispensable for all sport activity especially for sprint hurdlers and taekwondo athletes. Flexibility test of hurdlers finding showed that the pre-test had lower flexibility as compared to post test of hurdle athletes after eight week plyometric exercise ($p=0.0003<0.05$). The case in taekwondo showed that the pre-test of taekwondo athletes had lower flexibility as compared to post-test flexibility of taekwondo athletes ($p=0.0185<0.05$). In agreement to this finding the study conducted that the high explosive of the taekwondo in dollyo chagi that has high level of flexibility that trained by using the plyometric standing jump those who have high level flexibility, they can do the method of standing jump training to increase the explosive power of momtong dollyo chagi kick (Evi Susianti, 2018). Additional study the well-known training methods such as resistance training and plyometric training, strength and conditioning professionals may well incorporate sprint training into an overall conditioning program of athletes striving to achieve a high level of explosive leg power and dynamic stretching athletic performance (Goran markovic, 2007).

4.4. The influence of eight weeks plyometric training on explosive leg strength performance of sprint hurdle and taekwondo

Table 4.7. Two sample squat independent t-test of pre and post Hurdle athletes

S.n	**Variable**	**Obs**	**Mean**	**Std. Err**	**Std. Dev**	**[95%Conf.Interval]**	
1	Pre-test of Hurdle squat	20	44.9	0.160	0.718	44.563	45.236
2	post-test of Hurdle squat	20	45.9	0.298	1.333	45.27578	46.524
Diff		20	-1	0.299	1.337	-1.626	-0.373
mean(diff) = mean (pre Hsquat - post H squat)						t = -3.3431	
Ho: mean(diff) = 0						degrees of freedom = 19	
Ha: mean (diff) < 0			Ha: mean (diff)! = 0			Ha: mean(diff) > 0	
Pr(T<t) = 0.0017			Pr {ITI > ItI} = **0.0034**			Pr(T>t) = 0.9983	

This output provides useful descriptive statistics for the two pre and post-test that were compared, including the mean and standard deviation, as well as the actual results from the

independent T-test. The result showed that the group means are significantly different as the *p*-value in the Pr (|T| > |t|) row (under Ha: diff! = 0) is less than 0.05 (i.e., based on a 2-tailed significance level). Looking at the Mean column, the result showed that post strength test of hurdle athletes had taken higher than pre strength test of hurdles athletes during squat test method.

An independent t-test was run on a sample of 20 athletes to determine their differences on pre and post strength test between Hurdling athletes in commercial bank. The results showed that the pre-test of commercial bank hurdlers had significantly lower strength (44.9 ±0.718 reps) as compared to post test of hurdlers after eight week plyometric exercise (45.9± 1.333 reps), $t(19) = -3.3431$, $p = 0.0034$. This result implies that post squat test of hurdlers have higher strength significantly different from pre squat test of hurdling athletes.

Table 4.8. Two sample squat independent t-test of pre and post taekwondo athletes

S.n	**Variable**	**Obs**	**Mean**	**Std. Err**	**Std. Dev**	**[95%Conf.Interval]**	
1	Pre-test of taekwondo squat	20	45.3	0.262	1.174	44.750	45.849
2	post-test of taekwondo squat	20	46.15	0.264	1.182	45.596	46.703
Diff		20	-0.85	0.31	1.386	-1.499	-0.2
mean(diff) = mean (pre T squat - post T squat)						t = -2.7407	
Ho: mean(diff) = 0						degrees of freedom = 19	
Ha: mean (diff) < 0			Ha: mean (diff)! = 0			Ha: mean(diff) > 0	
Pr(T<t) = 0.0065			Pr {ITI > ItI} = **0.0130**			Pr(T>t) = 0.9935	

This output provides useful descriptive statistics for the two pre and post-test that were compared, including the mean and standard deviation, as well as the actual results from the independent t-test. It revealed that the group means are significantly different as the *p*-value in the Pr (|T| > |t|) row (under Ha: diff! = 0) is less than 0.05 (i.e., based on a 2-tailed significance level). Looking at the Mean column, the result showed that post strength test of

taekwondo athletes had taken higher than pre strength test of taekwondo athletes during squat test method.

An independent t-test was run on a sample of 20 athletes to determine their differences on strength between taekwondo athletes of the two clubs. The results showed that the pre-test of taekwondo athletes had significantly lower strength (45.3 ±1.174 reps) as compared to post test of taekwondo athletes (46.15 ± 1.182 reps), $t(19) = -2.7407$, $p = 0.0130$.

This result implies that the post squat test of taekwondo athletes have higher strength significantly different from pre squat test of taekwondo athletes. The researcher asses the squat test to find out leg strength of taekwondo and sprint hurdle athletes. The finding showed that the pre-test of taekwondo athletes had lower leg strength as compared to post test of taekwondo athletes ($p=0.0130 < 0.05$). In case of hurdling the pre-test of hurdlers had lower strength as compared to post test of hurdlers after eight week plyometric exercise ($p=0.0034 < 0.05$) . In agreement to this finding the study conducted on Effect of Plyometric Hurdle Hops and Tuck Jump Training on Strength and Leg Muscle Power in Martial Arts Athletes at Kostrad Company-C Malang indicates that there was an increase in leg muscle strength and power (putra, 2019). Additional study, researcher observe the mean difference on explosive strength and found increasing significant difference between pre-test and post-test on experimental group and researcher also observed significant difference between pre and post-test on explosive strength due to plyometric training effect (Islam, May 2021).

4.5 The relationship between hurdling and world taekwondo on lower extremity strength.

During Observation of Hurdle and taekwondo athletes on competition of Addis Ababa athletics champion (2013) had not good flexibility and explosive strength. But after eight week plyometric exercise better improvements were observed on lower body power performance, explosive strength, leg strength and flexibility. According to taekwondo athletes during competition of Ethiopia champion (2013) they had good flexibility and explosive strength. But after eight week plyometric exercise better improvement were gained on lower body power performance, explosive strength, leg strength and flexibility. Generally the eight week plyometric exercise was improved the lower body power performance explosive strength, flexibility and leg strength of hurdler and taekwondo athletes.

During interview of coaches' hurdles, taekwondo and staff administration of oromia WTF they negotiated hurdling event needs best model for our country athletes appropriately using scientific method of training for improvement of successful participation to compete with other country. The similarity of training on lower extremity with taekwondo athletes was prime because taekwondo athletes was work above 90% on lower extremity power, strength and flexibility. Hurdler must spend a lot of time on flexibility. The hurdler should be one of the most flexible athletes on the entire track and field team. For taekwondo flexibility is needed to optimize the use of leg power, shoulders, abdominal muscles and waist rounds to kick on (Mailapalli, 2015). In general, the interview result shows, hurdling and taekwondo had relation on lower extremity.

CHAPTER FIVE

SUMMARY, CONCLUSION, AND RECOMMENDATION

5.1. Summary

The main aim of this study is to examine the effect of eight-week plyometric exercise on performance of sprint hurdle and taekwondo athlete In the case of Addis Ababa sport clubs.

A researcher formulate following hypothesis.

1. To assess the impact of eight weeks plyometric training on lower body power performance of sprint hurdle and taekwondo.
2. To find-out the influence of eight weeks plyometric training on hip and trunk flexibility performance of sprint hurdle and taekwondo.
3. To find-out the influence of eight weeks plyometric training on explosive leg power performance of sprint hurdle and taekwondo.
4. To identify the relationship between hurdling and world taekwondo on lower extremity strength.

In order to answer those hypothesis the following where under taken. Quasi-experimental design aims to establish a cause-and-effect relationship between an independent and dependent variable in which repeated measures design is a research design that involves multiple measures of the same variable taken on the same or matched subjects either under different conditions or over two or more time paired.

Comment [WU1]:

Based on the paired sample t-test, the difference between pretest and post-test results was tested and both hurdling and taekwondo showed significant within test value differences. However, the difference in the post test is higher than that of the pretest.

5.2 Conclusion

The eight-week plyometric exercise demonstrated that the plyometric training was more effective than traditional training alone in improving the performance of athletes. The

findings highlight the potential value of the eight-week plyometric training maximizing lower body power performance, leg explosive power, flexibility and leg strength of athletes. Thus, short term plyometric exercise resulted in an improvement in lower body performance of taekwondo and hurdle athletes among sprint hurdles running athletes. According to the independent t-test, there is a significant difference between pre and post-test.

The finding of this study indicates that eight-week plyometric exercise improves performance of lower body power and leg explosive power of taekwondo and hurdle athletes and the taekwondo athletes has good vertical jumping length than hurdle athletes so the lower body performance of taekwondo athletes better improvement.

The finding of this study shows that standing long jump test of taekwondo and hurdle athletes reveals there was difference after eight week plyometric exercise by considering the mean value of post-test of participant. The mean value of taekwondo athletes has better than that of hurlers for that case the taekwondo athletes had better performance on leg explosive power.

The finding of this study shows that performance flexibility of taekwondo and hurdle athletes were increase after eight week plyometric exercise and the taekwondo athletes has more flexible than that of hurdle athletes due to this result using taekwondo athletes for sprint hurdle is appropriate because hurdler's has extremely doing flexibility from field event truck.

The study shows leg strength of taekwondo and sprint hurdle athletes also had difference before and after eight week plyometric exercise.The study showed that the pre-test of taekwondo and hurdling athletes had lower on leg strength as compared to post test.

The study suggests that taekwondo and sprint hurdler had relationship on lower extremity strength because the eight week plyometric exercise had same effect on leg strength of hurdlers and taekwondo athletes.

The study reveals there was great interest for athletics coaches because the performance of taekwondo athletes has fit for sprint hurdling sport relies greatly on lower body power performance explosive leg power high flexibility elastic strength with good leg strength and all of which were enhanced by the plyometric training regimen.

5.3 Recommendations

In the present study the effects of plyometric exercise both on sprint hurdler and taekwondo athletes was clearly observed. Based on the current findings it is interesting to recommend:

- Ethiopian athletics and World taekwondo Federations to regularly incorporate plyometric exercise in their trainings to improve the performances of hurdler and taekwondo athletes.
- Athletic clubs and coaches to give chances for taekwondo athletes during selection for further competitions in hurdling since they have better lower body performances.
- Awareness that the government, athletics federation and clubs have very low on taekwondo sport even if it has better performances on plyometric exercises.
- Further investigation is needed on the effects of plyometric exercises on the others sport events and core muscles.

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APPENDIX-01

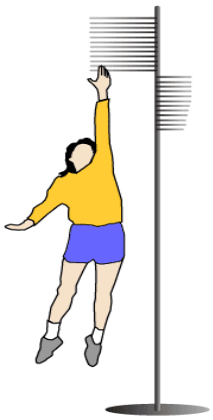
Vertical Jump Test (Sargent Jump, Vertical Leap)

The vertical jump test is a test of lower body power. The test was first described nearly 100 years ago (Sargent, 1921). The procedure below describes the method used for directly measuring the vertical jump height jumped. There are other methods such as using timing systems that measure the time of the jump and from that calculate the vertical jump height.

Purpose: to measure the leg muscle power

Equipment required: measuring tape or marked wall, chalk for marking wall (or Vertec or jump mat).

Pre-test: Explain the test procedures to the subject. Perform screening of health risks and obtain informed consent. Prepare forms and record basic information such as age, height, body weight, gender, test conditions. Perform an appropriate warm-up. See more details of pre-test procedures



Procedure (see also variations below): the athlete stands side on to a wall and reaches up with the hand closest to the wall. Keeping the feet flat on the ground, the point of the fingertips is marked or recorded. This is called the standing reach height. The athlete then stands away from the wall, and leaps vertically as high as possible using both arms and legs to assist in projecting the body upwards. The jumping technique can or cannot use a countermovement (see vertical jump technique). Attempt to touch the wall at the highest

point of the jump. The difference in distance between the standing reach height and the jump height is the score. The best of three attempts is recorded.

Variations: The vertical jump test can also be performed using a specialized apparatus called the Vertec. The procedure when using the Vertec is very similar to as described above. Jump height can also be measured using a jump mat which measures the displacement of the hips. To be accurate, you must ensure the feet land back on the mat with legs nearly fully extended. Vertical jump height can also be measured using a timing mat. The vertical jump test is usually performed with a counter movement, where there is bending of the knees immediately prior to the jump. The test can also be performed as a squat jump, starting from the position of knees being bent. Other test variations are to perform the test with no arm movement (one hand on hip, the other raised above the head) to isolate the leg muscles and reduce the effect of variations in coordination of the arm movements. The test can also be performed off one leg, with a step into the jump, or with a run-up off two feet or one foot, depending on the relevance to the sport involved. For more details see vertical jump technique.

Scoring: The jump height is usually recorded as a distance score. See the vertical jump norm table to rate scores. For more information, see a selection of vertical jump test results. It is also possible to convert jump height into a power or work score.

Advantages: this test is simple and quick to perform.

Disadvantages: technique plays a part in maximizing your score, as the subject must time the jump so that the wall is marked at the peak of the jump.

Comments: The jump height can be affected by how much you bend your knees before you jump, and the effective use of the arms. The test is also sometimes incorrectly spelled as the "Sergeant" or "Sargent" Test.

History: This method described above for measuring a person's vertical jump height is sometimes known as a Sargent Jump, named after Dudley Sargent, who was one of the pioneers in American physical education.

APPENDIX-02

Standing Long Jump Test (Broad Jump)

The Standing long jump, also called the Broad Jump, is a common and easy to administer test of explosive leg power. It is one of the fitness tests in the NFL Combine. The standing long jump was also once an event at the Olympic Games, and is also an event in Sports Hall competitions in the UK and part of the power quadrathlon and jumps decathlon assessment.

Purpose: to measure the explosive power of the legs

Equipment required: tape measure to measure distance jumped, non-slip floor for takeoff, and soft landing area preferred. Commercial Long Jump Landing Mats are also available.

Pre-test: Explain the test procedures to the subject. Perform screening of health risks and obtain informed consent. Prepare forms and record basic information such as age, height, body weight, gender and test conditions. Check and calibrate equipment if required. Perform a standard warm-up. The take off line should be clearly marked. See more details of pre-test procedures.

Procedure: The athlete stands behind a line marked on the ground with feet slightly apart. A two foot take-off and landing is used, with swinging of the arms and bending of the knees to provide forward drive. The subject attempts to jump as far as possible, landing on both feet without falling backwards. Three attempts are allowed. See some long jump video examples.

Scoring: The measurement is taken from take-off line to the nearest point of contact on the landing (back of the heels). Record the longest distance jumped, the best of three attempts. The table below gives a rating scale for the standing long jump test for adults, based on personal experiences. See some athlete results for the long jump test. You can also use this calculator to convert cm to feet and inches.

	Males		**females**	
rating	**(cm)**	**(feet, inches)**	**(cm)**	**(feet, inches)**
excellent	> 250	> 8' 2.5"	> 200	> 6' 6.5'
very good	241-250	7' 11" — 8' 2.5"	191-200	6' 3" — 6' 6.5'
above average	231-240	7' 7" — 7' 10.5"	181-190	5' 11.5" — 6' 2.5"
average	221-230	7' 3" — 7' 6.5"	171-180	5' 7.5" — 5' 11"
below average	211-220	6' 11" — 7' 2.5"	161-170	5' 3.5" — 5' 7"
poor	191-210	6' 3" — 6' 10.5"	141-160	4' 7.5" — 5' 2.5"
very poor	< 191	6' 3"	< 141	< 4' 7.5"

** table results adapted from personal experience and various sources.*

Variations / modifications: A long jump landing pit is sometimes used instead of a hard surface, which enables the subject to confidently put more effort into the jump, and to extend the legs further in front of the body for landing. This technique also allows those with greater skill to score longer jumps, which is undesirable if you are trying to test for leg power only. Generally longer distances should be achieved with this technique, so the norm table above would not be accurate. The Eurofit Test recommends using a graduated mat for ease of recording jump distance on the landing surface.

Advantages: this test is simple and quick to perform, requiring minimal equipment.

Disadvantages: there is some skill component in this test.

Comments: Falling or stepping backward after the landing will result in measurement to that point of contact rather than where the feet first touched. Some subjects will try to use a step at take-off, which is not allowed. The World Record for the standing long jump is held by Norwegian Arne Tvervaag, who jumped 3.71 meters (12 feet 2.1 inches).

APPENDIX-03

Squat Test

How many squats can you do? Stand in front of a chair or bench with your feet at shoulder's width apart, facing away from it. Place your hands on your hips. Squat down and lightly touch the chair before standing back up. A good sized chair is one that makes your knees at right angles when you are sitting. Keep doing this until you're fatigued.

Write down how many squats you can do. After you work out for a while, take the test again to see how much your lower body strength has improved.

How did you go?

Compare your results to the table below. Remember, these scores are based on doing the tests as described, and will lose accuracy if the test is modified, including using a higher or lower chair. In reality, you shouldn't worry too much about how you rate - just try and improve your own score. These figures can just be a guide.

Squat Test (Men)

Age	**18-25**	**26-35**	**36-45**	**46-55**	**56-65**
Excellent	> 49	> 45	> 41	> 35	> 31
Good	44-49	40-45	35-41	29-35	25-31
Above average	39-43	35-39	30-34	25-38	21-24
Average	35-38	31-34	27-29	22-24	17-20
Below Average	31-34	29-30	23-26	18-21	13-16
Poor	25-30	22-28	17-22	13-17	9-12
Very Poor	< 25	< 22	<17	<9	<9

Squat Test (Women)

Age	18-25	26-35	36-45	46-55	56-65
Excellent	>43	>39	>33	>27	>24
Good	37-43	33-39	27-33	22-27	18-24
Above average	33-36	29-32	23-26	18-21	13-17
Average	29-32	25-28	19-22	14-17	10-12
Below Average	25-28	21-24	15-18	10-13	7-9
Poor	18-24	13-20	7-14	5-9	3-6
Very Poor	<18	<20	<7	<5	<3

APPENDIX-04

Modified Sit & Reach Test

The objective of this test is to monitor the development of the athlete's hip and trunk flexibility.

Required resources

To undertake this test you will require:

'Sit & reach'

Yard stick

Assistant.

How to conduct the test starting position

Sit on the floor with the back and head against a wall, legs fully extended with the bottom of the feet against the sit and-reach box

Place the hands on top of each other, stretching the arms forward while keeping the head and back against the wall

Measure the distance from the finger tips to the box edge with a ruler. This becomes zero or starting point.

Movement

Slowly bend and reach forward as far as possible sliding the fingers along the ruler

Hold the final position for 2 seconds

Record the distance reached to the nearest 1/10 of an inch

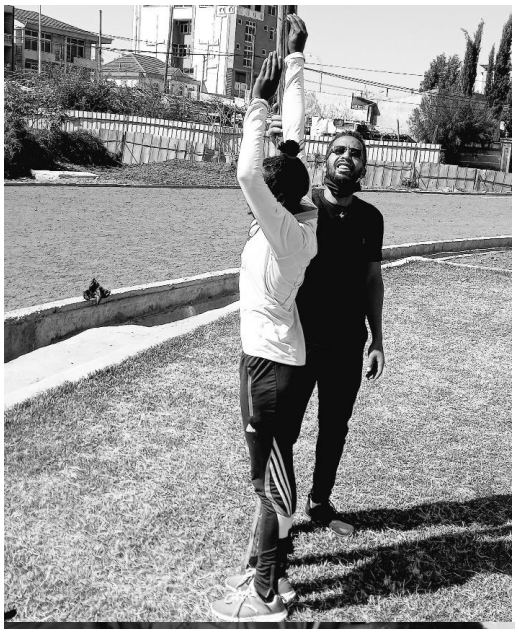
Repeat the test 3 times and note the best distance.

Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

APPENDIX-05

Photo picture during fitness test



APPENDIX-06

Observational checklist

No	Item	v. good	good	Satisfactory	Un satisfactory
	during competition, pre –test and post- test				
1	Lower body power performance of hurdler during competition of Addis Ababa clubs champion(2013ec)			*	
2	Leg Explosive power of hurdler on bar clearance during competition of Addis Ababa clubs champion(2013ec)			*	
3	Flexibility of hurdler on bar clearance and landing phase during competition Addis Ababa clubs champion(2013ec)			*	
4	Lower body power performance, leg strength and flexibility of hurdler during pre –test			*	
5	Lower body power performance, leg strength and flexibility of hurdler during post –test	*			
7	Lower body power performance of taekwondo athletes on lower extremity kick during competition of Ethiopian champion(2013ec)		*		
8	Leg explosive of taekwondo athletes on lower extremity kick during competition of Ethiopian champion(2013ec)			*	
9	Flexibility of taekwondo athletes on lower extremity kick lumbar stabilization during competition of Ethiopian champion(2013ec)		*		
10	Lower body power performance, leg strength and flexibility of taekwondo athletes during pre –test		*		
11	Lower body power performance, leg strength and flexibility of taekwondo athletes during post -test	*			

APPENDIX-07

exercise protocol

Week 1-2	week 3-4	week 5-6	week 7-8
Exercise			
Light lateral bounds 2x10	Cone hopes 3x5	Split squat jumps 3x5/side	Split squat jumps 3x5/side
Ankle hops 2x10	TRX Assisted split squat jumps 3x5/side	Repeated lateral bounds 3x5/side	Tuck jumps 3x6
Cone hopes 2x5/side	Lateral bound(long) 3x5 side	TRX Assisted tuck jumps 3x6	Single leg box jumps 3x5/side
TRX Assisted squat jumps 2x5	Repeated squat jump 3x5	Box jumps 3x6	Weighted squat jump 3x6
	box jumps 3x5	6 inch depth jumps 3x6	12-inch depth jumps 3x6

APPENDIX-08

Research Settings and Participants of the Study

No	Involved groups	Research instruments used	Respondents		
			Male	Female	Total
1	Hurdle athletes	_	12	8	20
2	Coaches of the hurdle athletics Club.	Questionnaire appendix 11	1	1	2
3	Teakwood athletes	_	10	10	20
4	Coaches of the taekwondo Club	Questionnaire appendix 10	2	-	2
Ground total			25	19	44

APPENDIX-09

Material used

No	Material	Amount	Purpose
1	Human resource	40 trainers and their coaches	As a sample and coaches for guidance
2	Hurdle	20	To facilitate the running process
3	Watch	3	Counting
4	Tape	1	Measuring distance
5	Sport clothes and shoe	10	To facilitate the running process

APPENDIX-10

Semi-structured interview for Taekwondo Coaches

First of all i would like to say thank you! For your posetive cooperation.

1. What do you think if taekwondo training are take achance to perform on hurdling do you think they are efficient withe regard to theit exercise?

……
……

2. is there any problem in taekwondo sport as our cuntriy to impower and consistency ?

……
……

3. do you believe that taekwondo athletes train almost similar training with regard to plyometric lower body exctrimity exercise?

……
……

APPENDIX-11

Semi-structured interview for hurdling coaches

First of all i would like to say thank you! For your posetive cooperation.

1.In your openion, What do you think of the main problem for unsuccessfully participation on hurdling event on our club?

……
……..

2. based on your, openion the similarity of the excercise that both hurdling and taekwando has, do you think that the taekwando sport can replace the hurdling compilation?

……
……

3. In your perspective, Do you think that there is a peroblem with the training that the athletes take on?

……
……