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EFFECTS OF CORE STRENGTH TRAINING ON SPRINTING PERFORMANCE AND SELECTED FITNESS VARIABLES:IN THE CASE OF FINOTE SELAM ANDNET ATHLETICS PROJECT

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BAHIR DAR UNIVERSITY

SPORT ACADEMY

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AUGUST, 2020

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By:

Nibret Shitahun

A Thesis Submitted to the School of Graduate Studies of Bahir Dar University, Sport Academy, department of Sport Sciencein Partial Fulfilment of the Requirements for the Degree of Master of Science in Athletics Coaching

Advisor:

Zerihun Birhanu (PhD)

August, 2020

Bahir Dar

DECLARATION

I, Nibret Shitahun, hereby declare that the thesis entitled on "**The effect of core strength training on the sprinting performance and selected fitness variables in case of Finote Selame Andnet athletics project athletes.**" is my original work and has never been presented or published in any other institution. I have followed all ethical principles of scholar in the preparation, data collection, data analysis and completion of this thesis. I also declare that any information used in this thesis has been dully acknowledged. I affirm that I have cited and referenced all sources used in this document. The work here, have been submitted for Bahir Dar University, Sport Academy in 2020 G.C for the requirements of degree of masters of Science in Athletics coaching.

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Approval of Thesis for Defence

I hereby certify that I have supervised, read, and evaluated this thesis titled "**The effect of core strength training on the sprinting performance and selected fitness variables in case of Finote Selame Andnet athletics project athletes**" by Nibret Shitahun, prepared under my guidance. I recommend the thesis be submitted for oral defence.

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EXAMINERS'APPROVAL SHEET

A Thesis Entitled on

Effects of Core Strength Training on Sprinting Performance and Selected Fitness Variables in Case of Finote Selam Andnet Athletics Project Athletes.

By:

Nibret Shitahun

We hereby certify that this Thesis submitted by Nibret Shitahun conforms to acceptable standards, and as such is fully adequate in scope and quality. It is therefore approved as the fulfilment of the Thesis requirements for the degree of Master of Science in Athletics Coaching.

Board of Examiners

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DEDICATION

I dedicate this thesis to my beloved mother, Emebet Alemu, who gives frank love, persistent and moral support for the last two years as well as still out my life to reach in this stage**.** Thank you mom as your mental and emotional support was the pillars of foundation in this thesis.

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LIST OF ABBREVIATIONS

BC	Before Christ
CG	Control Group
CI	Confidence Interval
CS	Core Strength
CST	Core Strength Training
EG	Experimental Group
GC	Gregorian calendar
GRF	Ground Reaction Force
M	Meter
Min	Minute
P	Level of Significant
PRT	Pre test
POS	Post test
S	Second
S&C	Strength training and conditioning
SPSS	Statistical Package for Social Science

Abstract

Strong core muscle was believed to help athletics performance; few scientific studies have been conducted to identify the effectiveness of core strength training for enhancing athletics performance. The purpose of this study was to investigate the effects of Core strength training on sprinting performance and selected fitness variables. The study applied quantitative research approach and employ quasi experimental design to attain the intended objectives. For this study the researcher has selected all 20male short distance athletes who participate in 100M and 200M sprint running in Finote Selam Andnet athletics project as a sample by using comprehensive sampling methods. Thus athletes were assigned randomly into two groups, 10 of them experimental and the rest 10 as control group. They were in the age category of 18 up to 26 years. Core strength training (CST) program was administered three days per week for about eight consecutive weeks for the experimental group in addition to the regular training program and the control group has only received the previously regular training program. Pre and post training tests were conducted to measure the athletes' sprinting performance and selected fitness variable changes for speed, strength, agility and sprinting performance. The data was collected using appropriate performance test such as flying 30M test for speed fitness, T' Drill Test for agility fitness, Core Muscle Strength & Stability test for strength fitness and 150M run test for sprinting performance. After gathering the PRT and POT value the data was analysed by using SPSS version 23.0 statistical software of paired sample T test with the level of significant at ($P \leq 0.05$) to know the difference between PRT and POT results. The results showed that eight weeks core strength training has significant effect on speed, agility, strength and sprinting performance for experimental group at ($P<0.05$), however, there were no significant improvements on comparison group. Based on this finding, it can be concluded that core strength training helps to improve speed, strength, agility, and running performance of sprinters.

Key words: *core strength training, speed, agility, strength, sprinting performance.*

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Sprint running include under track events which are races over short distances. It is among the oldest running competitions. A rapid movement from one place to another place is required in a many athletic activities especially in sprint running (kukolj, Ropret, Ungarkovic & Jaric, 2001 as cited in Degati & Kumar, 2017). Sprinting performance has fascinated audiences across the world since the ancient Olympic games in the 18th century (Richard,Mark, Harrison, & Kenny, 2015). In contrast to some sport skills, sprinting is a natural activity that most athletes skilled with (Brown & Ferrigno, 2005). The proverb that sprinters are innate or born and not developed was quiet popular with many coaches, but that is not. Even though there is no doubt that genetic gifts above and beyond the norm are essential to become a great sprinter, speed capabilities can be maximised using scientifically based training methods. Although, training for success in the sprint running can be challenging and complicated. Elements contain high-velocity running, speed endurance, strength and power, flexibility, neuro-muscular programming and mental preparation. One of the main challenges faced by most athletes and coaches are what is well-known as the speed barrier or speed plateau, where the athlete has extreme trouble to increase their running velocity despite increases in the volume or quality of training (International Association Athletics Federation, 2011).

Strength is one of the most dominant and implication biomoter abilities for sprint running performance. The fact that muscular strength appears to be influence running speeds. For instance, leg strength and power appear to be significantly related to sprint speed, with the strongest and most powerful athletes being able to run the fastest (Bompa & Haff, 2009). It is a key aspect of all sporting pursuits and can be seen as an integral part of most athletes' training programmes. Yet there is considerable confusion surrounding the concept of strength development and its relationship to performance (Gordon, 2009).

Another fitness variable that can potentially affect the sprints' performance is speed; it is a dominant and critical component for sprint running. Which is the change in distance over time and maximal speed is a critical component to anaerobic sport performance especially for sprint running. However, maximal speed may not be attained until the athlete has run at least 20–40M in a linear path (Ratamess, 2012). The

acceleration phase and predominantly the initial acceleration phase (0– 10M) are of major importance to athletes (Shinkle et al., 2012). The ability to move rapidly over varying distances is a fundamental aspect of many sports and not solely confined to activities such as sprinting. Still, the topic of speed is more intricate or difficult than simply a matter of getting from point A to point B as quickly as possible rather it comprises many factors all contributing to the general development of speed (Gordon, 2009). However it is the most dominant biomoter abilities for short distance running performance. It focuses on power, explosiveness and top speed. The use of the body centers on the development of force is highly intensive. Sprinters, then they regularly train at high speeds, are likely to produce more acute angles at the hip and knee. Its overall higher speed also leads to the regular production of an increased angular velocity at the hip (Bushnell, 2004). In sprinting, the muscles of the lower limb i.e. hip, knee and ankle joints have to accelerate the body and propel it in a horizontal direction while responding the force of gravity in the vertical direction. Various changes in the lean of the body is occur and muscle involvement differs between acceleration phase and maximum running speed (Delecluse, 1997). Therefore to strength our core especially around the hip, thigh and abdominal muscles core strength training has a great effect for thus sprinters.

Agility is also another fitness variable that can has potential effect on sprinting performance**.** It is quite complex and requires the optimal assimilation of several physiological systems and components of fitness. The ability to change direction rapidly in response to a stimulus is agility. If an athlete may have sufficient linear speed, this does not mean they will be very agile and coordinated. So it must be trained independently in order to maximize sprinting performance. It requires the athlete to coordinate several activities including the ability to react and start quickly, accelerate, decelerate, move in the proper direction, and maintain the ability to change direction as rapidly as possible while maintaining balance and postural control (Ratamess, 2012).

So as to improved sprint performance training methods have a great roles typically which is aim for hypertrophy and neuronal activation, velocity specific (speed and strength), and movement-specific (sprint-associated exercises) strength training. Regardless of the type of training, sprinters often perform hip flexor exercises in their training. However, hip flexion exercises are rarely give emphasis to strength programs for athletes in other sports (Deane, Chow, Tillman, & Fournier, 2005).

“Anatomically, the core can be defined as a muscular box with the abdominals in the front, para spinals and gluteus in the back, the diaphragm as the roof, and the pelvic floor and hip girdle musculature as the

bottom. Functionally, the core can be thought of as the kinetic link that enables the transfer of torques and angular momentum between the lower and upper extremities that is of vital for sport-specific and everyday activities" (Granacher et al., 2014). Many studies have been cited repeatedly, as they provide a point of departure for further investigations in the topic, and the importance of core strength training on athletic performance has been greatly debated in the last decade. Core training is executed by world-class athletes in cross-country skiing, speed skating, athletics, ski jumping, Nordic combined, snowboard, ice hockey, soccer, handball, rowing, kayak, swimming, cycling, golf, sailing, taekwondo, wrestling, orienteering and biathlon. Definitely, core training is one of a very few training forms common for all these sport disciplines. The total weekly core training volume varies noticeably between individuals and sport disciplines, ranges from 5 min to 2 h per week. Anecdotally, cross country skiers, rowers, kayakers, sailors and golfers typically perform core training than other athlete groups(Haugen, Haugvad &Røstad, 2016).

According to Dinç & Ergin (2019) study 8-week core strength training intervention showed no effect on athletes' balance but a positive effect on long jump and agility were observed on 28 volunteered athletes and was accepted at $p < 0.05$. They used standing long jump, Illinois and double right/left foot balance tests to determine the explosive force, agility and balance performance, respectively. Hung,Chung, Id, & Lai(2019) results reveal that 8-week core training may improve static balance, core endurance, and running economy in college athletes. As tested by sensory organization test, sport-specific endurance planks test and 4-stage treadmill incremental running test. However, Baker,Boone,& Nesser (2009) results suggested that no significant correlations were identified between core strength and strength and power in division I female soccer players. Another study conducted by Araujo,Cohen, & Hayes (2015) provides evidence that trunk dominant six weeks core stability training improves landing kinetics without improving jump height, and may reduce lower extremity injury risk in female athletes in sixteen female capoeira athletes. Body weight, average loading rate during the first landing phase, and jump height were not significantly different between week 0 and week 6.

Strong core muscles are supposed to help athletic performance, although there has been very little research on the effects of core strength training on running performance. Exercises devised or planned to train the core musculature are integral to many strength and conditioning programs, as greater core strength may provide a foundation for greater force production in the upper and lower extremities. However, good core functioning is commonly believed to enhance athletic performance, recent reviews have concluded that core training provides only marginal or minimal benefits to athletic performance (Weston, Hibbs, Thompson, & Spears, 2014). The subjects or participants of the study were Finote Selam Andnet short

distance athletics project, who were participating in 100 and 200M sprint running for the last one and above years. The aim of this study was to examine the effect of core strength training on the sprinting performance and selected fitness variables in the case of Finote Selam Andnet short distance athletics project athletes.

1.2 Statement of the Problem

Nowadays, it is generally accepted that sprint performance, similar to endurance performance, can improve significantly with training. Specifically, strength training plays a key role in this process. Sprint performance viewed multidimensional as an initial acceleration phase, a transition phase and maximum running speed phase. Immediately following the start action, the powerful extensions of the hip, knee and ankle joints are the basic accelerators of body mass. Different training methods are planned to increase the power output of these muscles (Delecluse, 1997). However core strength training is the one training types that develop the main accelerators of thus body muscles.

Core strength training (CST) is broadly used in the strength and conditioning, health and fitness, and rehabilitation industries with claims of improving performance and reducing the risk of injuries. It is supposed among those professionals that to develop athletic performance and prevent risk of injury, CST is one of the vital components in the strength and conditioning field. Core-related exercises i.e. Swiss ball training, balance training, weight training, and yoga have become widespread physical activities in recent years (Sato & Mokha, 2009). Good core functioning is commonly believed to enhance athletic performance, recent reviews have concluded that core training provides only marginal or minimal benefits to athletic performance (Weston et al., 2014). According to Deane, Chow, Tillman, and Fournier (2005) study there is a significance improvement in the acceleration of sprint and shuttle run time by doing 8 weeks hip flexor training, on the recreational athletes. Sato and Mokha also study on core strength training influence running kinetics, lower-extremity stability, and 5000M runners' performance and there results showed a significant effect on running performance from 6 weeks execution of CST for 4 sessions per week. Similarly, Hung, Chung, Id, and Lai (2019) results also indicates that eight weeks core training may improve static balance, core endurance, and running economy in college athletes. On the contrary, Cleveland (2011) study showed that core strength training did not produce a significant improvement in half marathon running time on well-trained distance runners after eight week core training.

Core strength training is not incorporated on the normal training programs in Finote Selam Andnet athletics project of the short distance running training programs. Although the annual plan focus on strength trainings such as general strength, maximum strength, strength endurance, elastic strength and

power only, nothing information is here about core body strength training on the short distance running coaching annual plan program. Coaches' efforts at planning their athletes' training are a complex practice involving in so many variables that the logic of how they all fit together to produce a peak performance is never obvious or clear. However, many numerous work as if their athletes' training programmes can be gathered in a coherent, rational way, or if systems exist to make planning a systematic sequence of steps or stages (Denison, 2010). A strong basis of muscular balance and core strength is crucial for middle and long distance runners. In their experience working with in elite runners, even those at an Olympic level, the weakness or lack of sufficient coordination in core musculature can lead to less efficient movements, compensatory movement patterns, strain, over use, and injury (Fredericson & Moore, 2005).

Running is a series of unilateral hip flexion and extension movements that can place considerable amounts of destabilizing or dislocation torques on the trunk. More simply defined, the hips and pelvis rotate on the stable base created by the core permitting movement of the subject. If the core is weak, the forces created will not be used properly. The function of the core is to resist the rotational forces of the activity and keep all motion moving in the desired direction, but not all activities mimic the demands of running (Shinkle, Nesser, Demchak, & Mcmannus, 2012). Over the past several years, the body of literature regarding on the relationship between core strength and athletic performance has significantly increased. Though, this relationship has still not wall defined, and relatively few studies have been attempted to quantify a correlation between the two variables (Chris, Jarrod, Joel, Matt, &Terry,2011).

The aim of this study was to examine the effect of core strength training on the sprinting performance and selected fitness variables in the case of Finote Selam Andnet athletics project athletes. Specifically, does a progressive core strengthening training program positively influence on sprinting performance and selected fitness variables? To answer this question and on above conflicting ideas, the researcher has an intention to study the effect of core strength training on sprinting performance and selected fitness variables.

1.3 Objective of the Study

1.3.1General Objective

The general objective of the study was to investigate the effect of core strength training on sprinting performance and selected fitness variables in the case of Finote Selam Andnet Athletics project athletes.

1.3.2 Specific Objective

The study was also attempts to address the following specific objectives:

1. To examine the effects of core strength training on sprinting performances of short distance athletes.
2. To investigate the effects of core strength training on speed performances of sprinters.
3. To determine the effects of core strength training on agility performances of sprinters.
4. To assess the effect of core strength training on strength performance of sprinters.

1.4 Hypothesis

For the purpose of this study the following hypotheses was formulated:

H_0; - Eight weeks core strength training has no significant effect on sprinting performances of short distance athletes.

H_0; - Eight weeks core strength training has no significant effect on speed performance of sprinters.

H_0; - Eight weeks core strength training has no significant effect on agility performance of sprinters.

H_0; - Eight weeks core strength training has no significant effect on strength performances of sprinters.

1.5 Delimitation of the study

The study has focused on the effect of core strength training on sprinting performance and selected fitness variables in case of Finote Selam Andnet athletics project athletes. It is difficult to conduct research in all projects that is found in West Gojjam Zone. Because it is time consuming and it takes a lot of budget. In addition, it is difficult to measure their testes since the study is experimental. However the scope or delimitation of this study identifies what the researcher wants to cover. The study was delimited to only short distance athletes in Andnet athletics project which is found in Amara region, West Gojjam Zone, Finote Selam Town. In this study there were 20 male sprinters who participated in short distance running only, this subjects selected age ranges from 18-26 years and healthy or athletes would have no any recent physical injury and heart problems include under the study. It was also delimited to fitness variables on speed, agility, and strength and the sprinting performance of short distance athletes. The study delimited also to 100 and 200M sprint runners only. Finally the study was delimited to conduct in the training year 2019/20 G.C.

1.6 Significance of the Study

The main benefit of any research was to increase knowledge; the study which carried out by one researcher may be further studied and would be studied by other researchers many times which is replication for a

specific issue with different subjects, methods etc. When we come to this study, it would have been the following significances:

Firstly the study was vital for coaches, sport professionals and researchers it gives valuable information about core strength training for the development of sprinters' performance, it creates better understanding of core strength training and sprinting performance would be valuable in designing exercise prescriptions for short distance runners, and developing strategies so as to improving sprinting time of athletes, include it to their normal training program routine. The findings of this study would have a great contribution to add new ideas to the existing knowledge of the coach and sport practitioners related to core strength exercise, in addition to the normal strength training of the coach such as strength endurance, maximum strength, power, elastic strength and weight training. Secondly it gives meaningful information about core strength training for athletes who participate on Finote Selam Andnet athletics project specially, in short distance running to develop their knowledge on different strength trainings in order to develop their sprinting performances. Finally the research was contributed as a literature for thus scholars, have an intention to core strength exercise on the performance and fitness variables of short distance athlete's to fill other barriers which is not observed on this study and it can serve as starting point for other researchers to carry out for related study.

1.7 Limitation of the Study

Research has many challenges and tasks from its very beginning up to its end. Among the many stages of the undertaking, the process of giving intervention to the experimental group, data collection and analysing I have faced a great problems, especially in experimental research designs. I can say that, of the challenges I have faced in this study, those that has happened during this stage had of a paramount difficulty. As a result, limitations like small sample size for both experimental and comparison group affect the influence of analysed statistical results. Here therefore the researcher has been facing limitations while conducting this research work such as lack of research works and articles specifically locally published in the area, financial constraints, transportation problem in traveling and luck of scientific tools of measurements, especially for core strength and stability test I have faced many challenges to analyse and interpret thus the collected data. Athletes extra training program may be affected the investigator's training sessions; some players may not be able to attend regularly the training sessions. Finally the pandemic of corona virus has also great influence on this study.

1.8 Definition of key terms

Core: refers the limbo pelvic region of the body, the muscles surrounding the hips, pelvis, and lower back (Nikolenko, Brown, Coburn, Spiering, & Tran, 2011).

Core strength: The sprinters ability of the core musculature to exert force and power.

Performance: Sprinters pursuit of excellence, where an athlete measures his or her performance as a progression toward excellence or achievement.

Fitness: involves the performance of the heart and lungs, and the muscles of the sprinters body.

Agility: Sprinters rapid whole body movements that require single or multiple changes in velocity or in response to an external stimulus(Sands, Wurth, & Hewit, 2012).

Speed: is the sprinters ability to cover a certain distance quickly (Bompa & Haff, 2009).

Strength: the sprinters ability to apply force (Gordon Dan, 2009).

Training: is a process by which an athlete is prepared for the highest level of performance possible(Bompa & Haff, 2009).

Athlete: the term athlete has come to be used to refer to trainers that participating in short distance athletics sport.

1.9 Organization of the Study

This experimental research was organized in five chapters. In the first chapter, presented the background to this study, it includes a discussion about core strength training in relation to sprinting performance and selected fitness variables, which was briefly described. It also comprises the statement of the problem, general objective of the study, specific objectives, research hypotheses, significance of the study, delimitation of the study, limitation of the study, operational definitions of key terms and organization of the study also described in detail. Chapter two concentrates on a review of related literature. In this section, relevant research works of both conceptual and empirical analysis was thorough and deeply reviewed. The third chapter of this study explains the research methods that include, the geographical location of the study area, the research approach, research design, study population, sample and sampling techniques, source of data, data collection instrumentation, method and procedure of data collection, inclusion and exclusion criteria, method of data analysis, ethical consideration were discussed in detail. In chapter four

the results obtained in the study and analysis were presented, which investigates the effect of core strength training on the sprinting performance and selected fitness variables in Finote Selam Andnet athletics project athletes. In addition, this chapter describes discussion of the results with the existing and past research works scrutinized in line with the present findings. Finally the Fifth chapter presents the summary, conclusion and recommendation of the study.

CHAPTER TWO

REVIEW OF RELATED LITERATURES

The purpose of this review was to present a detailed significant overview of a literature cautiously, the effect of core body strength training on the short distance running performance and fitness variables. The review conducted to consider as much realistic evidence as possible concerning on CST association with the improvement of short distance running performance, strength, speed, and agility fitness.

2.1 Historical Background of Athletics and Sprinting

Athletics is a collection of sporting activities which is comprise competitive running, jumping, throwing and walking. It is the natural pursuits of human beings. Some the usual activities like walking, running, jumping, and throwing are the movements which we learnt first as small children (Thompson, as cited in Birtukan, 2016). Track and field, cross-country running, road running and race walking are the most common types of competitive athletics. Organised athletics traced back to the ancient Olympic Games since in 776 BC. The rules and layout of modern events in athletics were well-defined in Western Europe and North America in 19^{th} and early 20^{th} century and move apart to other areas of the world including the continent of Africa. The tradition to participate in international game in the context of athletics in Ethiopia became a usual practice and its history in Ethiopia may traces back to the late 19th century (Yohannes, 2018). Even if track events have been broadly practiced sport activities in Ethiopia, however when we come to sprint running still there is no significant success shown in the field and is not free from many problems. Short distance running of Ethiopian national team was found to ineffective because the training are not continual that means the number of session's sprint runners engaging was not enough for successes (Birtukan, 2016). Sprinting is running over a short distance in a limited period of time. It is used in many sports that incorporate running, typically as a way of quickly reaching a target or goal, or avoiding or catching an opponent. Human physiology dictates that a runner's near-top speed cannot be maintained for more than 30–35 seconds due to the depletion of phosphocreatine stores in muscles, and perhaps secondarily to excessive metabolic acidosis as a result of anaerobic glycolysis. In athletics and track and field, sprints (or dashes) are races over short distances. They are among the oldest running competitions, being recorded at the Ancient Olympic Games. Track and field is mostly a sprint sport. All things being equal, speed usually wins the race. The pure sprint events include the 100 meters, 200 meters, 400 meters, and the 4x100 and 4x400 relays (LA84 Foundation, 2008).

At the professional level, sprinters begin the race by assuming a crouching position within the starting blocks before driving forward and gradually getting into an upright position because the race progresses and momentum is gained. The set position differs depending on the start. The set position differs depending on the start. The use of starting blocks allows the sprinter to perform an enhanced isometric preload; this generates muscular pre-tension which is channelled into the next forward drive, making it more powerful. Body alignment is of key importance in producing the optimal amount of force. Ideally the athlete should begin during a 4 point stance and drive forwards, pushing off using both legs for max force production. Athletes remain within the same lane on the running track throughout all sprinting events, with the only exception of the 400 m indoors. Races up to 100 M are largely focused upon acceleration to an athlete's maximum speed. All sprints beyond this distance increasingly incorporate a component of endurance.Since the ancient Olympic Games in the eighth century BC sprinting performance has captivated audiences across the world. Many studies have been conducted using sprinters as a study population. The majorities of these are acute studies and investigate a wide variety of topics such as physiological changes alteration in stride length and frequency and acute biomechanical changes (Richard, Mark, Harrison, & Kenny, 2015).

2.2 Sprint Training and Mechanics of Sprint Running

According to Brown and Ferrigno (2005) there are three sprinting technique variants i.e. acceleration, transition and maximum velocity. When applying each these variants of running mechanics are typically addressed body position including visual focus; (the athlete should look in the direction that he or she intended to go); arm action (the athlete should facilitate leg action with aggressive hand and knee hammering or punching motions); and leg action (the athlete should move the legs explosively and minimize ground support time).

The phases of sprinting begin with the starting position, acceleration, and maximum speed. The starting position is essential for attaining optimal stability allowing maximal propulsive forces for acceleration. Acceleration is marked by an increase in velocity. Once the athlete begins to accelerate and reaches peak speed or velocity, several phases can be identified that assist the coach in stressing proper technique. Sprinting can be characterized by two major phases: flight phase and the support phase. The flight phase describes motion of the leg that is not in contact with the ground. It can further be broken into the initial, middle, and late flight phases. The initial flight phase describes recovery motion of the back leg from the time it leaves the ground until there is moderate knee flexion and further hip hyperextension. The hip and

knee musculature decelerates backward rotation of the thigh and lower leg/foot. The midflight phase describes motion of the back leg as knee flexion increases and hip flexion positions the thigh in alignment with the torso. The late flight phase describes motion for preparation of ground contact. The hip flexes forward and the knee extends to attain an optimal unilateral landing position and signifies the beginning of the support phase. The support phase describes motion of the leg that is in contact with the ground. It can further be broken into the early and late support phases. The early support phase describes motion of the leg as it contacts the ground. Braking and shock absorption take place as the hip extends, knee slightly flexes, and the ankle dorsiflexes. The late support phase describes triple extension of the leg to maximize propulsive forces during push-off thereby continuing the motion of the center of gravity forward. Triple extension involves hip and knee extension and ankle plantar flexion. The final segment of the late support phase concludes with the propulsion leg leaving the ground indicating the beginning of the early flight phase. The cycle repeats for the duration of the sprint (Phillips, 2016).

2.3 Sprint Performance Determinants

To gate maximum results from speed training, there are numerous factors to consider above and beyond pure genetic potential. Thus includes stride length, stride frequency, strength functional flexibility, acceleration and proper technique (Brown & Ferrigno, 2005). Power, technique, and sprint-specific endurance are believed to be key primary determinants of sprinting performance. Strong relationship occurs between maximal horizontal power output and sprint performance; the shorter the sprint distance is, the higher the relation with maximal horizontal power output. Power output demand in sprinting increases exponentially with velocity. Although the basic principles of sprinting are relatively simple and governed by the laws of motion, the way an athlete solves the mechanical limitations and utilizes the degrees of freedom within these constraints is far more complex (Haugen, Seiler, Sandbakk, & Tønnessen, 2019).

2.3.1 Stride Length and Frequency

Stride length and frequency are the key elements of running speed, if we increasing one or both will results increased speed. On the other hand they are interrelated in such a way that the one increasing one often in the reduction of the other. For instance when an increases in stride length, they may reach too far forward with the lower leg, results in over striding. This decreases stride frequency, which results in a lower running speed. Stride frequency is measured by the number of strides taken in a given amount of time or a give distance by using good sprinting technique, stride frequency can be increased without sacrificing stride length. While stride frequency is calculated in terms of the number of steps taken per minute, stride

length is the distance covered measured from the center of mass in one stride during running. Stride length can be enhanced by improving sprint mechanics and the athlete's power, absolute strength and elastic strength through numerous forms of training. This includes strength training; the use of weighted pants, weighted vests, running chutes, and harnesses; and uphill running (Brown & Ferrigno, 2005).

2.3.2 Proper Technique

Sprint mechanics is another terms for sprinting technique. Proper mechanics allows the athlete to maximize the forces that the muscles are generating; this greatly enhances the chance that an athlete will achieve the highest speed expected of him or her, given his or her genetic potential and training. Good technique also increases neuromuscular efficiency. This also allows for smooth and coordinated movements that contribute to faster running speeds. There are three main elements of proper sprinting mechanics this are posture, arm action, and leg action. Posture means the alignment of the body. Arm action refers the range of motion and velocity of an athlete's arms. The movement of the arms counteracts the rotational forces generated by the legs. Leg action refers to the relation of the hips and legs relative to the torso and the ground. Making explosive starts and achieving maximum speed requires hip, knee and ankle extending in a coordinated fashion to produce the greatest force possible against the ground (Brown & Ferrigno, 2005).

2.4 Strength Training and Conditioning

Strength training is a vital component of track and field. Such training visibly improves the basic strength, power, speed and general fitness of athletes. It also helps in the prevention and rehabilitations of injuries when it is done correctly. However, the first goal of all training must be to develop the health and fitness of young athletes. The second goal should be to improve competitive performance (LA84 Foundation, 2008). Strength training and conditioning is a term that has been adapted to include several modalities of exercise. Strength training via resistance training serves as the core, and other modalities of exercises are included contingent on the needs of the athlete. For example, an strength training and conditioning program for strength and power athletes would include weight training but also plyometric, sprint/ agility training, flexibility exercises, and aerobic training (in addition to the rigors of practice and competition). For ever person exercising for general fitness, weight training would be comprised in addition to flexibility and cardiovascular training. Multiple modalities of training improve numerous health- and skill-related components of muscular fitness. Hence, the combination of multiple modalities of training is critical to enhancing whole conditioning. The significance of a high-quality strength training and conditioning program cannot be overemphasized. From athletic position, improving and establishing good motor skill

technique is critical but can only take an athlete to a firm level of achievement. Several times, it is the health and skill related components of fitness that separate athletic talent. Elite athletes possess greater strength, power, speed, and jumping ability compared to athletes of slighter rank (Ratamess, 2012).The preferred method of strength training combines the use of free weights with other methods of developing strength and power such as plyometric, medicine ball work, and agility training. Using multi joint, large muscle mass exercises (e.g., cleans, snatches, pulls, squats, etc.) provides greater transfer to the athlete's sporting events compared with single-joint, small muscle mass exercises (Bompa & Haff, 2009).

2.5 Principles of Strength Training

The universal principles of strength training program to be successful: Progressive overload, Specificity, Recovery, Variability and Individuality. Progressive overload, or progressive resistance, is the basis of strength training. Gradual increases in the amount of repetitions completed or weight lifted stress the body to adapt to higher levels of strength. Generally, progressive increases are the measure of better strength. Strength training also needs to be specific to the demands of track and field and its individual events. As a consequence, strength training for track and field should be intended at increasing the whole strength, and particularly, the power of the athlete. However all gains are made during periods of recovery. Without adequate rest between workouts, the strength of the athletes will actually decrease. The process of super compensation that produces increased strength occurs during the athlete is recovering from training, but not is training time. The neuromuscular system makes its greatest changes in response to an unaccustomed stimulus, or shock. This requires strength training include a relatively great amount of variability. Research has shown frequent variations in volume, intensity and mode of strength training produce the greatest gains in strength (LA84 Foundation, 2008).

2.6 What is the Core?

"Anatomically, the core can be defined as a muscular box with the abdominals in the front, Para spinals and gluteus in the back, the diaphragm as the roof, and the pelvic floor and hip girdle musculature as the bottom. Functionally, the core can be thought of as the kinetic link that enables the transfer of torques and angular momentum between the lower and upper extremities that is of vital for sport-specific and everyday activities" (Granacher et al., 2014). The word core strength is often use interchanged with core stability. Nevertheless, core strength is a component of core stability and the two terms are not synonymous. Core strength is the muscular control required around the lumbar spine to sustain functional stability (Akuthota & Nadler, 2004). "Core stability is defined as the ability to control the position and motion of the trunk

over the pelvis to allow ideal production, transfer and control of force and motion to the terminal segment in combined athletic activities" (Kibler, Press, & Sciacca, 2006). Core stability states to the musculature control around the lumbo-pelvic region, with the aim of sustaining efficient stability in a neutral position and supportive in the generation and transfer of energy from the trunk to the extremities (Araujo, Cohen, & Hayes, 2015). Kibler et al.also announced that the core consists of the spine, abdominal structures, hips, pelvis, as well as the proximal lower extremities. According to core stability is the effective recruitment of the muscles that stabilise the Lumbo Pelvic–Hip complex, together with those that stabilise the shoulder girdle.

2.7 Core Strength Exercise

Stability work ought to be start as it were after the competitors had created great mobility, as reasonable muscle length and extensibility are imperative for proper joint work and productivity (Fredericson & Moore, 2005). Beginner exercises incorporate the three big exercises as described by McGill. These include the Curl-up, Side Bridge, and the Bird dog. The bird dog exercise can progress from 4 point kneeling to 3 point to 2 point kneeling and after that progression to a physioball (McGill, as cited in Akuthota & Nadler, 2004). Core stability could be a significant component in typical athletic exercises (Kibler, Press,&Sciascia,2006). Although core training is not the main training form for any sport discipline, the majority of competitive athletes perform such training to some extent (Haugen et al., 2016). According to Shinkle, Nesser, Demchak, and Mcmannus (2012) study, results indicate that core strength does have a significant effect on an athlete's ability to create and transfer forces to the extremities. Currently, plank exercises are considered an adequate method of training the core for athletes to improve core strength and stability. This can be an issue since it puts the athletes in a non-functional static position that's exceptionally once in a while imitated within the requests of sport-related exercises. Creating core muscle quality may offer assistance keep ground reaction force inside an ideal run which increments stability of a person (Sato & Mokha, 2009). In spite of the fact that Kible, Press, & Sciascia more over expressed as core muscle movement is best caught on as the pre-programmed integration of local, single-joint muscles and multi-joint muscles to supply stability and deliver movement. Core stability is ordinarily utilized to fortify the muscles around the abdominal, lumbar, and pelvic regions or districts, since the muscles of these districts play a critical part in stability conjointly in controlling the lumbar posture by utilizing tonic or postural muscles during whole-body works out (Marshall and Murphy, as cited in Yu & Park, 2013). The core can be thought of as the kinetic link that allows the transfer of torques and angular

momentum between the lower and upper extremities that is of vital for sport-specific and everyday activities (Granacher et al., 2014).

2.8 The Role of the Core

The core musculature is composed of 29 sets of muscles that back the lumbopelvic- hip complex. These muscles offer assistance to settle the spine, pelvis, and active chain a midutilitarian developments. When the system works productively, the result is suitable distribution of forces; ideal control and productivity of development; satisfactory assimilation of ground-impact powers; and an absence of excessive compressive, translation, or shearing forces on the joints of the kinetic chain. The first stage organize in a stable core is to create the abdominal muscles. Richardson, Hodges, and Julie (2004) have discovered that there are two different types of muscles fibres (slow-twitch and fast-twitch) that make up the abdominal muscles and that because of this different fibre composition, different exercise regimens are required to properly train these muscles. Slow-twitch fibres mainly make up the local muscle system, the muscles of the deeper abdominal muscle layers (Fredericson & Moore, 2005). The muscles and joints of the hip, pelvis and spine are centrally found to be able to perform many of the soothing functions that the body will require in order for the distal segments e.g. the limbs to do their specific function, providing the proximal stability for the distal mobility and function of the limbs. In addition to its local functions of stability and force generation, core activity is involved with almost all extremity activities such as running, kicking and throwing (Kibler et al., 2006).

2.9 Core Strength Training and Performance

"Core strength training is a viable (i.e., high adherence rate of ≥81%) and safe (i.e., no injuries reported) training modality that produces visible increases in health and skill-related components of physical fitness in healthy male and female youths i.e., strength, flexibility, balance, coordination, and speed" (Granacher et al., 2014). According to Weston, Hibbs, Thompson, and Spears (2014) study showed Isolated core training improves sprint performance in national-Level junior swimmers, compared with the control group, the core-training intervention group had a possibly large beneficial effect on 50M swim time at 90% confidence interval. Moreover, it showed small to moderate improvements on a timed prone-bridge test and asymmetric straight-arm pull-down test, and there were moderate to large increases in peak Electromyography activity of core musculature during isolated tests of maximal controlled contraction. It clearly demonstrates that, beneficial effect of isolated core training on 50M front-crawl swim performance. The ability to function in an athletic setting is based on the core's ability to act as the center of the kinetic

chain. Aside from providing direct stability to the core area, it also affects the motion of the upper extremity and the lower extremity. Weakness within the lumbopelvic hip complex has been linked to chronic instability, it have been linked to both upper extremity and lower extremity injuries. Considering the wide variety of movements associated with various sport activities, athletes must possess sufficient strength in hip and trunk muscles to provide stability (Sell, 2013). Baker, Boone, and Nesser (2009) results found no significant relationships between core strength and strength, and athletic performance variables in division 1 female soccer players. For this result the investigator stated two reasons that the tests used to measure core strength are not specific to strength and athletic performance, and core strength does not play a role in strength and athletic performance. Schilling, Murphy, Bonney, and Thich (2013)study in effect of core strength and endurance training on performance in college students showed improvement in trunk flexor and extensor endurance ($p < 0.05$) along with squat and bench press strength ($p < 0.05$) were obtained with the strength group. Improvement in trunk flexor and right lateral endurance ($p < 0.05$) along with strength in the squat ($p < 0.05$) were found with the endurance group.

According to Araujo,Cohen, and Hayes (2015) six weeks of core stability training improves landing kinetics among female athletes, the trunk dominant core stability training increases landing kinetics without improving jump height, and may reduce lower extremity injury risk in female athletes. Eight weeks of core specific training does not result in improved half marathon running time. Yet core exercises increased strength and stability of the core musculature, this increase does not necessarily show a subsequent enhancement in performance (Cleveland, 2011). However Shinkle et al. (2012) results indicate that core strength does have a significant effect on an athlete's ability to create and transfer forces to the extremities in collegiate football players. However, Sato and Mokha (2009) study shows core strength training did not have a significantly influence on ground reaction force variables and lower-leg stability, but a significant interaction occurred, between core strength training and 5000M run time after 6 weeks execution. So that it may be an effective training modality for improving runner performance. Similarly, on Fredericson and Moore (2005) study core musculature was importance to middle and long distance runners performance and help to achieve desired stability, balance, and neuro- muscular control. According Hung, Chung, Id, and Lai (2019) results eight weeks core training may improve static balance, core endurance, and running economy in college athletes.

2.9.1 Core Strength Training for Speed and Agility Performance

The core stability and functional training resulted in significant changes in the strength of various muscle groups: quadriceps, abdominal oblique muscle, shoulder girdle, and chest. It was also a significant

reduction in the time of the 30 meter sprint at $p < 0.05$. Core stability and efficient training had a optimistic effect on the strength and running speed on female footballers (Niewolna & Zwierko, 2015). Core strength training is a viable high adherence rate and safe training modality that produces visible increases in health and skill-related components of physical fitness in healthy male and female youths i.e., strength, flexibility, balance, agility, and speed (Granacher et al., 2014). Similarly, Dinç and Ergin (2019) investigated that after 8 week intervention, showed significant improvement in the explosive force and agility performance; while no significant difference was found in the double right/left foot balance test results, at $p < 0.05$ significance level. Schilling et al. (2013) study after 6 weeks core strength training intervention to the university students for two times at a week didn't showed improve in the agility performance using Pro agility test at $p < 0.05$.

2.9.2 Core Strength Training for Strength Performance

According to Niewolna and Zwierko (2015) study core stability and functional training had a positive effect on the strength and running speed on female footballers. Cleveland (2011) study also showed that core exercises increased strength and stability of the core musculature. Core strength training is a viable high adherence rate and safe training modality that produces visible increases in strength physical fitness in healthy male and female youths (Granacher et al., 2014). Following 9 weeks a progressive core strength training program Prieske et al. (2016) study result shows trunk muscle strength, sprint, and kicking performance was improved on unstable and stable surface in elite youth soccer players. On the other hand Baker et al. (2009) results showed core strength and strength have no significant relationships in division 1 female soccer players using 1RM bench press, and 1RM squat strength tests.

2.10 How is Core Strength Evaluated?

There is no a standard way that has been defined to measure core strength. Different investigators have used different techniques to try to gauge the relative strengths of specific core muscles via electromyogram data and isometric dynamometer values. Any evaluation technique will need to take into consideration that the muscles to be tested should be tested in functional positions when possible. If the muscle is mainly used in a closed chain manner, it should be tested in a closed chain manner. If the muscle is activated in different planes of motion, it should be tested in various planes of motion. If muscles are used primarily in an eccentric manner, they need to be tested in an eccentric manner. Frequently, to assess all of the different muscles that function together to provide core strength, evaluation of specific motion patterns and quality of movement may be done. This method of analysis is harder to quantify, but is more similar to actual

three-planar core functioning (Kibler et al., 2006). According to Sell (2013) study's result illustrate that medicine ball toss tests have excellent reliability but are not valid against isokinetic strength, indicating that modifications to these medicine ball toss tests may be necessary. Anderson, Hoffman, Johnson, Simonson, and Urquhart, (2014) results suggest that normative values can be established for the 60 degree flexion and trunk extensor endurance tests regardless of gender; however right side plank and left side plank tests were significant for differences between genders. Their results also propose that increased activity level improved core endurance. According to Tse, Mcmanus, and Masters (2005)trunk endurance was assessed using flexion, extension, and side flexion tests. Nowadays, plank exercises are considered an adequate method of training the core for athletes to improve core strength and stability (Shinkle et al., 2012).

2.11 The Core and Injury Prevention

According to Leetun, Ireland, Willson, Ballantyne, and Davis (2004) study showed that core stability has an important role in injury prevention. Haugen, Haugvad, and Røstad (2016)stated that stabilization training of the core may enhance the recovery time for certain injuries, but no better than any other training forms in the long term. They conclude that, isolated core stability training should not be the primary emphasis for programs with the goal of enhancing athletic performance, preventing injuries or reducing injury recovery time. Core stability is a vital aspect of the human body as it not only provides strength and balance, but it aids in creating anticipatory postural adjustments, or pre-programmed activation of core muscles, that allow the body to handle perturbations during activities such as kicking, throwing, and running (Kibler et al., 2006). Araujo, Cohen, and Hayes (2015) study shows that core stability training which comprises isometric trunk exercises have a significant constituent of lower extremity injury prevention programmes and may have contributed to the preferential landing kinetic by doing six weeks of core stability training intervention on female capoeira athletes. In the rehabilitation sector, improvements in lower back injuries have been reported by improving core stability (Hibbs et al., 2008).

2.12 Conceptual Modal

A conceptual framework signifies the researcher's synthesis of literature on how to explain a phenomenon. It maps out the activities required in the course of the study given his earlier knowledge of other researchers' point of view and his perceptions on the subject of research.

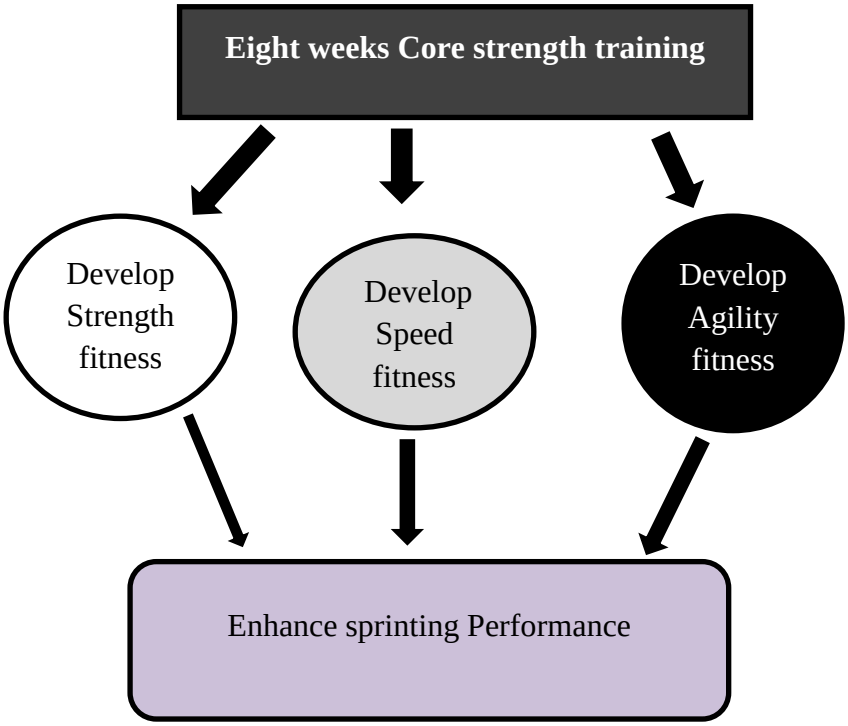

Figure 1 Simple Conceptual Model

The above simple conceptual model shows when doing core straining training for eight weeks improves fitness variables such as speed, agility and strength, if this fitness variables improved by CST the performance of sprinters has also improved.

CHAPTER THREE

RESEARCH METHODS

This chapter explains the research methods that the researcher was employed for this study. The chapter begins by explaining the study area description, the research approach, the design of the study, and subjects of the study followed by a brief explanation of the data collection instrument. It also provides details of the procedures of data collection. Finally, this chapter also includes explanation of the data analysis techniques, inclusion and exclusion criteria and ethical issues or consideration.

3.1. Geographical Location of the Study Area

The study was conducted in Finote Selam town which is found in northern part of Ethiopia located in the West Gojjam Zone of the Amhara Region, on the road connecting Bahir Dar, Gondar and Addis Ababa, the town 387 km far from Addis Ababa and 176 km from Bahir Dar. The name was given by Emperor Haile Silassie during the Italian attack on Ethiopia. Formerly its name was Wojet. Now Finote Selam is the capital city of West Gojjam Zone. The town has a longitude and latitude of 10°42′N 37°16′E/ 10.700°N 37.267°E with an elevation of 1917 meters above sea level. It is surrounded by Jabi Tehnan Woreda. Based on 2007 national census by the Central Statistical Agency of Ethiopia, the town has a total population of 25,913 of whom 13,035 are men and 12,878 are women (Finote Selam town municipality office, 2019). In this town sport activity participated like; Football, Basketball, Volleyball, Handball, Athletics, Para Athletics, Gymnastics, Taekwondo, karate, Table Tennis, Badminton and Cultural Game (Finote Selam town sport office, 2019).

3.2 Research Approach

On scientific studies, there are different research approaches to achieve the stated objectives, this study follows quantitative research approach and used systematic measurement and statistical tools to analysis the data and examine the effect of core strength training on sprinting performance and selected fitness variables.

3.3 Research Design

According to Kothari (2004), the experimental design is the only means of research that can consistently test the hypothesis and show the cause and effect relationships of variables. The experimental approach is a quantitative research method in which one attempts to identify cause and effect relationships by conducting an experiment so the researcher have used this method because of the purpose characteristics of the study.

The study mention with the effect of core strength training on the sprinting performance and selected fitness variables in terms of strength, agility and speed that are supposed to enhance the sprinting performance and fitness of athletes.

As stated in chapter one the objective of this study was to investigate the effect of core strength training on sprinting performance and selected fitness variables. In order to achieve the intended objective the study needs experiment therefore; the researcher used quasi experimental design to know the causal impact of treatment on the target study population. In this design the research subjects were divided randomly in to two groups as experimental and comparison groups and the dependent variables were measured in both groups at same time-period before the treatment. Then post-test was implemented after the experimental group take core body strength training for eight consecutive weeks and dependent variables were measured for both groups at the same time-period immediately after the treatment group was finished their training. The study design layout for treatment group after pre-test which means before the post-test, the treatment group execute core strength training beyond the normal training program from February to March in 2020. The layout for this study was as follows:

Table 1

The Study Design Layout

For treatment group	**Core strength training programs**
Exercise day	Tuesday , Thursday, and Saturday
Frequency	3 days per week
Total duration	8 weeks
Session duration	1: 00 H
Intensity	Moderate (55-70HRmax)
Time of training	Morning and afternoon

3.3 Study Population, Sample and Sampling Technique

The study was conducted on Finote Selam Andnet short distance athletics project. The study population consists of all individuals with in Finote Selam Andnet short distance athletes (N=20). The researcher was used comprehensive sampling technique in order to include all 20 athletes who have been engaged in 100 and 200M sprint running for at least 1 years and above as a sample (n=20), samples participated in this study were male sprinters only. Then the researcher assigned or divided these subjects in to two groups randomly as experimental and control group equally. However this research subjects were male sprinters, this subjects included for this study from the age 18-26 years old category.

3.4 Source of Data

The study was used only primary source of data; it is enough to gather valuable information that is vital for the study. Primary data constitutes the information that is collected personally by a researcher or assistants in any form for the purpose of the research at hand. Hence the research was experimental; the data collected from selected athletes have taken Finote Selam Andnet 100 and 200M short distant athletes as a primary source of data to collect sprinting performance and selected fitness test results from pre and post-tests value.

Table 2

The Dependant Variables and Their Corresponding Tests

Dependent variables	**Test**
Speed	Flying 30 Test
Agility	T’ Drill Test
Strength	Core Muscle Strength & Stability Test
Performance	150 m run test

3.5 Data Collection Instrument

The data gathered from the pre and post training tests from both experimental and comparison groups result of sprinting performance and selected fitness tests of Finote Selam Andnet athletics project male sprinters. The data was collected using the appropriate performance and fitness tests such as, flying 30

meter test for speed performance, T' drill test for agility performance, core muscle strength and stability test for strength performance and 150 M run test to measure the sprinting performance of short distance athletes. Prior to start the tests, the following materials like cones, stop watch, whistle, record sheets, pen, mat and measuring tape (Meter) were used throughout the study to collect the data during the tests. The detail of each tests and procedures are discussed below.

3.6 Procedure of Data Collecting

3.6.1 Performance and Fitness Test

3.6.1.1 Core Muscle Strength and Stability Test

According to Mackenzie (2005), the objective of the Core muscle strength Test can be used to monitor the development of the athlete's core strength. To undertake this test, it needs: flat non-slip surface, mat, stop watch and an assistant. The test was conducted by using an assistant, is responsible for instructing the athlete as to the position to assume at the appropriate stage. Throughout the test, the back, neck and head should be maintained in the posture as per figure below. If the athlete is unable to hold this position, then the test is to be stopped.

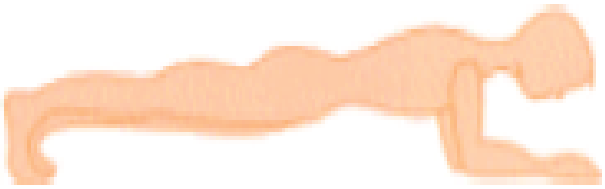

Figure 2 Core muscle strength & stability test

Adopted From Mackenzie 101 Performance Evaluation Tests, (2005)

The test have 9 stages, Stage 1; The athlete warms up for 10 minutes, using the mat to support their elbows and arms, assumes the Start Position, once the athlete is in the correct position the assistant starts the stopwatch, hold this position for 60 seconds; Stage 2 The athlete lifts their right arm off the ground and extends it out in front of them parallel with the ground, hold this position for 15 seconds; Stage 3 The athlete returns to the Start Position, lifts the left arm off the ground and extends it out in front of them parallel with the ground, hold this position for 15 seconds; Stage 4 The athlete returns to the Start Position, lifts the right leg off the ground and extends it out behind them parallel with the ground, hold this position for 15 seconds; Stage 5 The athlete returns to the Start Position, lifts the left leg off the ground and extends

it out behind them parallel with the ground, hold this position for 15 seconds; Stage 6 The athlete returns to the Start Position, lifts the left leg and right arm off the ground and extends them out parallel with the ground, hold this position for 15 seconds; Stage 7 the athlete returns to the Start Position, lifts the right leg and left arm off the ground and extends them out parallel with the ground, hold this position for 15 seconds; Stage 8 the athlete returns to the Start Position, hold this position for 30 seconds; finally Stage 9 the test was end. The assistant records the stage and time at which the athlete is unable to maintain the correct body position or is unable to continue with the test. But for this study only the time was recorded for simplification of analysing the data. However, there have no normative data for this test. The result is analysed by comparing it with the results of pre-tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement. If the athlete can complete this test, then it indicates they have good core strength. If they are unable to complete the test, it indicates they have no good core strength. If core strength is poor, then the torso will move unnecessarily during motion and waste energy. Good core strength indicates that the athlete can move with high efficiency. Test reliability refers to the degree to which a test is consistent and stable in measuring what it is intended to measure. Reliability will depend upon how strict the test is conducted and the individual's level of motivation to perform the test. Test validity refers to the degree to which the test measures what it claims to measure and the extent to which inferences, conclusions, and decisions made based on test scores are appropriate and meaningful. This test provides a means to monitor the effect of core strength training on the sprinting performance and selected fitness variables of Finote Selam Andnet athletics project athletes. There are no published tables to relate results to a potential performance in competition. The advantages of this test; no equipment required, simple to set up and conduct and can be conducted almost anywhere. But, it required an assistant to administer his test. The test can be performed for both pre and post-tests. To compare the results of pre and post-tests, it was show effects of eight week core strength training on the development of sprinters' strength performance.

3.6.1.2 T Drill Test

According to Mackenzie (2005), the objective of this test is to monitor the development of the athlete's speed with directional change. To undertake this test it requires: flat surface, 4 cones, stop watch and an assistant. The test was conducted as follows:3 cones are set five metres apart on a straight line, the fourth cone is placed 10 metres from the middle cone so that the cones form a 'T', the athlete starts at the cone at the base of the 'T', the coach gives the signal to 'Go' and starts the stop watch. the athlete runs to the middle cone, touches the cone; then side steps 5 metres to the left cone, touches that cone; then side steps 10

metres to the far cone and touches that one; side steps 5 metres back to the middle cone, touching that one; finally runs 10 metres backwards to the base of the 'T' and touches that cone immediately the assistant stops the watch and records the time. The results was analysed by comparing it with the results of previous tests. It is expected that, with appropriate core strength training between each test, the analysis was showed an improvement in the Finote Selam Andnet sprinter's agility performance. Reliability will be depending upon how strict the test is conducted and the individual's level of motivation to perform the test. There are no published tables to relate their result to the normative.

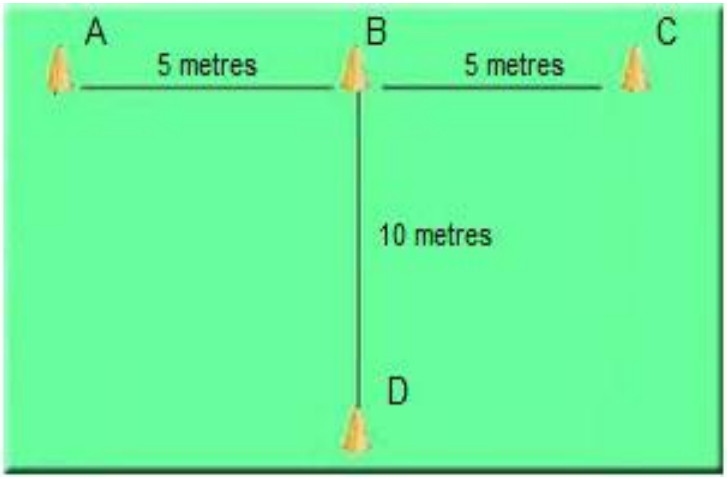

Figure 3 T' drill test

The Figure Adapted From Hoffman(1991)

3.6.1.3 Flying 30 Meter Test

According to Mackenzie (2005), the objective of this test is to examine or test the development of the athlete's maximum speed. To undertake this test assistant and necessarily equipment was available like 400M track 60M marked section on the straight, Cone to mark 30M point, data recording sheets, stop watch and pen. The test comprises of 3 x 60M runs from a standing start and with a full recovery between each run. After warming up the athlete starts and uses the first 30M to build up to maximum speed and then maintains the speed to the next 30M. The assistant should record the time for the athlete to complete the first 30M and whole 60M, to determine the athletes flying 30M time and subtract the time for the first 30M from the time for the whole 60M. Then the final result was the time taken calculated by adding the whole three results of flying 30 meter and divided by three is the average of time of flying 30 meter. The result was analysed by comparing post-test with the results of pre-tests can be perform for both treatment

and controlled group. The analysis was show an improvement in the effects of core strength training on sprinter's speed performance.

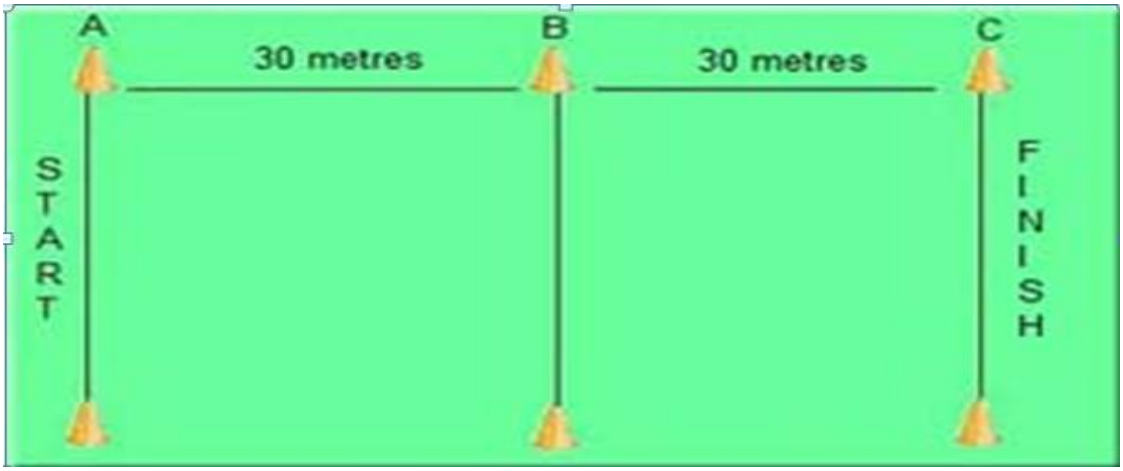

Figure 4 Flying 30 meter test

Adopted From Mackenzie 101 Performance Evaluation Tests, (2005)

3.6.1.4 150 Metre Run Test

According to Mackenzie (2005), the objective of this test is to observer the development of the athlete's specific endurance for 100 metres sprinters and speed for 200 meters sprinters. To carry out this test it requires: 400M track, 150M marked section, stop watch and an assistant. To demonstrate the test the athlete undertakes a 150M run from a standing start next, the assistant records the time for the athlete to complete 150M run. The 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. Reliability depends on how strict the test is conducted and the individual's level of motivation to perform the test. However it has no published tables to relate results to potential performance in competition. The analysis was show an improvement in the effects of core strength training on sprinter's performance.

3.7 Methods of Data Analysis

After giving interventions of eight weeks core strength training for experimental group, the data that are collected from Pre and Post-tests were analysed by using statistical software of statistical package for social sciences (SPSS) version 23.0 for simplicity of analysis for both groups. The paired t-test was used to compare the pre and post-tests result. These include mean, standard deviations, t and p value with 95% of confidence interval (CI= 95%) or the level of significance at 0.05. Finally the data was presented in a tabular and graphic form for easy to understand.

3.8 Inclusion and Exclusion Criteria

Subjects who seage from 18-26 years old 100 and 200M short distance athletes include in this study. However, individuals with cardiac or heart problem, diabetes mellitus, bone and joint injury, that taking medications and other any recent physical injuries was not included for this study.

3.9 Ethical Considerations

As regards to ethical consideration, the researcher was governed by the research code of ethics in maintaining privacy and other related values. The researcher should not put participants in a situation where they might be at risk of harm as a result of their participation; it may be either physical or psychological. The whole participants have got cleared information about the purpose of the study and agreed to participate in this study. Before starting the research, the researcher got information from coach and all project members about their voluntarism for the participation on the study.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1 Introduction

This chapter also deals with the analysis of pre and post test data collected from experimental group (n=10) and comparison group (n=10) on the study. The main objective of the study was focused on to examine the effects of core strength training on the sprinting performance and selected fitness variables in the case of Finote Selam Andnet athletics project athletes. The performance and fitness tests which were selected for this study were flying 30 meter test for speed, T drill test for agility, core strength and stability test for strength and 150M running test for 100 and 200M sprinting performance, all this tests were adopted from Mackenzie 101 performance evaluation tests, 2005. The pre and post-tests data were recorded from both experimental and control groups before and after eight weeks of core strength training intervention given for experimental group, and the scores were recorded. The collected pre and post-test data were analysed using paired sample t-test at 95% confidence interval for both experimental and comparison groups and the results are listed below.

4.2 Results of the Study

4.2.1 Descriptive Statistical Results of participant Demographic Characteristics

Table 3

Descriptive Statistical Results of Participant Demographic Characteristics

	Group			
	EG		CG	
Variables	Mean	SD	Mean	SD
CA	21.2	2.348	21.2	2.440
Weight	59.5	6.819	59.6	6.802
Height	1.703	0.06447	1.707	0.06783
Training year	2.2	1.033	2.4	0.966

Key:*EG= Experimental Group, CG = Comparison Group, SD= Standard Deviation, CA= Chronological Age*

The above table shows as descriptive statistical results of participant's demographic characteristics of Finote Selam Andnet short distance athletics project that was included on this study as sample of experimental and comparison groups. There for the above table shows that the mean and standard deviation value of experimental and control groups of the study subjects. So that the mean chronological age value for (EG=21.2, CG=21.2) and SD values for (EG=2.348, CG=2.440); Mean training year value for (EG=2.2, CG=2.4) and of SD value for (EG=1.033, CG=0.966); Mean weight value for (EG=59.5, CG=59.6) and of SD value for (EG=6.819, CG=6.802); Mean height value for (EG=1.703, CG=1.707) and of SD value for (EG=0.06447, CG=0.06783). Based on the above descriptive statistical data value the demographic characteristics for both experimental and comparison groups were relatively or nearly the same training age, chronological age, weight and height before and after giving eight weeks of core strength training for experimental group.

4.2.2 Paired Sample Statistic Results

Table 4

Paired Samples Statistic Results

		Group			
		EG		CG	
Test		Mean	SD	Mean	SD
Flaying 30M Speed test	PRT	4.09	0.21318	4.07	0.27508
	POT	3.9	0.22608	4.03	0.25408
T Drill Agility test	PRT	11.53	0.44234	11.49	0.58963
	POT	11.15	0.43269	11.42	0.57116
Core Strength & stability test	PRT	163.5	3.567	164.1	5.021
	POT	177.4	2.675	163.7	4.373
150 M run test	PRT	20.847	1.55248	20.871	1.51232
	POT	20.305	1.37451	20.860	1.53275

On table 5, the result has shown that pre and post test results of mean and standard deviation values of flying 30 meter test, T drill agility test, core strength and stability test and 150M run test, for both experimental and comparison groups.

4.2.3 Paired Sample Statistics of Flying 30 Meter Test

On table 4, the analysed data shows that the result of pre and post-tests of flying 30 meter test for experimental and comparison group. The Pre-test mean value of flying 30 meter test for experimental group was 4.09 with a Std. deviation value of 0.21318 and for comparison group mean result level were 4.07 with a Std. deviation value of 0.27508. After exposing experimental group for eight week core strength training post test data was recorded for both groups. Regarding to post test data, the mean value of flying 30 meter test results for experimental group was 3.9 with Std. deviation value of 0.22608whereas for comparison group the mean value of flying 30 meter test were 4.03 with the Std. deviation of 0.25408.After core strength training given to EG, the mean score of flying 30 M test for EG has a significant change from pre to post test. But the mean values of CG flying 30 M test stay very close from pre to post test. This result shows different results from pre to post test. The analysed result shows there was an increment on speed performance from pre to post test for experimental group. However we cannot say that the result is statistically significant unless the pre and post test scores of the groups computed to examine whether these results show statistically significant difference or not. Thus, the comparison of these results was presented under paired T test.

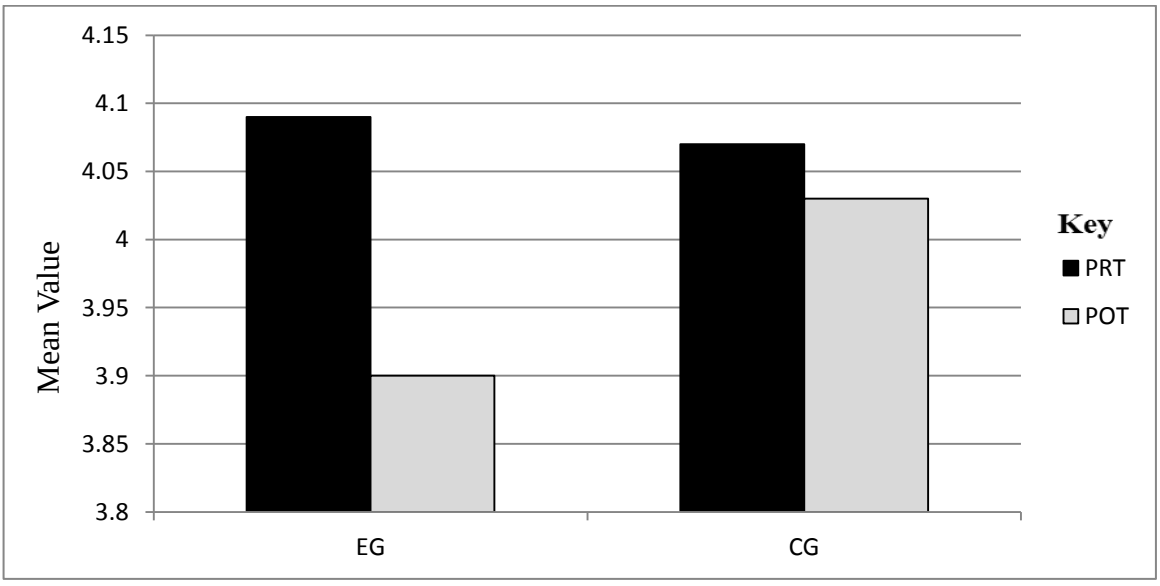

Figure 5 Paired sample statistics of flying 30 meter test

4.2.4 Paired Sample Statistics of T Drill Agility Test Results

As indicated in Table 4, the results of T drill agility test paired samples t-test PRT mean value of experimental group was 11.53 with Std. deviation value of 0.44234 and for the mean value of comparison group T drill agility pre-test results were 11.49 with Std. deviation value of 0.58963. After exposing experimental group for eight weeks core strength training post test data was recorded for both groups. As regards to post test data, the mean value of T drill agility test results for comparison group was 11.42 with Std. deviation value of 0.57116 and for experimental group the mean value of T drill agility post test results were 11.15 with a Std. deviation value of 0.43269.After eight weeks core strength training given to EG, the mean score of T drill agility test for EG has a significant change from pre to post test. But the mean values of CG T drill agility test stay very close from pre to post test. This result showed different results from pre to post test. The analysed result shows there was an increment on agility fitness performance from pre to post test for experimental group. But we cannot say that the result is statistically significant unless the pre and post test scores of the groups computed to examine whether these results show statistically significant difference or not. Thus, the comparison of these results was presented under paired T test.

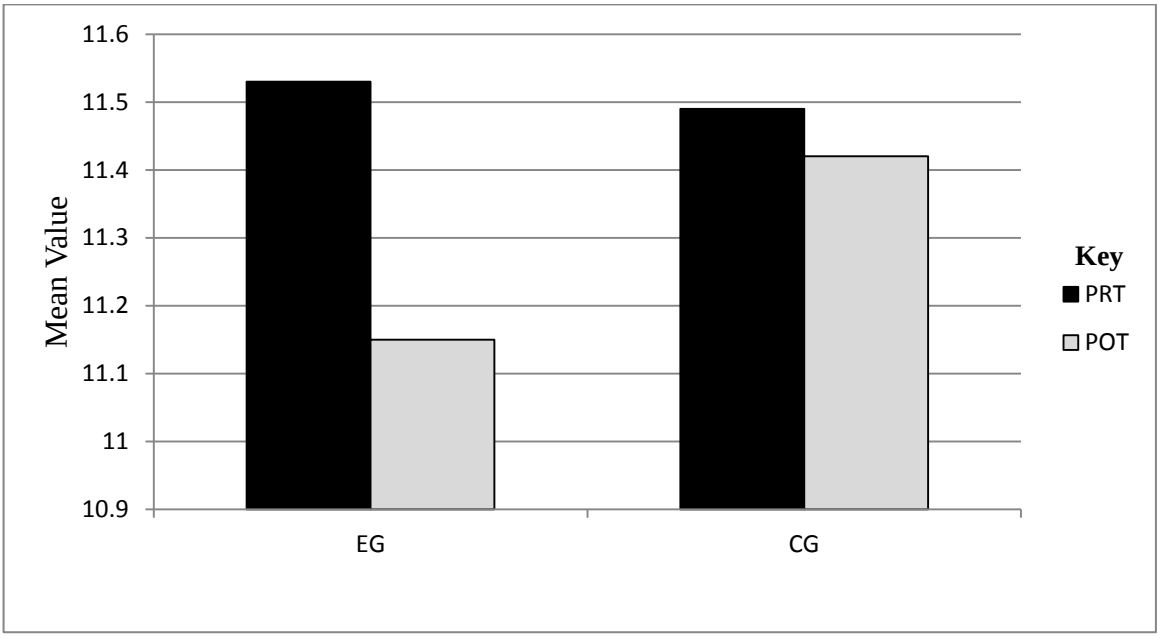

Figure 6 Paired sample statistics of T drill agility test results

4.2.5 Paired Sample Statistics of Core Strength and Stability Test Results

As indicated in Table 4, the results of core strength and stability test paired samples t-test pre-test mean value of experimental group was 163.5 with Std. deviation value of 3.567and for control group the mean value of core strength and stability pre-test results were 164.1 with Std. deviation value of 5.021. After exposing experimental group for eight weeks core strength training post test data was recorded for both groups. As regards to post test data, the mean value of core strength and stability test results for experimental group was 177.4 with Std. deviation value of 2.675 and for comparison group the mean value of core strength and stability post test results were 163.7 with a Std. deviation value of 4.373 are recorded. After eight weeks core strength training given to EG, the mean score of core strength and stability test for EG has a significant change from pre to post test results. But the mean values of CG core strength and stability test stay very close from pre to post test results. This result shows different results from pre to post test. The analysed result shows there was an increment on strength fitness performance from pre to post test for experimental group. However we cannot say that the result is statistically significant unless the pre and post test scores of the groups computed to examine whether these results show statistically significant difference or not. Thus, the comparison of these results was presented under paired T test.

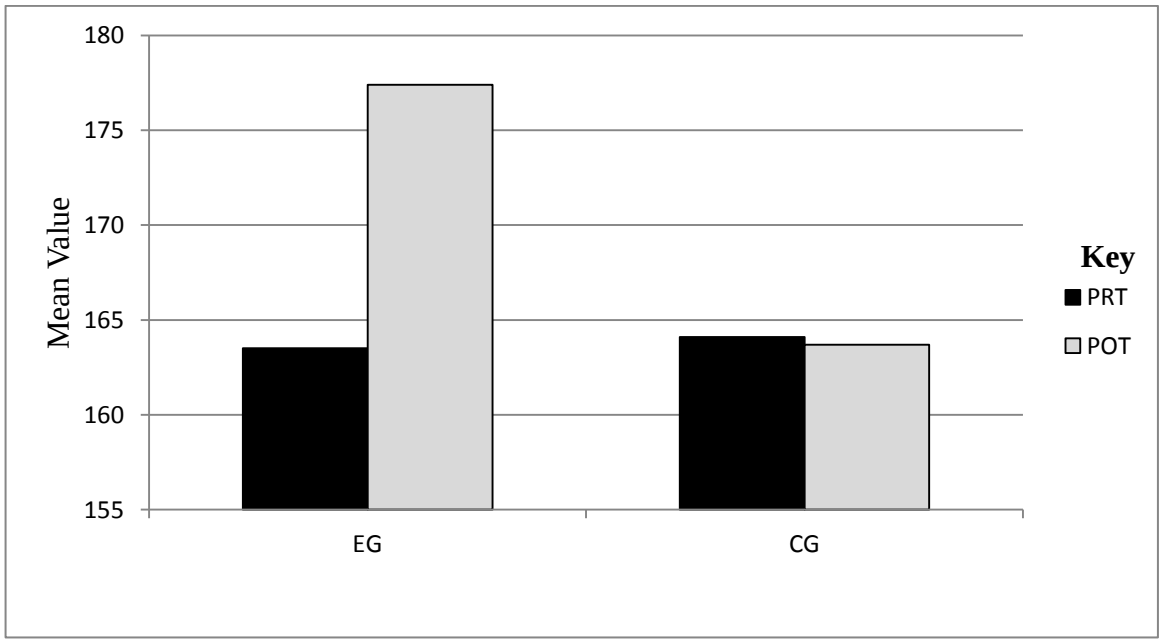

Figure 7 Paired sample statistics of core strength and stability test results

4.2.6 Paired Sample Statistics of 150M Run Test Results

The above table 4 shows that the pre and post 150M run test results for both experimental and control groups. As shown in the table 4 the pre-test mean value of EG was found to be 20.847with a standard deviation of 1.55248 and of CG pre-test mean value found to be 20.871with a standard deviation of 1.51232. However after core strength training given to EG, the mean score value for 150M run test of EG was 20.305 with a standard deviation of 1.37451 and the post-test mean value for CG was 20.860with a standard deviation of 1.53275 are recorded. As the above result reveals that the mean value of EG150M run test for 100 and 200M sprinters have a significance change from pre to post test results. Whereas the mean value of CG 150 M run test result stay very close from pre to post test. This result shows different results from pre to post test. But we cannot say that the result is statistically significant unless the pre and post test scores of the groups computed to examine whether these results show statistically significant difference or not. Thus, the comparison of these results was presented under paired t test.

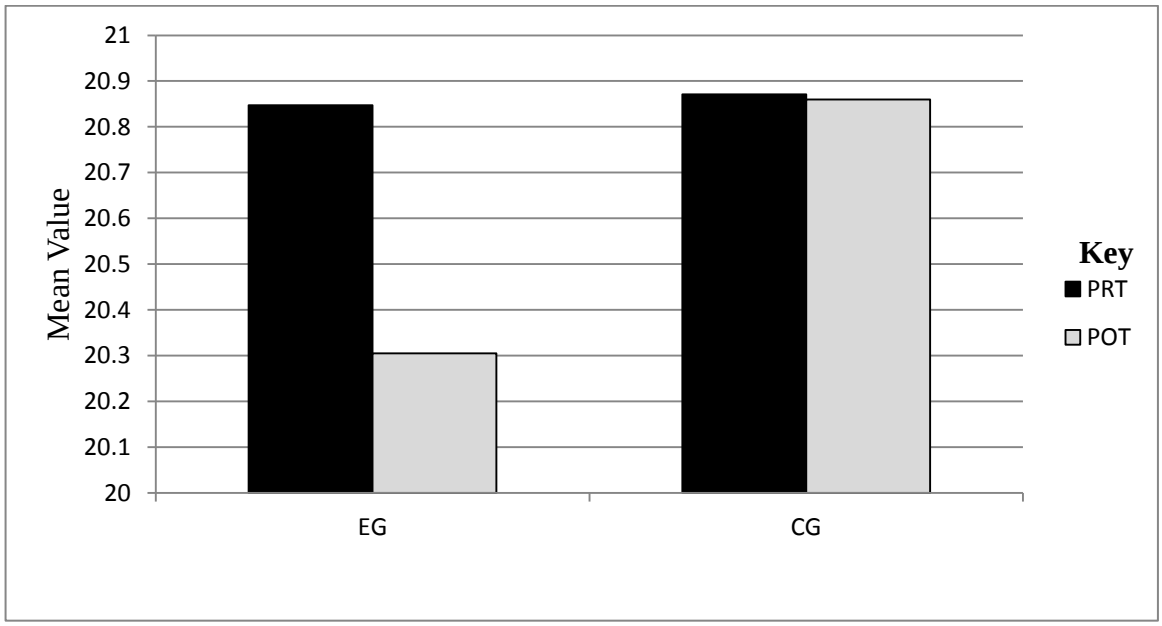

Figure 8 Paired sample statistics of 150M run performance test mean results

4.3 Paired Test Results and Mean Comparison Results

Table 5

Mean Comparison Results

		Paired Differences						
				95% CI				
Test	Subject	Mean	SD	Lower	Upper	T-value	df	P-value
Flaying 30m	EGPRT-POT	0.19	0.08756	0.12736	0.25264	6.862	9	0.00
	CGPRT-POT	0.04	0.10750	-0.0369	0.1169	1.177	9	0.269
T Drill agility	EGPRT-POT	0.38	0.12293	0.29206	0.46794	9.775	9	0.00
	CGPRT-POT	0.07	0.16364	-0.04706	0.18706	9.775	9	0.209
Core S&S	EGPRT-POT	-13.9	4.254	-16.943	-10.857	-10.332	9	0.00
	CGPRT-POT	0.40	2.119	-1.116	1.916	0.597	9	0.565
150M RT	EGPRT-POT	0.542	0.53139	0.16187	0.92213	3.225	9	0.01
	CGPRT-POT	0.011	0.14579	-0.09329	0.11529	0.239	9	0.817

Key: *EG=Experimental Group, CG=Comparison Group, CI=Confidence Interval, DF=Degree of Freedom, SD=Standard Deviation, PRT=Pre Test, POT=Post Test, RT=Running Test, S&S=Strength and Stability*

As can be seen in table 5a paired samples t-test was conducted in flaying 30 meter test to investigate the effect of core strength training on speed performance of athletes for both EC and CG. There were a significant change on speed performance for EG per to post-test comparisons (MD = 0.19, SD = 0.08756, t (9) = 6.862 and P value = 0.00)whereas CG (MD = 0.04, SD = 0.1075, t (9) = 1.177 and P value = 0.269). These results suggest that the speed performance of experimental group was significantly improved at (P <0.05) in flying 30 meter speed test after eight weeks core strength training, however, there was no significant improvement on comparison group speed performances from pre to pot test results. So that the formulated null hypothesis that eight weeks core strength training has no significant effect on speed performance of sprinters were rejected at 0.05 level of confidence interval.

As can be seen in table 5 a paired samples t-test was conducted in T drill agility test to determine the effect of core strength training on agility performance of athletes for both EC and CG. There were a significant change on speed performance for EG per to post-test comparisons (MD = 0.38, SD = 0.12293, t (9) = 9.775 and P value = 0.00) whereas CG (MD = 0.07, SD = 0.16364, t (9) = 9.775 and P value = 0.209). These results suggest that the agility performance of experimental group was significantly improved at (P <0.05) in T drill agility test after eight weeks core strength training, however, there was no significant improvement on comparison group agility performances from pre to pot test results. So that the formulated null hypothesis that eight weeks core strength training has no significant effect on agility performance of sprinters were rejected at 0.05 level of confidence interval.

As can be seen in table 5 a paired samples t-test was conducted in core strength and stability test to assess the effect of core strength training on strength performance of athletes for both EC and CG. There were a significant change on speed performance for EG per to post-test comparisons (MD = -13.9, SD = 4.254, t (9) = -10.332and P value = 0.00) whereas CG (MD = 0.40, SD = 2.119, t (9) = 0.597 and P value = 0.565). These results suggest that the strength performance of experimental group was significantly improved at (P <0.05) in core strength and stability test after eight weeks core strength training, however, there was no significant improvement on comparison group strength performances from pre to pot test results. However the formulated null hypothesis that eight weeks core strength training has no significant effect on strength performance of sprinters were rejected at 0.05 level of confidence interval.

As can be seen in table 5 a paired samples t-test was conducted in 150M run test to assess the effect of core strength training on sprinting performance of athletes for both EC and CG. There were a significant change on sprinting performance for EG per to post-test comparisons (MD = 0.542, SD = 0.53139, t (9) =3.225 and P value = 0.01) whereas CG (MD = 0.011, SD = 0.14579, t (9) = 0.239 and P value = 0.817). These results suggest that the strength performance of experimental group was significantly improved at (P <0.05) in 150M run test after eight weeks core strength training, however, there was no significant improvement on comparison group sprinting performances from pre to pot test results. However the formulated null hypothesis that eight weeks core strength training has no significant effect on sprinting performances of short distance athletes were rejected at 0.05 level of confidence interval.

The above table 5 shows the significance differences of the two groups (EG and CG) of pre and post test results because of eight weeks core strength training. According to the data presented in the table 5, the pre and post test result of all variables showed a statistically significant difference in EG. Hence, (P <0.05)

post-training speed, Agility, strength fitness and sprinting performance was significantly improved from pre to post-test values for the EG whereas there was no significant improvement on CG ($p>0.05$).

4.4 Discussion

The purpose of this study was to examine the effect of eight weeks core strength training on sprinting performance and selected fitness variables in the case of Finote Selam Andnet short distance athletics project athletes. On the literature review showed that training particularly core strength training have significant effect on the improvement of athlete's performance and fitness levels. In this study also core strength training showed improvements on sprint running performance and fitness variables mainly on speed, agility, strength and sprinting performance of short distance athletes. Therefore, the discussion part provides an explanation of the results of the present study and how it relates to previous scholar studies. The findings of these studies in each variable were discussed as follows.

Finding from speed: - On table 5, Flying 30 meter pre to post test result suggests that experimental group was significantly improved their speed (MD = 0.19, SD = 0.08756 and, p value = 0.00), significant at 0.05 level of confidence. But in comparison group no significant improvement were found in speed performance in the sprinters (MD = 0.04, SD = 0.1075 and P value = 0.269) significant at 0.05 level of confidence. The improvement of experimental group in speed performance was due to the intervention or influence of eight weeks core strength training. The mean results of experimental group before and after core strength training was decreased by 0.19seconds to cover 30 meters. The mean results of comparison group during pre and post-test was decreased by 0.04 seconds to cover 30 meters. This result indicated that effective change was observed on sprinters after participating eight weeks core strength training on speed performance.

This result was supported with the findings of Granacher et al.(2014)following 10 weeks of core strength training using stable versus unstable surfaces on physical fitness in adolescents, the results showed significantly greater improvements on the stable group in sprint time and in speed performance. This result also agreed with Weston et al. (2014)doing 12 weeks isolated core training significantly improves 50M sprint swimming performance of junior swimmers in the national level. On the other hand Niewolna and Zwierko (2015) result with core stability and functional training had a positive effect on running speed of the female footballers at ($p < 0.05$).

Finding from Agility: - On table 5, T Drill pre to post test result suggests that experimental group was significantly improved their agility performance (MD = 0.38, SD = 0.12293 and, p value = 0.00), at 0.05 level of confidence. Were as in comparison group no significant improvement were found (MD = 0.07, SD = 0.16364 and P value = 0.209)at 0.05 level of confidence. The improvement of experimental group in agility fitness performance was due to the contribution of core strength training for eight weeks. The mean results of experimental group before and after core strength training were decreased by 0.38 seconds to cover T drill test. The mean results of comparison group during pre and post-test was decreased by 0.07 seconds to cover T drill test. This result indicated that effective change was observed on sprinters after participating eight weeks core strength training on agility performance.

This result was supported with the findings of Granacher et al.(2014) following 10 weeks of core strength training using stable versus unstable surfaces on physical fitness in adolescents, unstable group showed significantly greater improvements than the stable group in agility performance at $p < 0.001$ level of confidence interval. Similarly, Dinç and Ergin (2019) study showed the same results on Illinois agility test after 8 weeks core training intervention had significant improvement in the agility performance, at $p < 0.05$ significance level. On the contrary Schilling, Murphy, Bonney, and Thich (2013)study after 6 weeks core strength training intervention to the untrained university students for two times at a week didn't showed improve in the agility performance using Pro agility test at $p < 0.05$.

Finding from strength :- The finding of this study on results presented in case of strength on table 4 proved that, there were significant differences between the pre to post test of core strength and stability test in experimental group (MD = -13.9, SD = 4.254 and P value = 0.00), significant at 0.05 level of confidence. However, in comparison group there were no significance difference found from pre to post test of core strength and stability test scores (MD = 0.40, SD = 2.119 and P value = 0.565) significant at 0.05 level of confidence. The reason behind to the increment of strength for experimental group was due to the intervention of eight week core strength training. The mean score of experimental group before the involvement of eight week core strength training and the mean score of after the involvement of eight week core strength training, the mean difference value was increased by 13.9 in core strength ability. On comparison group without the involvement of core strength training the pre and post-test mean deference were decreased by 0.40 in strength fitness ability. This result indicated that core strength training have significant effect to improvement strength performance of sprinters.

As a result this study supported with the findings of Niewolna and Zwierko (2015) agreed with core stability and functional training had a positive effect on strength of the female footballers at ($p < 0.05$). Likewise, Granacher et al. (2014) also support study that core strength training enhance strength of male and female physical fitness on school-aged children. Following 9 weeks a progressive core strength training program Prieske et al. (2016) study result also showed that improvement in trunk muscle strength performance on unstable and stable surface in elite youth soccer players.

Findings from sprinting performance:- The finding of this study on the results presented in case of sprinting performance on table 4 proved that, there were significant differences between the pre to post test of 150Mrun test in experimental group (MD = 0.542, SD = 0.53139 and P value = 0.00), significant at 0.05 level of confidence. However, in comparison group there were no significance difference found from pre to post test of 150Mrun test scores (MD = 0.011, SD = 0.14579 and P value = 0.817) at 0.05 level of confidence. The reason behind to the increment of running performance for experimental group was due to the intervention of eight weeks core strength training. The experimental group with the involvement of core strength training the pre and post-test mean difference value was decreased by 0.542 in 150Msprintingability. On comparison group the pre and post-test mean deference were decreased by 0.011 in 150M sprinting performance ability. This result indicated that core strength training has a significant effect on sprinting performance of short distance athletes.

The above discussed result was supported with the findings of Sato and Mokha (2009)that the pre and post test result was showing a significant improvement on 500M running performance after six weeks of core strength training at 0.05 level of confidence. Hung,Chung, Id, and Lai (2019) also agreed with this finding that 8 weeks of core training may improve static balance, core endurance and running economy of male college athletes. Similarly, Shinkle et al. (2012) study also indicates that core strength does have an effect on performance in on athletic population. On the contrary Cleveland(2011)disagree with this finding, his study results showed that no significant interaction between core strength and running performance in the long distance runners at ($p<0.05$) level of confidence.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary

The purpose of this study was to investigate the effect of eight weeks core strength training on the sprinting performance and selected fitness variables in the case of Finote Selam Andnet athletics project athletes. For this purpose, the researcher reviewed the available literatures in order to decide the focus of the study. In order to attain the general objective of the study, the following specific research objectives were formulated.

- To examine the effects of core strength training on sprinting performances of short distance athletes.
- To investigate the effects of core strength training on speed performances of sprinters.
- To determine the effects of core strength training on agility performances of sprinters.
- To assess the effect of core strength training on strength performance of sprinters.

Based on the above specific objectives the following hypotheses were formulated:

H_0; - Eight weeks core strength training has no significant effect on sprinting performances of short distance athletes.

H_0; - Eight weeks core strength training has no significant effect on speed performance of sprinters.

H_0; - Eight weeks core strength training has no significant effect on agility performance of sprinters.

H_0; - Eight weeks core strength training has no significantly effect on strength performances of sprinters.

In dealing with the above basic objectives, the study conducted on Finote Selam Andnet athletics project athletes with the total population of 20 sprinters. In this study compressive sampling techniques were applied, 10 subjects were randomized to experimental group of core strength training for 2 month and 3 days per week, and 10 subjects serve as control group were attended on regular training which is given from the coach. A pre-test and post-test of sprinting performance and selected fitness tests were taken to gain the necessary information required for the study.

The data were collected by using the appropriate running performance and fitness quality tests before eight weeks core strength training intervention and after eight weeks core strength training. Paired T test was used for comparisons of means and data were analysed by using SPSS version 23.0 with significance level of 0.05%. Final result of the study showed that significant improvement in the experimental group in both parameters (speed, agility, strength, and sprint running performance) while, in the control group there was not significant improvement. Generally the improvement was seen in the experimental group of the study as all variables were tested. As a result we can conclude that eight week score strength training have a positive effect on sprinting performance, speed, agility and strength fitness performance of sprinters.

5.2 Conclusions

Based on the major findings and results of this study, the following points were stated as a conclusion.

- Eight weeks core strength training has a significant effect on sprinting performances of short distance athletes.
- Eight weeks core strength training has a significant effect on speed performance of sprinters.
- Eight weeks core strength training has a significant effect on agility performance of sprinters.
- Eight weeks core strength training has a significantly effect on strength performances of sprinters.

5.3 Recommendations

Based on the results, findings and discussions of the study, the following would be recommended:

5.3.1 Recommendations for Practice

- Since core strength training has a significant effect in sprint running performance and improving fitness variables sport professionals, coaches as well as athletes ought to exercise at least for 2 days and above per week with gradual increment of intensity regularly to bring improvement.
- Considering the importance of core strength training on improving physical fitness variables; Finote Selam Andnet short distance coach should make the exercise as part of their training program for their athletes commonly.
- Core strength training should be included in all training that comprises the development of short distance running performance and fitness variables either for competition, or rehabilitation purposes

5.3.1 Recommendations for Future Study

- This research was done for eight weeks core straining program, yet the program may be extended for a better performance enhancement in running performance and fitness variables, similar study may under taken by employing subject of other age, group and using others variables, which are not observed in this study.
- This study was conducted to examine the effect of core strength training on speed, agility and strength and also sprinting performance of short distance project athletes. Yet to come it is recommended for other researchers that further study should be conducted to examine effect of core strength training on reaction time, balance, flexibility etc.

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APPENDICES

Appendix 1 *Demographic Characteristics of the Participant*

From No.1 - 10 for Experimental Group and from No.11 - 20 for Comparison Group of Listed Below.

No	Name	Sex	Age	Weight	Height	Training year
1.	AK	M	23	52	1.71	4
2.	AT	M	18	52	1.60	1
3.	HM	M	19	52	1.70	1
4.	BM	M	24	63	1.77	3
5.	MG	M	18	54	1.60	1
6.	SB	M	23	57	1.70	3
7.	GA	M	24	66	1.70	2
8.	ZS	M	20	63	1.75	2
9.	HS	M	22	67	1.80	2
10.	YF	M	21	69	1.70	3
11.	DA	M	22	60	1.70	3
12.	MS	M	26	74	1.80	4
13.	TD	M	24	66	1.82	3
14.	AA	M	19	55	1.60	3
15.	TW	M	21	64	1.65	3
16.	NS	M	18	60	1.75	1
17.	TA	M	19	56	1.70	1
18.	FF	M	21	53	1.65	2
19.	MZ	M	22	56	1.70	2
20.	HA	M	20	52	1.70	2

Appendix 2 *Basic Information for Core Strength Training Program*

The main purpose of this training program is to examine the effect core strength training on sprinting performance and selected fitness variables for eight week experimental periods. The frequencies of the exercise are 3 days/week. Before the pre-tests were taken from the participants, the researcher was identifies each sprinters personal best of exercises repetition in order to put formative training plan. At the time of interventions, there was 10 minutes appropriate warm-up before core strength training for experimental group as listed below each day. After finished daily core strength training workout, both groups continue the main training program.

No.	**Item**	**Duration**
1.	Frequency	3 days per week
2.	Duration of all training	8 weeks
3.	Intensity	Moderate (55-70HRmax)
4.	Days of training	Tuesday (Morning) Thursday (Morning) Saturday (After noon)
5.	Number of athletes'	Experimental group 10 Comparison group 10
6.	Intervention training	Core strength exercises
7.	(___minute)	Recovery time in between sets with active rest
8.	(___minute)	Recovery time in b/n exercise with active rest
9.	(+)	The remaining time from a given single exercise and additional to the recovery time

Appendix 3 *Eight week core strength training programs for EG*

No	Week1	Exercise	Set & Reps	Recovery
1.	Tuesday	Prone plank	2*for 1 min	15 s
2.		Bridge	3*for 1 min	15 s
3.		Curl up	3* 30	10 s
4.		Set ups	3* 20	10 s
5.		Supine Bent-Knee Raises	3* for 1 min	10 s
6.		One arm Plank	3*30s each	15 s

No	Week 1	Exercise	Set & Reps	Recovery
1.	Thursday	One arm plank	3*2 min	15 s
2.		Prayer Cat Camel	4* 30 s	10 s
3.		Puss up	3* 20	15 s
4.		Prone Cobra's	2* 1 min	10 s
5.		Bird Dog	4*2 min	15 s
6.		Curl up	3*35	20 s

No	Week 1	Exercise	Set & Reps	Recovery
1.	Saturday	Abdominal Crunches	3* 1.5 min	20 s
2.		Supine Single Leg Butt Lift	3* 2 min	30 s
3.		Supine Dead Bugs	3*2 min	30 s
4.		Side plank	4*2 min	30 s
5.		Lunges	3*2 min	30 s
6.		Squat	4*1 min	10 s

No	Week 2	Exercise	Set& Reps	Recovery
1.	Tuesday	Prone plank	5*2 min	10 s
2.		Bridge	3* for 1 min	10 s
3.		Curl up	4* 35	25 s
4.		One arm plank	4* for 1 min	15 s

5.		Supine bent knee raise	3* for 2 min	25 s
6.		Super man	3* for 2 min	30 s

No	Week 2	Exercise s	Set & Reps	Recovery
1.	Thursday	Prone plank	4* for 2min	20 s
2.		Prayer cat camel	3* for 2 min	20 s
3.		One arm plank	3* for 2 min	10 s
4.		Prone cobra's	3* for 2 min	20 s
5.		Bird dog	4* for 2 min	15 s
6.		Curl up	4* 40	30 s

No	Week 2	Exercises	Set & Reps	Recovery
1.	Saturday	Abdominal crunches	5* for 3 min	25 s
2.		Supine Single Leg Butt Lift	3* for 2 min	10 s
3.		Supine dead bugs	4* for 1 min	10 s
4.		Side plank	4* f0r 2 min	20 s
5.		Lunges	3* for 2 min	10 s
6.		Squat	5* for 2 min	25 s

No	Week 3	Exercises	Set & Reps	Recovery
1.	Tuesday	Prone plank	5* for 2 min	10 s
2.		Prayer cat camel	5* for 2 min	10 s
3.		One arm plank	5* for 2min	15 s
4.		Prone cobra's	5* for 2 min	20 s
5.		Bird dog	4* for 2 min	10 s
6.		Curl up	5* 35	25 s

No	Week 3	Exercises	Set & Reps	Recovery
1.	Thursday	Prone plank	3* for 2 min	20 s
2.		Bridge	4* for 2 min	20 s
3.		Curl up	5* 40	20 s
4.		Supine bent knee raise	3* for 2 min	20 s

5.		Super man	4* for 2 min	20 s
6.		Puss up	5* 25	20 s

No	Week 3	Exercises	Set & Reps	Recovery
1.	Saturday	Abdominal crunches	4* for 2 min	20 s
2.		Supine single leg butt lift	5* for 2 min	20 s
3.		Supine dead bug	4* for 2 min	10 s
4.		Side plank	5* for 2 min	10 s
5.		Lunges	5* for 2 min	20 s
6.		Squat	4* for 2 min	20 s

No	Week 4	Exercises	Set & Reps	Recovery
1.	Tuesday	Prone plank	4* for 2 min	30 s
2.		Bridge	4* for 2 min	20 s
3.		Curl up	4* 40	25 s
4.		Puss up	5* 30	20 s
5.		Supine bent knee raise	4* for 2 min	25 s
6.		Super man	4* for 2 min	10 s

No	Week 4	Exercises	Set & Reps	Recovery
1.	Thursday	Side plank	4* for 2 min	20 s
2.		Prayer cat camel	4* for 2min	20s
3.		One arm plank	5* for 2 min	25 s
4.		Prone cobras	4* for 2 min	20 s
5.		Bird Dog	4* for 2 min	20 s
6.		Abdominal control Curl up	3* for 2 min	30 s

No	Week 4	Exercises	Set & Reps	Recovery
1.	Saturday	Abdominal crunches	5* for 2 min	25 s
2.		Supine single leg butt lift	5* for 2 min	20 s
3.		Supine dead bug	5* for 2 min	20 s
4.		Side plank	5 * for 2 min	20 s
5.		Squat	5* for 2 min	20 s
6.		Puss up	5* 40	20 s

No	Week 5	Exercises	Set & Reps	Recovery
1.	Tuesday	One arm plank	5* for 2 min	20 s
2.		Prayer cat camel	4* for 2 min	25 s
3.		Puss up	6* 35	20 s
4.		Prone cobras	4* for 2 min	20 s
5.		Bird dog	4* for 2 min	20 s
6.		Abdominal control curl up	4* for 2 min	25 s

No	Week 5	Exercises	Set & Reps	Recovery
1.	Thursday	Abdominal crunches	4* for 2 min	25 s
2.		Supine single leg butt lift	5* for 2 min	25 s
3.		Side plank	6* for 2 min	25 s
4.		Squat	5* for 2 min	15 s
5.		Puss up	6* 30	20 s
6.		Supine dead bug	5* for 2 min	25 s

No	Week 5	Exercises	Set & Reps	Recovery
1.	Saturday	Prone plank	5* for 2 min	15 s
2.		Curl up	5* for 2 min	20 s
3.		Puss up	5* 35	30 s
4.		Bridge	5* for 3 min	20 s
5.		Supine bent knee raise	5* for 2 min	20 s
6.		Super man	5* for 2 min	20 s

No	Week 6	Exercises	Set & Reps	Recovery
1.	Tuesday	One arm plank	4* for 3 min	30 s
2.		Prayer cat camel	6* for 2 min	25 s
3.		Puss up	5* 30	20 s
4.		Prone cobras	4* for 3 min	20 s
5.		Bird dog	5* for 2min	20 s
6.		Abdominal control curl up	5 * for 2 min	20 s

No	Week 6	Exercises	Set & Reps	Recovery
1.	Thursday	Abdominal crunches	5* for 2 min	25 s
2.		Supine single leg butt lift	4* for 2 min	25 s
3.		Side plank	4* for 2 min	25 s
4.		Squat	5* for 2 min	25 s
5.		Puss up	6* 30	25 s
6.		Supine dead butt	4* for 2 min	25 s

No	Week 6	Exercises	Set & Reps	Recovery
1.	Saturday	Prone plank	5* for 2 min	20 s
2.		Curl up	5* for 2min	25 s
3.		Puss up	5* 40	25 s
4.		Bridge	5* for 2min	25 s
5.		Supine bent knee raise	5* for 2min	25 s
6.		Super man	5* for 2min	25 s

No	Week 7	Exercises	Set & Reps	Recovery
1.	Tuesday	One arm plank	5* for 2 min	25 s
2.		Prayer cat camel	5* for 2 min	25 s
3.		Puss up	6* 30	25 s
4.		Prone cobras	5* for 2 min	25 s
5.		Bird dog	5* for 2 min	25 s
6.		Abdominal control curl up	5* for 2 min	25 s

No	Week 7	Exercises	Set & Reps	Recovery
1.	Thursday	Abdominal crunches	5* for 2 min	25 s
2.		Supine single leg butt lift	5* for 2 min	25 s
3.		Side plank	5* for 2 min	20 s
4.		Squat	6* for 2 min	25 s
5.		Press up	6* for 2 min	25 s
6.		Supine dead bug	6* for 2 min	25 s

No	Week 7	Exercises	Set & Reps	Recovery
1.	Saturday	Prone plank	6* for 2 min	25 s
2.		Curl up	6* for 2 min	30 s
3.		Side plank	6* for 2 min	30 s
4.		Bridge	6* for 2 min	30 s
5.		Supine bent knee raise	5* for 2 min	25 s
6.		Super man	5* for 2 min	30 s

No	Week 8	Exercises	Set & Reps	Recovery
1.	Tuesday	Abdominal crunches	6* for 2 min	20 s
2.		Supine single leg butt lift	6* for 2 min	20 s
3.		Side plank	5* for 3 min	20 s
4.		Squat	6* for 2 min	20 s
5.		Puss up	6* 30	20 s
6.		Supine dead bug	6* for 3 min	20 s

No	Week 8	Exercises	Set & Reps	Recovery
1.	Thursday	Prone plank	5* for 3 min	30 s
2.		Super man	5* for 2 min	20 s
3.		Bridge	6* for 2 min	30 s
4.		Puss up	7* 30	25 s
5.		Curl up	5* for 3 min	30 s
6.		Supine bent knee raise	5* for 3 min	30 s

No	Week 8	Exercises	Set & Reps	Recovery

1.	Saturday	One arm plank	5* for 2 min	30 s
2.		Prayer cat camel	5* for 2 min	25 s
3.		Prone plank	6* for 2 min	25 s
4.		Prone cobras	5* for 2 min	25 s
5.		Bird dog	6* for 2 min	25 s
6.		Abdominal control curl up	6* for 2 min	25 s

Appendix 4 ***PRT test results for core strength and stability tests of the research subjects***

		Strength								
		Core strength and stability test in seconds								
No	**Name**	**1st** Stage 60 s	**2nd** Stage 15 s	**3rd** Stage 15 s	**4th** Stage 15 s	**5th** Stage 15 s	**6th** Stage 15 s	**7th** Stage 15 s	**8th** Stage 30 s	**Total**
1.	AK	60 s	15 s	15 s	15 s	15 s	10 s	10 s	21 s	161
2.	AT	60 s	15 s	15 s	15 s	15 s	13 s	12 s	12 s	157
3.	HM	60 s	15 s	15 s	15 s	15 s	13 s	10 s	25 s	168
4.	BM	60 s	15 s	15 s	15 s	15 s	13 s	9 s	25 s	167
5.	MG	60 s	15 s	15 s	15 s	15 s	15 s	11s	20 s	166
6.	SB	60 s	15 s	15 s	15 s	15 s	9 s	12 s	19 s	160
7.	GA	60 s	15 s	15 s	15 s	15 s	12 s	12 s	21 s	165
8.	ZS	60 s	15 s	15 s	15 s	15 s	11 s	12 s	23 s	166
9.	HS	60 s	15 s	15 s	15 s	15 s	10 s	11 s	23 s	164
10	YF	60 s	15 s	15 s	15 s	15 s	10 s	10 s	21 s	161
11.	DA	60 s	15 s	15 s	15 s	15 s	11 s	11 s	10 s	152
12.	MS	60 s	15 s	15 s	15 s	15 s	13 s	12 s	24 s	169
13.	TD	60 s	15 s	15 s	15 s	15 s	1 3s	14 s	16 s	163
14.	AA	60 s	15 s	15 s	15 s	15 s	13 s	12 s	20 s	165
15.	TW	60 s	15 s	15 s	15 s	15 s	12 s	13 s	23 s	168
16.	NS	60 s	15 s	15 s	15 s	15 s	13 s	12 s	24 s	169
17.	TA	60 s	15 s	15 s	15 s	15 s	15 s	10 s	18 s	163
18.	FF	60 s	15 s	15 s	15 s	15 s	13 s	10 s	24 s	167
19.	MZ	60 s	15 s	15 s	15 s	15 s	12 s	11s	20 s	163
20	HA	60 s	15 s	15 s	15 s	15 s	14 s	10 s	18 s	162

Appendix 5 *POT results of core strength and stability test*

		Strength								
		Core strength and stability test in seconds								
		1st Stage	**2nd** Stage	**3rd** Stage	**4th** Stage	**5th** Stage	**6th** Stage	**7th** Stage	**8th** Stage	**Total seconds**
No	**Name**	60 s	15 s	15 s	15 s	15 s	15 s	15 s	30 s	
1.	AK	60 s	15 s	15 s	15 s	15 s	15 s	15 s	30 s	180 s
2.	AT	60 s	15 s	15 s	15 s	15 s	15 s	15 s	27 s	177 s
3.	HM	60 s	15 s	15 s	15 s	15 s	15 s	15 s	30 s	180 s
4.	BM	60 s	15 s	15 s	15 s	15 s	15 s	15 s	25s	175 s
5.	MG	60 s	15 s	15 s	15 s	15 s	15 s	15s	23 s	173 s
6.	SB	60 s	15 s	15 s	15 s	15 s	15 s	15 s	26 s	174 s
7.	GA	60 s	15 s	15 s	15 s	15 s	15 s	15 s	30 s	180 s
8.	ZS	60 s	15 s	15 s	15 s	15 s	15 s	15 s	28 s	178 s
9.	HS	60 s	15 s	15 s	15 s	15 s	15 s	15 s	30 s	180 s
10	YF	60 s	15 s	15 s	15 s	15 s	15 s	15 s	27 s	177 s
11.	DA	60 s	15 s	15 s	15 s	15 s	12 s	9 s	12 s	153
12.	MS	60 s	15 s	15 s	15 s	15 s	11 s	10 s	26 s	168
13.	TD	60 s	15 s	15 s	15 s	15 s	13s	14 s	16 s	163
14.	AA	60 s	15 s	15 s	15 s	15 s	10 s	10 s	23 s	163
15.	TW	60 s	15 s	15 s	15 s	15 s	12 s	11 s	25 s	168
16.	NS	60 s	15 s	15 s	15 s	15 s	12 s	10 s	24 s	166
17.	TA	60 s	15 s	15 s	15 s	15 s	10 s	10 s	19 s	162
18.	FF	60 s	15 s	15 s	15 s	15 s	12 s	11 s	21 s	164
19.	MZ	60 s	15 s	15 s	15 s	15 s	13 s	12 s	22 s	167
20	HA	60 s	15 s	15 s	15 s	15 s	12 s	11 s	20 s	163

Appendix 6 *PRT and POT Test Results for Flying 30M and T Drill Agility Test of the Research Subjects*

		Flying 30M Test		T Drill Agility Test	
No	**Name**	**Pre Test**	**Post Test**	**Pre Test**	**Post Test**
1.	AK	3.8	3.6	11.3	11.0
2.	AT	4.2	3.9	12.1	11.7
3.	HM	4.1	3.8	12.2	11.9
4.	BM	4.0	3.9	11.0	10.5
5.	M G	3.8	3.7	11.2	10.8
6.	SB	4.3	4.2	11.9	11.3
7.	GA	3.9	3.6	11.3	11.1
8.	ZS	4.1	4.0	11.0	10.7
9.	HS	4.3	4.1	11.5	11.2
10	YF	4.4	4.2	11.8	11.3
11.	DA	3.8	3.9	11.5	11.7
12.	MS	4.2	4.1	10.7	10.4
13.	TD	3.6	3.7	10.5	10.6
14.	AA	3.7	3.5	12.3	12.1
15.	TW	4.2	4.1	11.4	11.5
16.	NS	4.3	4.2	12.0	11.9
17.	TA	4.4	4.3	12.2	12.0
18.	FF	4.1	4.2	11.2	11.1
19.	MZ	4.3	4.2	11.5	11.5
20	HA	4.1	4.1	11.6	11.4

Appendix 7 ***PRT and POT Test Results of 150 M Run Performance Test***

		150 M performance test in seconds	
No	**Name**	**PRT**	**POT**
1.	AK	23.6	22.20
2.	AT	22.21	21.96
3.	HM	21.50	20.80
4.	BM	18.97	18.50
5.	M G	22.04	20.60
6.	SB	19.23	19.05
7.	G A	18.93	18.14
8.	ZS	20.31	20.20
9.	HS	20.45	20.40
10	YF	21.23	21.20
11.	DA	18.84	18.90
12.	MS	19.40	19.50
13.	TD	21.60	21.80
14.	AA	22.07	21.90
15.	T W	18.70	18.50
16.	NS	22.20	22.40
17.	TA	23.20	23.10
18.	FF	20.50	20.40
19.	MZ	21.40	21.40
20	HA	20.80	20.70

Appendix 8 *Paired Sample Test Results*

		Group			
		EG		CG	
Test		Mean	SD	Mean	SD
Flaying 30M	PRT	4.09	0.21318	4.07	0.27508
Speed test	POT	3.90	0.22608	4.03	0.25408
T Drill	PRT	11.53	0.44234	11.49	0. 58963
Agilitytest	POT	11.15	0.43269	11.42	0. 57116
Core Strength &	PRT	163.3	3.567	164.1	5.021
stability test	POT	177.4	2.675	163.7	4.373
150M run test	PRT	20.847	1.55248	20.871	1.51232
	POT	20.305	1.37451	20.860	1.53275

Appendix 9 *Mean Comparison Results*

				Paired Differences				
				95% CI				
Test	Subject	Mean	SD	Lower	Upper	T-value	df	P-value
Flaying	EGPRT-POT	0.19	0.08756	0.12736	0.25264	6.862	9	0.00
30m	CGPRT-POT	0.04	0.10750	-0.0369	0.1169	1.177	9	0.269
T Drill	EGPRT-POT	0.38	0.12293	0.29206	0.46794	9.775	9	0.00
agility	CGPRT-POT	0.07	0.16364	-0.04706	0.18706	1.353	9	0.209
Core	EGPRT-POT	-13.9	4.254	-16.943	-10.857	-10.332	9	0.00
S&S	CGPRT-POT	0.40	2.119	-1.116	1.916	0.597	9	0.565
150M	EGPRT-POT	0.542	0.53139	0.16187	0.92213	3.225	9	0.01
run test	CGPRT-POT	0.011	0.14579	-0.09329	0.11529	0.239	9	0.817

Appendix 10 *During Core Strength Training and Test for EG*