2021-06-22

EFFECTS OF CALISTHENICS EXERCISE ON SOME SELECTED PHYSICAL FITNESS QUALITIES AND SHOOTING PERFORMANCE AT GEBEZEMARIAM MALE HANDBALLTEAM PLAYERS

DIRES, GIRMA

BIHAR DAR UNIVERSITY

SPORT ACADEMY

POST GRADUATE PROGRAM IN HAND BALL COACHINIG

EFFECTS OF CALISTHENICS EXERCISE ON SOME SELECTED PHYSICAL FITNESS QUALITIES AND SHOOTING PERFORMANCE AT GEBEZEMARIAM MALE HANDBALLTEAM PLAYERS

BY

DIRES GIRMA ALEMAYEHU

MAY, 2021

BAHIR DAR

BAHIR DAR UNIVERSITY

SPORT ACADEMY GRADUATE STUDIES

EFFECTS OF CALISTHENICS EXERCISE ON SOME SELECTED PHYSICAL FITNESS QUALITIES AND SHOOTING PERFORMANCE AT GEBEZEMARIAM MALE HANDBALL TEAM PLAYERS

BY

DIRES GIRMA ALEMAYEHU

A **THESIS SUBMITTED TO THE SCHOOL OF GRADUATE STUDIE OF BAHIR DAR UNIVERSITY SPORT ACADEMY IN PARTIAL FULFILLMENT FOR THE REQUIREMENTS OF MASTER OF SCIENCE IN HANDBALL COACHING**

PRINCIPAL ADVISOR: HAILEYESUS BAZEZEW (Ph.D)

CO -ADVISOR: BEWUKETU CHEKOL (Asst.Prof)

MAY, 2021

BAHIR DAR

ADVISOR'S APPROVAL SHEET

BAHIRDAR UNIVERSTY

SPORT ACCADMY

Approval of thesis for defense

I hereby certify that we have supervised, read, and evaluate this thesis titled "The effect of calisthenics exercise on some specific physical fitness qualities and shooting performance at Gebezemariam male handball team player" by Dires Girma prepared under my guidance. I recommend the thesis be submitted for oral defense.

_____	_____	_____
Principal Advisor's name	Signature	Date
_____	_____	_____
CO - Advisor's name	Signature	Date

EXAMINER'S APPROVAL SHEET

BAHIR DAR UNIVERSITY

SPORT ACADEMY

Approval of thesis for defense

We hereby certify we have examined this Thesis entitled "The effect of calisthenics exercise on some specific physical fitness qualities and shooting performance at Gebezemariam male handball team player" by Dires Girma. We recommend that this is approved for the degree of "Master of Science in coaching Handball".

Board of examiners

_____	_____	_____
External examiner's name	Signature	Date
_____	_____	_____
Internal examiner's name	Signature	Date
_____	_____	_____
Chair person's name	Signature	Date

DEDICATION

I dedicate this thesis work to my mother fikirie Alemseged, and my wife Emebet gashu whose encourage and help me up to my success**.** In addition, the researcher extended his dedication to my best friends Yeshambel Desalew and Zeleke Tagilo for being there for me throughout the entire master's program.

.

DECLARATION

I, **Dires Girma**, hereby that this study for the partial fulfillment of the requirement for the **"**EFFECTS OF CALISTHENICS EXERCISE ON SOME SELECTED PHYSICAL FITNESS QUALITIES AND SHOOTING PERFORMANCE AT GEBEZEMARIAM SHOOTING PERFORMANCE AT GEBEZEMARIAM MALE HANDBALL TEAM PLAYERS**''** is my real original work and all sources of materials used in this thesis have been acknowledged. It has not previously formed on the basis for the award of any Degree, Diploma of any University, Other institution of higher learning or publication except where due acknowledgement is made in acknowledgements.

Name of the candidate	Signature	Date

ACKNOWLEDGMENTS

First and for most, I want to thanks to God the Almighty power for enabling me to accomplish my task. Then, I would like to express my grateful thanks to my principal advisor, Dr. Haileyesus Bazezew for his Constructive and unreserved comments, advice, competent guidance and encouragement in formulating and successful completion of this thesis. Without his valuable co-operation and expert guidance this study could not been completed.

Secondly, I express my sincere and heartfelt gratitude to my co-advisor Mr. Bewuketu Chekol who's, Constructive and unreserved comments, advice, competent guidance and encouragement in formulating and successful completion of this thesis.

Thirdly, I would like to express my heart full gratitude for Gebezemariam male handball team players who were voluntarily participated in this study and for undergoing the testing procedures. Without their valuable cooperation, voluntary and support the study could not been completed.

Last but not the least, a word of thanks goes to my wife Wro, Emebet Gashu and My father Girma Alemayehu who has been a source of courage and strength in every aspect of my life to reach this level.

.

TABLE OF CONTENTS

CONTENTS **PAGE**

LIST OF TABLE

LIST OF FIGURE

LIST OF ABBREVIATIONS

CO=Control group

EG=Experimental group

MD=Main difference

N=Number

POT=Post test

PT=Pre test

STD=Standard deviation

SPSS= Statistical Package for Social Sciences

ABSTRACT

The objective of this study was to find out the effect of calisthenics exercise on some selected physical fitness qualities and shooting performance at Gebezemariam male handball team players. To achieve the objective of the present study, quantitative research approach and experimental research design were employed. The total subject for the study were twenty-six (n =26) male handball players of Gebezemariam handball team players. They participate in the team actively and frequently in 2013E.C competition season. The study populations were little; all are taken as a sample by using comprehensive sampling technique. All players with the age of (EG=20, 08 ±2.842 CG =21.46± 2.933) were randomly segregated into two groups, an experimental group (n=13) and a control group (n=13). Both the experimental group (EG, n = 13) and control group (CG, n = 13) participated in the regular handball training, but only EG performed additional calisthenics exercise for 12 weeks, with 3 sessions per week, each lasting 50 to 60 minutes. The data were collected through field test of physical fitness qualities and shooting performance on two occasions first before administration of calisthenics exercise as pre-test second after twelve weeks of the calisthenics exercise as post-test. The data collected from the participants of the study were analyzed using SPSS version 23 software by paired t-test with level of significant 0.05. The results showed that calisthenics exercise significantly improved muscular endurance, muscular strength, Explosive power, coordination and shooting performance at ($p<0.05$). Similarly, 30m sprint time was significantly reduced ($p<0.05$).But no significant differences were found in all of the variables in CG ($p>0.05$). Based on the result, it can be concluded that twelve-week calisthenics exercise has a positive effect on improvement of physical fitness variables and shooting performance of handball players. Therefore, this type of training method is suggested to handball players and coaches for improving physical fitness components and shooting performance of handball players.

Key words: Calisthenics exercise, Speed, Muscular endurance, Muscular strength, Power, Coordination, Shooting performance.

CHAPTER ONE

1. INTRODUCTION

1.1 Background of the study

Competitive team sports like handball, basketball, and football are very popular sport across the world that include a lot of different movements like running, jumping, pushing, passing, catching, throwing, blocking, walking, jogging, moderate running, sprinting, fast forward, sideward, and backward movements (Mohamed *et al*., 2009). The success of it depends on the effectiveness of the actions of individual players as well as teamwork. Proper assessment of both individual and team actions, which may lead to good teamwork is the basis of the training process (Andrzej Szwarc 2007)**.**Among those team sports, team handball, attracts great attention and generates international excitement and uniting people across the world (Kamar, 2008).

Handball is a competitive team sport began as a game between two teams of eleven players, and was played outdoors. It has introduced into an indoor team sport in which two teams compete against each other, within seven players on each side, including a goalkeeper, following handball rule and regulations, (Czerwinski& Taborsky, 1997; Massuca *et al*., 2014; Ziv & Lidor, 2009). Now a day it handball the popular competitive team sport that is played over 130 countries across the world at the woreda, regional, national, and international levels from amateur to professional levels (Gorostiaga, et al., 2006 ;Póvoas, 2012). The modern handball game's origins were in Scandinavia in the early19th century and the number of participant increases from day to day and reachs around 19 million people across the world. (International Handball Federation, 2014), and has been an Olympic sport since 1972 in Munich Olympic for men and since 1976 in Montreal Olympic for women.

According to Wagner *et al*., (2014), modern handball is fast, complicated and a dynamic, competitive sport that requires a well-developed physical fitness and shooting performance. It is fastest competitive team sports, characterized by repeated jumps,

running, pushing, changes in direction, body contact at high speed, and specific technical movement patterns occurring in response to the varying tactical situations of the game (Karcher & Buchheit, 2014). In addition to the above it has been argued that muscular strength; muscular endurance, coordination, power, speed and handball skills are the most important factor in competitive team handball, (Vijayaragavan & Perumal, 2016; Tanwar, 2013).

Furthermore, handball is a body contact sport it needs a high level of general and specific physical fitness qualities. It is complex and highly demanding intermittent sport so; a handball a player needs a well-developed physical fitness Qualities (Povovas *et al*., 2012; Sibila, Vuleta, & Pori, 2004). According to Vijayaragavan &Perumal, (2016).Handball player needs physical Fitness components such as strength, endurance, power, speed, agility, coordination, and so on. Physical fitness is an essential factor for performance of sport (Buchheit, Mendez, Quod, Quesnel, and Ahmaidi, 2010). Caspersen, Powell, and Christenson (1995) define physical fitness as all skill that an individual has to perform physical activity. Generally, Physical fitness is the physical ability of individuals to do some activities effectively and efficiently.

Based on the above explanation handball players should develop physical fitness variables via different trainings. That is why the researcher goes through on specific physical fitness components such as muscular strength, muscular endurance, coordination, speed and power as the researcher believes that these components are vital in case of handball sport. Therefore, to improve their physical fitness qualities and shooting performance, coaches should arrange specific handball conditioning training.

According to Srivastava .R *et al*., (2016), Calisthenics exercises one part of physical training that greatly enhances the physical fitness quality of any sport player. Calisthenics exercise can develop muscular endurance, cardiovascular fitness, coordination, power, balance, agility and speed. Calisthenics can be beneficial for both muscular and cardiovascular fitness. Calisthenics exercise uses body weight as a form of resistance to enhance a physical fitness component. It is an aerobic and dynamic exercise and is suitable for sedentary and older people. They are rhythmic, smooth, enjoyable exercise

that are easy to perform alone or in a group format and can be modifying according to subject's fitness level. Calisthenics consist of a variety of simple movement that are intended to increase muscular strength, muscular endurance balance, agility coordination and so on using a weight of one's body for resistance.

Besides this, calisthenics are exercise consists of variety of gross motor movements, running, standing grasping, pushing etc. Mostly performed rhythmically and without or with minimal materials, so essentially, body weight exercise. They intend to improve strength, speed, endurance and flexibility, through movements such as pulling, pushing, bending, jumping, or swinging, using only one's body height for resistance; usually conducted in concert with stretches. When performed vigorously and with Varity, calisthenics can provide the benefits of muscular and aerobic conditioning, Moreover to improving psychomotor skills such as balance, agility and coordination. Many consider calisthenics as movement through space meaning you can move freely without any restriction blocking your full strength (Abebaw, 2018).

Know about the effects of calisthenics exercise programs on physical fitness qualities can help coaches select the best exercise stimulus to improve the individual performance of their players. The majority of specific handball action involves stretch shortening cycles, because concentric action produces higher peak torque when preceded by an eccentric contraction (Enoka, 1997; Hakkinen *et al*., 2000; Komi, 2000). As a result, calisthenics exercise is essential to develop shooting performance (Marques and Gonzalez- Badillo, 2006).

In addition to physical fitness qualities, handball players are expected to develop handball skills such as shooting, passing, dribbling, faking, pivoting, and offense and defense and so on. It seems that Chittibabu, (2014) said that having physical fitness qualities only is not enough; rather it also needs technical and tactical skills of sport.

Shooting performance is one of the fundamental handball skills because; to become a winner in handball game, the team needs to score more goals than the other team. To perform this, handball players need high levels of shooting performance. Winning or losing depends on whether a team attains its ultimate aim that by scoring a goal So,

Shooting performance is the key to winning or losing matches. It greatly depends on the accuracy and speed of a shoot (García *et al*., 2011; Marques *et al.*, 2007).Shooting accuracy is the most important aspect to reach optimum result in competitive team handball because of being high intensity intermittent types of sport. Shooting the ball hard is not enough to beat a goalie; accuracy is essential (Clanton & Dwight 1997). Shooting performance has been related to maximal force, the rate of force development and stretch shortening cycle capacity (Rimmer&Sleivert, 2000). Therefore, shooting assessment is a useful index of the muscular ability to generate power and used to monitor a level of performance (Quagliarella *et al*., 2010). Shooting requires different qualities such as concentration, coordination, velocity, accuracy, throwing power and jumping power (Clanton and Dwight, 1997). To achieve this, handball players improve this skill through different training. Related to this, researchers suggested that team-handball players should train to shoot the ball very accurately (Wagner, Finkenzeller, Würth & von Duvillard, 2014).

When the researcher evaluates the training program of Gebezemariam male handball team players, a coach and players give less attention to physical fitness and handball skill training due to different reasons like absence of training equipments, machine, and gym in Gebezemariam town. Most of their training program focuses on a handball game-oriented without incorporating physical fitness and handball sport skill. Because of these players showed limitations in their physical fitness status and shooting performance. The researcher believes that if a different type of training programs that requires equipment, machine, and Gym replace by body Wight (calisthenics) exercise and incorporates in their training program, it would have an influence on Physical fitness qualities and sport skills otherwise the situation made player have poor physical fitness level and handball technical skills. Due to this reason, the researcher decided to give calisthenics exercises for handball players to determine its effect on specific physical fitness qualities and handball shooting performance.

Therefore, the aim of the study was to investigate the effect of calisthenics exercise on some selected physical fitness qualities and shooting performance among Gebezemariam male Handball players.

1.2 Statement of the Problem

Now a day handball is fast, complicated and a dynamic team sport (Wagner *et al*., 2014). Successful performance in handball requires good physical fitness level, technical, tactical skills to be successful in the competition (Van den, 2004) and to accomplish the required result so, handball players should develop both health, and skill- related physical fitness qualities and sport skills via different pieces of training programs. Therefore, to increase their physical fitness qualities, and handball skills, players or coaches should arrange specific handball technical, tactical, psychological and physical training program (Jenson *et al*, 1997).

The researcher had worked four years in Quarit district Gebezemariam town sports office as a sports training and tournament officer at that time the researcher observed a major problem that hinders the development of a handball player physical fitness qualities and shooting performance in the Gebezemariam male a handball team.

As a researcher observation Gebezemariam male handball team players and coach have some awareness of different training programs like weight training, resistance training has a positive effect on physical fitness qualities ,and shooting performance they do not actively engage in it because, most of these training programs required heavy and costly type equipment like a machine, free-weight ,and gym. Due to this reason, Gebezemariam male handball team players give less attention to both physical fitness training and handball technical skill training. Most of their training program focuses on a handball game-oriented without incorporates physical fitness training and handball skill training. This trend might case of a Gebezemariam male handball team player to have a low level of physical fitness and shooting performance. But calisthenics exercises do not require any special equipment, it is a low cost of practice, being this mainly practiced anywhere such as public parks, and its easiness, requiring none or minimal equipment has been seen to be effective for the development of physical fitness qualities and it only uses bodyweight as resistance. This is one intention for the researcher to conduct this study to check the effect of calisthenics exercise on specific handball player physical fitness and shooting performance at Gebezemariam male handball player and replace a heavy and

costly equipment-training program by calisthenics exercise program to develop physical fitness qualities and technical skills of handball players.

A few studies reported that the effect of different calisthenics exercise has a positive effect on physical fitness qualities (Srivastava, R, 2016, Thakur.R *et al*., 2016, Pilates, 2016, Sudarson, 2019, Kaya *et al*., 2012, Adeniji, 2007, Abebaw, 2018). These studies already show that calisthenics exercise significantly improved physical fitness variables but none of the researchers has reported the effect of calisthenics exercises on handball-specific physical fitness variables, ,and shooting performance in team handball players. This is the other intention for the researcher to fill the gap by analyzing the relation between calisthenics exercise, physical fitness and shooting performance. Therefore, the purpose of the present study was to investigate the effect of calisthenics exercise on specific physical fitness, and shooting performance at Gebezemariam male Handball team players.

1.3 Objectives of the Study

The study has both general and specific objective.

1.3.1 General Objective

The general objective of the study was to examine effects of calisthenics exercise on some selected physical fitness qualities and shooting performance at Gebezemariam male handball team players.

1.3.2 Specific Objectives

In addition to the general objective, the research addressed the following specific objectives:

1. To examine the effects of 12 week's calisthenics exercise on the running speed of handball players.
2. To examine the effects of 12 week's calisthenics exercise on the muscular endurance of handball players.
3. To examine the effects of 12 week's calisthenics exercise on the muscular strength of handball players.

4. To examine the effects of 12 week's calisthenics exercise on the explosive power of handball players.
5. To examine the effects of 12 week's calisthenics exercise on the coordination of handball players.
6. To examine the effects of 12 week's calisthenics exercise on the shooting performance of handball players.

1.4 Hypotheses

To put clearly, this research was an attempting to test the following hypotheses.

1. $H_{0.1}$: There is no significant effect of twelve weeks of calisthenics exercise on running speed.
2. $H_{0.2}$: There is no significant effect of twelve weeks of calisthenics exercise on muscular endurance.
3. $H_{0.3}$: There is no significant effect of twelve weeks of calisthenics exercise on muscular strength.
4. $H_{0.4}$: There is no significant effect of twelve weeks of calisthenics exercise on explosive power.
5. $H_{0.5}$: There is no significant effect of twelve weeks of calisthenics exercise on coordination
6. $H_{0.6}$: Twelve weeks of calisthenics exercise does no significant effect on shooting performance.

1.5 Significance of the Study

It is obvious that ultimately quality and well-designed training program holds to maximize the benefits of handball training. Therefore, this study attempts to assess and give information about the effect calisthenics exercise on some selected physical fitness qualities and shooting performance at Gebezemariam male handball team players so, the main significance of this study was to check the effects of calisthenics exercise on some selected physical fitness qualities and shooting performance.

Generally, this study had the following significances.

First, the study may increase the awareness of participants to engage calisthenics exercise to boost their physical fitness and shooting performance. Second, it helps for coaches and sport science experts to know further about the effect of calisthenics exercise and the ways of evaluating participant's physical fitness level and shooting performance. Third, it may also give an insight for curriculum developers and policy makers and those who are working on the professional development of sport science, who have a role to improve an athlete's physical fitness status and sport skills performance to develop norms and appreciate more calisthenics exercise in sport science programs. Furthermore, it gives recommendations for coaches, players & other concerned body about the effect of calisthenics exercise on some selected physical fitness qualities and shooting performance in team handball and use as a springboard for researchers who want to conduct further research on this issue. Finally, this study provides avail baseline information and reference data on the effects of calisthenics exercise on some selected physical fitness qualities and shooting performance of handball players, coaches, instructors, and trainees.

1.6 Delimitation of the Study

The researcher strongly believes that it would be better to conduct the study in large scale. Nevertheless, due to the constraints of time and finance, the researcher was delimited on the effects of calisthenics exercise on some selected physical fitness qualities and shooting performance at Gebezemariam male handball team players. Although there are many physical fitness variables the dependant variables were delimited on speed, muscular endurance, muscular strength, power and coordination because, all these physical fitness qualities are very important for handball player. Likewise, since the term handball skills are broad, the scope of the present study were delimited on handball shooting performance because; to win the handball game, the team needs to score more goals than the other team. It is determined by shooting performance of a team. The evaluation methods of selected physical fitness qualities and shooting performance was delimit to 30 m speed run test (for speed), push up test (for muscular endurance), pull up test (for muscular strength), vertical jump and standing long jump test (for power), hand eye coordination test (coordination) and jump shoot score and

shooting accuracy test (for shooting performance). Calisthenics included squat, jump squat, push up, dig up, and pull up, alternative arm swing, foot tap and so on.

The time of training was delimited to 12 weeks, three days per week, each lasting from 50 to 60 minutes for calisthenics exercise per sessions. Therefore, the researcher tried to study specifically on the above-mentioned variables in Gebezemariam male handball team players in the academic year of 2013 E.C.

1.7 Limitations of the Study

While conducting the research, the researcher was facing the following Limitations; Inadequacy of available relevant research materials that are done in our country is one of the limitations encountered, to overcome this challenge the researcher was used researches done by foreignness. In addition, the scarcity of sufficient books, literature in the area of study and references were the major shortcoming that the researcher encountered during the execution of the study. Moreover, lack of internet access, lack of asphalt handball court and lack of scientific tools of measurements were the major factor that the researcher encountered during the execution of the study.

1.8 Operational definition of key terms

Effect- something brought about by a cause or an agent; result (Mifflin, 1998).

Gebezemariam: is a town, which is fund in Quarit district west Gojjam zone, Amahara regional state.

Calisthenics exercise : are exercise consists of different movements like:, running, standing, grasping, pushing, etc often performed rhythmically and with minimal equipment, so essentially, body weight exercise (Srivastava R, 2016).

Physical Fitness: is a condition in which a person has enough energy to overcome fatigue and enjoy an individual life (NASPE 2009).

Jumping power: It is the ability of muscle to jump as far as or as high as possible which is measure in meter or centimeter.

Coordination: The capability of understanding as relatively stabilized and generalized pattern of motor control and regulation processes (Hirtz1985, Harre1986 Meinel and Schnabel 198.)

Muscular Endurance: is the ability of an athlete's to overcome fatigue which is test in minute or second.

Muscular strength: is the explosive strength of upper and lower limbs that provides force during the handball game.

Power: it is the ability to integrate speed and strength to produce movement to shoot or to jump (Sharkey, 1990).

Shooting: it is the act of throwing the ball into the goal in order to score a goal (Arto Starck 2011). Shooting is the end action of attacking system. It is a basic element determines the scores and it decide the winning team

Shooting accuracy: it is the ability of an athlete to shoot the ball at intended target from a specific distance.

Handball: is fast, complicated and a dynamic, competitive sport that requires a well-developed physical fitness and shooting performance (Wagner *et al*., 2014).

Speed: is the ability to do a given work quickly, which is tested in second (John, 1996).

1.9 Organization of the Study

The paper of the present thesis organized into five main chapters. The first chapter is an introductory part of the paper in which the backgrounds in the study were presented and the problems to be researched were identified. Moreover, this chapter highlights the basic research hypotheses, objectives, significance, limitation of the study, delimitation of the study, definitions of operational terms and organization of the study. The second chapter focuses on review of related literature. It this chapter the concept of physical fitness , physical fitness in handball, training of fitness, general principle of sport training were presented. Moreover, history of calisthenics, definition of calisthenics, the benefits calisthenics exercise for handball player, effect of calisthenics exercise, physical requirements of handball player, mental requirement of handball player, technical

requirement of handball player, shooting in handball and its importance for handball players were discussed. On the other hand, the third chapter covers the research methodology like research approach, research design, population, sample size and sampling technique of the study, source of data, study variables, data collection instruments, procedures of tests' administration, methods of data analysis, training protocol, reliability of the test and ethical issues were presented. The fourth chapter discussed the results of the study data analysis, interpretation, discussion and result of the data. The last chapter concerns with summary, findings, conclusions, recommendations for the study.

CHAPTER TWO

REVIEW OF RELATED LITERATUR

2.1 Concept of physical fitness

The concept of physical fitness was vague for many of the people in the world. But different scholar's defined physical fitness in different ways but the meaning resembles one central idea. For example, Haskell& Kiernan, (2000), define physical fitness is as "the ability to carry out daily tasks with vigor and alertness, without fatigue and with ample energy to enjoy free- time pursuits and to meet unforeseen emergencies."Similarly, Garson (2009) defined that physical fitness is the ability of a person to perform daily tasks effectively with vigor by traits and capacities associated with at low risk for the development of chronic diseases and premature death. Moreover, David Goldsmith (2010) defined physical fitness as the ability to cope effectively with the stress of everyday life.

In general, physical fitness is a capability to meet the ordinary, unusual demands of daily life *efficiently* and *effectively* without being overly fatigued. Simply it is the body's ability to function safely and effectively, and contributes the total quality of life. The all- round fit person has a healthy and happy outlook though out life. young man absolute require fitness because it is used to keeps man mentally alert, breeds self- reliance and adjust well with his environment as his mind and body are in complete harmony. Physical fitness is probably the most popular and frequently used term in physical education. The main important aim of physical Educators is to improve physical fitness level. According to Nixon and cozens (1964), it was the desire to establish a scientific approach to the development of physical fitness which formed the basis of the first meeting of physical educators in 1885 when the profession of physical education originated.

The United States president‘s Council on physical fitness and sports defined the terms physical fitness as the ability to carry out daily task with vigor and alertness, without undue fatigue, with ample energy to enjoy leisure time pursuits and to meet unforeseen emergencies (Clarke, 1971).

Physical fitness components divided into two: the first one Skill-related physical fitness component and the second one is healthy related physical fitness component. Skill related physical fitness components are components of fitness that are related to sports performance which consists of six components; agility, balance, coordination, speed, power and reaction time (Wilmore & Costill, 2002) and these components are more related to performance than to health (Corbin, 2006). Health related fitness a physiological state of well-being that decreases the risk of hypo-kinetic disease; a basis for participation in exercise, and vigor for the tasks of daily living. It includes components like muscular endurance, cardio respiratory endurance, muscular strength, flexibility, and body composition, which are directly associated with improving health (Arschel *et al.*, 1991).

2.2 Physical fitness in handball

Modern team handball is quick, complicated ,and a dynamic sport that needs well-developed endurance, strength, speed, coordination, Power and shooting performance (Wagner *et al.*, 2014).In the year 2000, a significant change occurred when teams were allowed quick throw-off, which enhance the physical demands by improving the speed of the team handball game (Massuca *et al*., 2014; Wallace & Cardinale, 1997). Players need to be able to repeatedly carries high-intensity activity throughout the game, as they work at both high and low intensity (Corvino, Vuleta, &Sibila,2016;Massuca *et al*.,2014;Michalsik, 2018). Handball players apply fast muscular contractions Such offense, defense, change direction, dribbling, sprinting, and endurance movements which are repeated again and again such as in running walking etc (Corvino *et al*,2016;Hermassi,Aouadi,*et al*,2015; Matthys *et al*.,2011). Physical fitness is a key performance factor in team handball (Buchheit, Mendez-Villanueva, Quod, Quesnel, & Ahmaidi, 2010). Caspersen, Powell, and Christenson (1985) define physical fitness as all variables that an individual has to do physical activity (Shahbazi, Rahimizadeh, Rajabi, &

Abdolmaleki, 2011). Handball can affect cardiovascular, metabolic and musculoskeletal as well as develop muscle mass (Hornstrup *et al*., 2018). Advanced handball players are generally heavier and taller than beginner handball player (Massuca *et al*, 2015). Elite handball players have higher throwing velocity, and movements in a game performed quicker than beginner one (Wagner *et al*., 2017). Researchers have found that workload during a handball game was around 70-80% of maximal oxygen uptake, where the player is traveling between 39 to 47km per game (Michalsik *et al*., 2012,). The following physical fitness components are the key qualities that are masters by handball players.

2.2.1 Power

Power is one of the main factors in movements that dons with high force in a short time (Sabido, Hernández-Davó, Botella, & Moya, 2016). Power defined as work done divided by time (Bompa & Haff, 2009). Power development is a key interest in sport science and how coaches and players can increase that power (Baker, 2001). Power is the ability to produce high force in a short time; it helps a player to perform a fast movement (Can, 2017; Sabido et al., 2016). Success in most sports depends on how much power players has (Can, 2017; Newton & Dugan, 2002; Newton & Kraemer, 1994). Team handball is high power-dependent. Handball players perform a lot of movement such as sprinting, jumping, running, changing direction and throwing that involves high-intensity muscular action (Hermassi *et al*., 2014; Sabido *et al*., 2016). There is a relationship between handball performance and power output, one of the reasons being that power output can affect performance at any point in a movement and decide success for handball players. Therefore, it is an important component (Can, 2017; Knuttgen&Komi, 2003; Laver, Landreau, Romain, & Popovic, 2018; Sabidoetal, 2016) So, handball player must be achieved high level of explosive power is fundamental. This explosive power is the most essential part of most player skills and enables players‟ activities during the game to be not only at the required height and with the necessary power but also at the right moment. A handball player's use of explosive power in vertical and horizontal movements is critical. The relationship between explosive power and the technical and tactical level of the player is especially evident when observing the player's activities at the field, attack from the Head and kicking the ball to the goal (Michal, 2009).The standing long -jump

and vertical long jump is a test for lower body power. This test is very important because the ability to jump is a measure of power. In many sports, such as football and basketball, power is a very important component for players. The players in these sports rely on power to succeed.

In addition to this (Tanwar, 2013) define that power is capacity to release the maximum force in shortest possible time. A power player is not only strong but also creates the force in a shortest possible time. Power defined as strength ability of the player during the use of power in both passing and shooting. The players use power to have a great strength of their body muscles of lower and upper extremities.

2.2.2 Muscular Strength

Strength defined as the maximum amount of force of muscle and nervous system to overcome resistance, (Alegre, Jimenez, Gonzalo-Orden, Martín-Acero, & Xavier, 2006). High muscle strength, as well as muscle balance, can use handball players to increase their performance and prevent injury, (Boreham, 2006; Dawes & Roozen, 2012; Hermassi *et al*., 2014). Handball players need to be strong in both upper and lower limbs to receive oppositions from opponents, play defense, and shoot with high speed, jump and sprint (Cardinale, 2014).

Muscular strength is a key factor in the performance of team handball (Kvorning, 2006). Many scholars agree that higher maximal power and strength may be associated with an advantage in shooting, blocking, hitting, pushing and throwing velocity (Marques, & González-Badillo, 2006). Handball needs many different qualities, such as shooting, passing, blocking, throwing in, goalkeeping, jumping, running, sprinting, starting, faking, defensive and attacking movement, stopping, and changing direction (Lees &Nolan, 1998). Different types of training methods is used to improve strength, endurance ,and power in sports to enhance physical quality ,and thereby specific, team sport physical quality, such as sprinting, blocking and jumping (Santos & Janeira, 2008).

2.2.3 Muscular Endurance

Human body has two type of metabolism, aerobic and anaerobic. If the human body uses an aerobic metabolism, it uses the energy system that does not require oxygen (Wallace & Cardinale, 1997). And also a human body use aerobic metabolism, the body is using the energy system that require oxygen. The ATP-PCR system is anaerobic and therefore does not require oxygen. This energy system gives energy to the muscles for 3-15 seconds in full work, like in a short sprint. After these 15seconds the body switches to the glycolic system, which is also anaerobic and does not needs oxygen (Kenney *et al*.,2015).In a handball game, the athletes are highly active and perform actions with high intensity with rest in between (Karcher & Buchheit, 2014; Shahbazi *et al*., 2011). These actions will impose high demands on both aerobic- an anaerobic energy system (Laver *et al*., 2018). The average heart rate with male elite handball players was 163 beats min-1, corresponding to 71% relative workload (Michalsik, 2018). However, players work at a different workload with different heart rates according to their playing position on the court. A goalkeeper has the lowest heart rate demands. They spend <70% HR max for about 60% of playing time and wasted no time in 90% or higher of HR max. Wings spend the most substantial part of the time in 70-80% of HR max and 80-90% of HR max. Backs and Pivots spend more time in 80-90% of HR max (Karcher & Buchheit, 2014). Players need to be able to recover between high- and low-intensity actions in the game (Karcher & Buchheit, 2014; Wallace & Cardinale, 1997). Wing players have to be able to work in a specific type of metabolic pathway according to their position on the court. Wings sprint at high frequency with a great distance, while backs and pivots perform a large number of actions over more extended periods with 80% intensity of the maximum heart rate (Michalsik, 2018; Póvoas, Ascensão, *et al*., 2014).

2.2.4 Speed

Handball Player requires speed especially when going to fast break. Most other times game speed is required to break past the opponent. Speed is an important prerequisite factor in team handball (Hoff & Almasbakk, 1995). Team handball consists of many high intensive situations that consist of repeated high-intensity sprints, jumps, running, starting, body contact, duels and changes of direction (Karcher & Buchheit 2014). To

done these movements efficiently and for the players‟ ability to perform well in the team, they have to increase their ability to accelerate quickly to high speeds and effectively change directions in in-game situations (Murphy, Lockie & Coutts 2003).Speed is the capacity to cover a distance quickly. Harnessing the capacity to move quickly in a straight line is an important component of successful performance in a vast variety of sports (Little & Williams, 2005).

Speed of motion is very important during fake. When a player is trying to faking an opponent to wrong direction, it is important when the player is quicker than opponent. These situations can still be won even if attacker player is not faster, but then it needs more strength put into the situation. Depending on their position, Players in the team have different speed performance. Wing players are usually quicker and a bit lighter, pivots slower but stronger.

2.2.5 Coordination

According to various studies (Joris *et al*., 2007; Manchado et al., 2013; Van Muijen *et al*., 1991), the factors that determine throwing velocity are technique; coordination and maximum explosive power of the muscles in the upper and lower body, hence the importance of developing training methods that improve both accuracy and throwing velocity.

Coordination the ability to perform complicated movement such as those involves more than one body part at during the sometime. It is the ability to perform these movements out the optimal speed efficiently and accurately Coordination is the integration of sense organs with the muscle function. For instance, in handball the coordination of eye, hands, legs and brain is essential in case of passing, dribbling, shooting etc. Balance is also a main factor influencing the learning of skills and executing the technique during the game situations. Lacking in balance ability, player will be disturbed in executions of skills successfully which in turn results in affecting the team coordination. In the game of handball, the coordinative ability in balancing helps the players to develop the ability to control their bodies, which enables them to reduce the unwanted movements, free from the opponent distractions and to move easily with the ball to the directions in which they

required. Balance is one among the essential abilities that are determining the performance of the handball players because of its use in man-to-man defense during the game. Balance is an ability to maintain the line of gravity of a body within the base of support with minimal postural sway. Maintaining the balance requires coordination of input from the multiple sensory systems including the vestibular, somato sensory and visual systems (Gribble; Hertel, 2004 cited in Vijayaragavan & Perumal, 2016). In nature the balance divided into, static and dynamic based on its movements (Vijayaragavan & Perumal, 2016). Calisthenics exercises are more likely to improve coordination. It is useful for individuals who require improved coordination (Kaya, D. 2012).

2.3 Training Fitness

Training is the base for performing a certain skill performance so that it is improve player's performance using programmed training sessions. Training program defined as systematic process of preparing for a certain physical objective. This objective or goal used to be synonymous with peak performance (Dolman et.al, 2005).

Regular training program has needed for all areas of fitness. Here are some important factors to determine for an effective sport-training program. The training had directed to achieve specific objective and individualized to increase the physical capabilities of particular players. In order to maximize, the physical load needs has increased over time, as the players get fitter. By using cross training and by including fitness into the training drills, it will keep it interesting and maintain the interest of the players (Robert Wood, 2008).

According to Baechle, and Earle, (2008), training fitness has the following basic elements:

Volume-Volume is the amount of work done. The combination of Sets and repetitions of an exercise make a volume. For example, if you are a runner, volume is the amount distance you covered.

Intensity- it is the difficulty of the task. Intensity is the level of resistance used in certain sport training.

Volume-Load -Volume-load is the combination of intensity and volume and .Volume.

Frequency- It defined as the total amount of exercise done in a certain amount of time (Baechle, 2008).

2.4 General Principles of sport Training

Training is preparation, instruction, education and prerequisite for sport performance (Wondemu and Damen, 2004). The human body adapts well when exposed to stress .The term stress in the context of sport training reference to an exertion above the normal, regular activity. The specific activities that result in stress differ for each individual and it depend on a person‘s level of physical fitness (Mueller, M. J. & Maluf, K. S. 2002). Sport training is the continuous long-term process that is progressive and recognizes the individual athlete's needs and capabilities. Sport training planned based on basic principles. These principles of training need a fully understood before the coach can produce training programs. The basic sport training principles of sport's are: *overload, specificity, progression reversibility, individualization, variety and active involvement* Cushion C, (2010). For the athlete to excel in athletics with measurable and predictable outcome, it is important to subject the athlete to a systematic training process, which will ready the athlete for the chosen event in athletics. The time of systematic conditioning may take years and this had pointed out to the athlete on a regular basis. The process of conditioning should consist of training programs which specific objectives to achieve. A best training program had based on the following principals: from Omnibus of Richard Stander, South Africa. For the athlete to excel in athletics with measurable and predictable outcome, it is important to subject the athlete to a systematic training process, which will ready the athlete for the chosen event in athletics. The time of systematic conditioning may take years and this had pointed out to the athlete on a regular basis. The process of conditioning should consist of training programs which specific objectives to achieve. A best training program had based on the following principals: from Omnibus of Richard Stander, South Africa. Brown, J. (2001).

Overload: It is the principle that placing increasing amount of stress load on the body in order to get an improvement in fitness level. Simply it is defined as doing more than

normal *Loading* is the process of performing training loads. If a new training load changes an athlete's fitness, there is a response from the athlete's body. This response by the body is an *adaptation* to the stimulus of the load. To progress and improve our fitness level we have to put our bodies under further stress. Doing this had cause long-term adaptations, enabling our bodies to work more effectively to cope with this higher level of performance. Smith, D. J, (2003)

According to Zaffagnini *et al*., (2016) overloading has achieved by following the acronym FITT.

Frequency: Increasing the number of times you train within a week

Intensity: it defined as increasing the difficulty of the training. For example, running at 12 km/h instead of 10 or increasing the weight you are squatting.

Time: Increase the duration of time that you are training for each session

Type: Increase the difficulty of the training you are doing.

Reversibility: It is a principle that indicates inactivity outcomes in loss of gain through overload. It simply put," If you don't use it, you will lose it". If you stop training then the improvements, you have made reversed (Swenson, R. 2014)

Specificity: It is the principle that indicates the need for a specific type of exercise to improve fitness of a specific part of the body Stone, M. H. *et al.*, (2007). The type of training that you do should be specific to your training. You should train the suitable energy system which you use predominantly for your training and the physical fitness components most important to your sport. You should also test the fitness variables, which are necessary in your training program to see your capacity. Specificity of training is the basic important aspect when selecting appropriate facilities for sport training, especially if performance improvement is a primary goal. Specificity includes not only bioenergetics but also it includes mechanics of training (Wilmore and Costill, 1994). This discussion will be focus with mechanical specificity. Transfer of training effect studies with the level of performance adaptation, which can outcomes from sport training and is

highly related to specificity. Mechanical specificity defined as the kinetic and kinematic associations between a sport training and degree of performance. It includes like, movement patterns, acceleration, peak force, rate of force development, and velocity Parameters. The most similar training is to the actual physical performance the higher the probabilities of transfer (Behm, 1995). Siff and Verkoshanski (1998) suggested that the level of transfer of training effect depends upon the level of dynamic correspondence. They argued that the basic mechanics, but not necessarily the outward appearance, of training movements should be similar to those of performance to reach higher transfer.

Adaptation: Physiological responses to training are very predictable if the body is carefully, progressively, challenged, adaptations will occur, and the body will become stronger. It is the general concept of progressive overload. When the body has, experience will "adapt" to that stress. For example, adaptation may include muscle growth (hypertrophy) following repeated bouts of resistance training or improved cardio respiratory efficiency following aerobic exercise. As the fitness level increases, so does your capacity to work harder and longer. To achieve an optimal level of physical stress, keep in mind the progressive over load principles. As your fitness level improves, you should gradually increase the intensity of the physical stress you are imposing on your body. There are three components that determining appropriate stresses. These are intensity, frequency, and duration. When you manipulate these components intelligently, you can create the fitness and performance result you are after (Knight .K, 2012).

Progression: It is a corollary of the overload principle that indicates the need to gradual increase overload to achieve optimal benefit. Because you will be experiencing fitness gains, you will need to adjust your training frequently to insure further improvement. Remember the concept of progressive overload. Determining the appropriate intensity of training is a constant challenge to any coach or athlete. First, you must start at a work level that you can handle easily. This will ensure a degree of success and help develop confidence in your training. The intensity has gradually increased progressively raise your fitness level .Too much too soon and you run the risk of soreness, injury, and disappointment. Too little too late, and your fitness will plateau and you will probably get bored with the program and eventually quit together (Kraemer, W. J, 2007).

Variance: In order to keep you interested and to give your body a different challenge, your training should be varying. Remember a change is as good as a rest. Many professional athletes will play a completely different sport in between their main season, to keep their fitness up whilst still having a rest.

2.5 History of Calisthenics exercise

Calisthenics exercise comes from in ancient Greece and linked to Greco-Roman gymnastics. It is comes from the ancient Greek word "kallos" which means beauty and "sthenos" which means strength i.e, calisthenics is of combination of Beauty and strength (Srivastava, R. 2014).

The first encounter of Calisthenics exercise can be argue to be from the Spartan era (600-400B.C) Calisthenics exercise would have been a major part of a Spartan soldier's workout regime. Some of the calisthenics exercise included in their training programs are Lunges, squats, crunches, jumping jacks, pull ups, pushups, dips and planks. Every culture and civilization has utilized Calisthenics exercise in one way. The Shaolin monks in China used Calisthenics exercise to build their strength so that they could protect their monasteries from looters and robbers. Traditional Indian wrestlers used calisthenics exercises to condition their bodies. The Roman gladiators trained Calisthenics in their camps. The army up to this day uses Calisthenics exercise as a way of testing physical fitness level.

In 527 B.C, Shaolin Monks are the first group of "Warriors" to use exercise to improve mental and physical performance. They are not a military fighting force. They were, however, the first group of people that trained as combatants all day, every day that used calisthenics exercise in their training program. The monks trained a calisthenics exercise to protect their monasteries from Chinese looters. While they were not a traditional fighting force, to this day Shaolin monks still said to have been some of the most deadly fighters in history (Srivastava, R. 2014). The Persian Empire was the first organization to use calisthenics exercise for warriors that trained in offensive tactics, and they started them at the young age of six. Since then calisthenics have been used by military forces to dominate their enemies" Calisthenics exercise introduced in ancient Greece, where it

was mentioned in a Persian scout report on Spartan warriors before the battle of Thermopylae, with the Persians interpreting the odd synchronized motion as dance, and thus a sign of weakness". Calisthenics has been a decisive advantage that has proven to improve human mental and physical performance for thousands of years. Their implementation has only been improved up on and continues to deliver faster workout results than any apparatus or equipment. The only thing you need to increase your mental and physical performance is yourself (Srivastava, R. 2014).

Now a day the term calisthenics used to indicate a defined exercise with similar features to gymnastics but mainly done outdoors, in parks, using bars and rings. The objective of this discipline is to improve muscular strength and endurance in a variety of its expressions, such as performing the maximum number of repetitions of pull-ups, dips and pushup with and without an external resistance. This discipline is also known as street workout and although there still is not a federation recognized by the International Olympic Committee, there is a private organization known as World Street Workout and Calisthenics Federation with its head quarters in Riga, Latvia, that promotes its diffusion and organizes local and international competitions (World Street Workout and Calisthenics Federation, 2011). In addition to this there is other private organizations that organize and promote the diffusion of calisthenics exercise worldwide and organize international competitions (World Calisthenics Organization, 2012).

2.6 Definition of Calisthenics

The term calisthenics originally referred to a set of body weight exercises used to enhance the general physical fitness level (Beecher C, 1856).Calisthenics exercise is a form of exercise based primarily around mastering your own bodyweight, using minimal equipment. It consisting of different movements without the use of equipment, but mainly using your own body weight as resistance. Calisthenics is a combination of two Greek words 'kallos' and 'sthenos', which means beauty and strength. When the Greeks saw body weight training all those years ago, they named it 'beautiful strength. Calisthenics combines strength training and basic gymnastic movements that can done anywhere; at

home, in the park, at the gym or even in the office. It is low costs of practice mainly it is practiced in anywhere and easiness (Krishnan K, and Arumugam C. 2013)

Calisthenics exercises are one form of exercise consisting of a variety of simple, rhythmical, movement, intend to enhance a physical fitness components with movements such as bending, jumping, swinging, twisting, kicking, by using one's body weight as resistance. Calisthenics when performed vigorously and with variety can benefit both muscular endurance and strength, in addition to improving psychomotor skills such as balance, agility and coordination. Calisthenics exercise can be perform by people in all age groups and genders and without risk of injury when perform properly (Srivastava R, 2013).

2.7 Benefits of Calisthenics exercise for hand ball players

- Calisthenics do not require any special equipment. It is a form of exercise consisting of different movements without the use of equipment, but mainly using your own body weight as resistance.
- It has intended to improve fitness level within movements such as bending, jumping, swinging, kicking; using only one's body weight for resistance (Srivastava, R. 2016). Calisthenics are dynamic and aerobic exercises and are suitable for both sedentary and older people. They are rhythmic, smooth, enjoyable exercises that are easy to done both alone and a group format, and can be modified according to subject's physical fitness levels.
- Callisthenic exercises consist of a variety of simple movements that are intended to improve physical fitness using the weight of one's own body for resistance.
- Callisthenic fitness training can develop muscle endurance, cardiovascular fitness, coordination, power, balance, agility and speed (Srivastava R *et al*., 2016).
- **C**alisthenics Exercises used to develop physical fitness variable such as muscular endurance and strength that are perform without special materials (Santhosh, R., & Davidson, S.A)

- A calisthenics exercise does not need any equipment it use one's body weight as a resistance. Some of the basic calisthenics exercises are squats, pull-ups, pushups, lunges dips, jumping jacks, setups and crunches.
- Doing calisthenics exercise is more important to maintain correct form and posture throughout the exercises than to complete a certain amount of repetitions.
- It is effective for aesthetic physical fitness development and has been gaining improving popularity over the years (Krishnan K, and Arumugam C, 2013).
- Calisthenics improve muscular strength, muscular endurance, balance, and coordination and augment the body's general well-being by placing controllable, regular demands upon the cardiovascular system. The exercises can function as physique builders or serve as warm-ups for more-strenuous sports or exertions. (Perrottet, T. 2004).
- A calisthenics exercise does not require setting up time, you can transition from one exercise to the next quickly and easily which makes your workout effective and efficient.
- Calisthenics exercises teach you to master your own body. They improve coordination, balance and self-awareness. Deferent from resistance machines, that guides your movements. Doing bodyweight exercises effectively means you must control your limbs and keep proper body position. This has a positive carryover to sports and other "functional" activities.

2.8 Effect of calisthenics exercise

According to Srivastava R., (2014) Calisthenics exercise has the following effect

- Calisthenics exercise performed by people in all age groups and genders and without risk of injury when done properly.

- By adding calisthenics to your exercise regime and going on a good diet, tremendous improvements to your level of fitness.

- Develops s overall stamina, strength, energy, agility, coordination, balance, and promotes over all fitness for your health.

- Develop mental health just as it does psychomotor skills like balance and coordination. Can help treat mental problems such as stress, anxiety, depression, etc. and can boost yourself-esteem.

- You can achieve higher vigor, coordination, and agility from your muscles by performing calisthenics exercise.

2.9 Physical requirements of handball players

Kekk, (2009) describes that during a handball match, players run approximately 4000-6000m. Average intensity in handball player is 80-90% of maximum heart rate. Playing has shown to have a significant connection with maximum consumption of oxygen (VO2max) and for that reason. Oxygen consumption might be a restrictive factor.

Coaches Info (2011) defines an handball game is characterized by two halves of 30 minutes each, it is important to make sure that training sessions create similar or higher levels of intensities for similar or longer duration in to produce enhancement in players' fitness level. Here we present some examples of common handball drill and propose a classification of the metabolic demand of specific handball drills. By following players' heart rate during different type so training, it is founded out that 2vs2 drills produce higher, and as so closer to game like, heart rate.

2.10 Mental requirements of handball players

Handball is a competitive team sport. For a single player probably the biggest challenge is to be able to rely on others. No one can win by himself or herself. Players do not need to be best friends, although that helps, they just need to be able to get along with each other. Winning is not something that just happens, it requires both physical and mental workout during career (Arto Starck, 2011:7).

2.11 Technical elements of handball players

Technical skills are necessary for every sport. Technique is the ability to done a movement efficiently and effectively (Czerwinski & Taborsky, 1997). In addition to a high level of physical fitness elements, technical skills are a necessary skill to success in

team handball, (Hermassi, van den Tillaar, *et al*., 2015).The technical tool during a team handball-training session allows one to effective develop motor skills (Huseaien, Ivanov, & Vyaltsev, 2016). When a player increase technical and tactical skills in a movement, she/he is receiving reliable information about the qualitative characteristics of the movement which will give her/him the ability to develop a higher level of physical skills and technical preparedness that ensures fast improvement in motor skills (Huseaien *et al*., 2016). Performance of Handball players determined by the' technical, tactical, social and physical patterns (Michalsik, 2018). Playing actions like passes, receiving, tackles, shots, fakes, blocking and side cutting are all examples of activities that require technical skills. Handball Game divided in to an offence and defense. Different techniques are required at offensive and defensive play.

Technique of handball players divided in to two: (1) Defensive technique: (2) Offensive technique.

According to Istvan, Vincze&Hajdu *et al*., (2015), the technical element divided in to three as technical elements of offense, technical elements of defense and technical elements of goalkeeper. This classification is shows in the following figure.

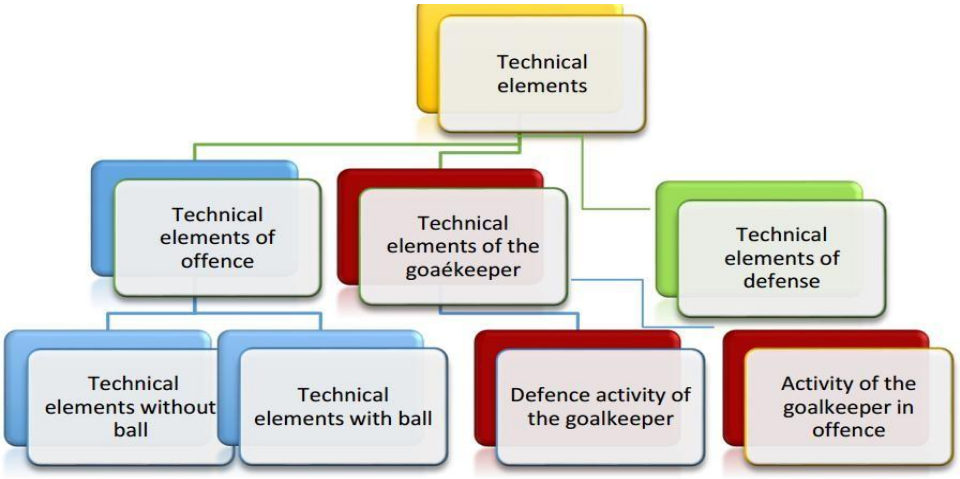


Figure 1: Technical elements of handball players

Adopted from (IstvanJuhász, Bíró, ImreJuhász, Váczi, Vincze, Hajdu, 2015, *p.10)*

Technical elements of offence are also classifies in to two (Istvan Juhász *et al*., 2015)

Technical elements without ball*: it* includes the basic position of the offending player, start, run, stop, jump up, fake and landing.

*(2)*Technical elements within the ball *:* it includes the possession of the ball like shooting the ball, catching the ball, dribbling the ball, faking with the ball (start fake, fake run movement, feinting a pass- and a shot), blocks, blocking-breakaway and techniques to gain a goal(shooting the ball).

Technical elements of defense: Technical elements of defense including like: basic position, movement in basic position, collisions, different activities to get the ball (Czerwinsk &Taborsky, 1947, p.10). These are summarized as follow.

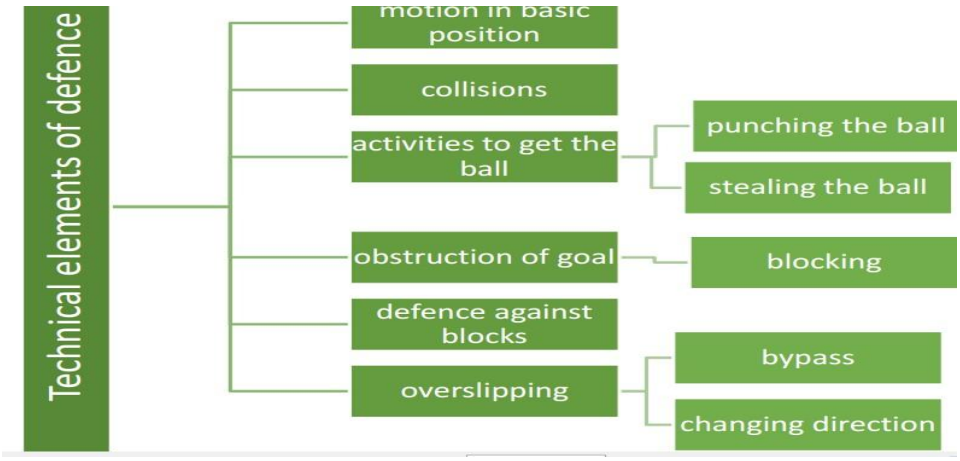


Figure 2: Technical elements of defense

Adopted from (Istvan Juhász, Bíró, Juhász, Váczi, Vincze, Hajdu, 2015, *p.11)*

Generally, considering activities, which are performed on the court, handball technique is divided into catching the ball, passing, shooting, dribbling, fake movements, offensive and defensive movement, goalkeeper's technique (Czerwinsk &Taborsky, 1947).

2.12 Tactical requirements of handball player

Tactical skill is describe as the choice of the most important and effective action in the given concrete situation. The higher level of physical condition and the greater the repertoire of technical skills, the more useful and more successful the tactics of action can be (Czerwinsk Taborsky, 1947). Tactics is all the ways of movements used against the opposite team. It is a behavior, which is use to reach the planned purpose, the use of the most successful methods in situations and actions. Tactic is classifies as tactics of attack and tactics of defense. These are describing in the following figure.

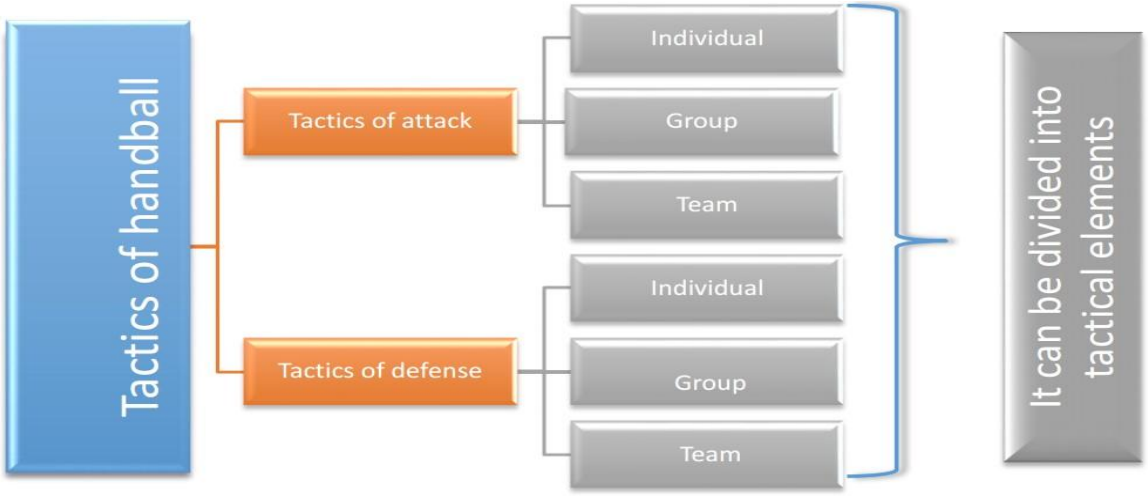


Figure 3: classification of tactical skills

Adopted from (IstvanJuhász, Bíró, Juhász, Váczi, Vincze, Hajdu, 2015, *p.32)*

2.13 Shooting in handball

Shooting is one of the key technical skills for team handball players. They are key skill that determines the score of a team. Shooting is the final of the attack with hopes of scoring. The aim of the organization of attack is to create an advantageous place from which one player of the team can execute a direct goal shot with a high chance of scoring. It is most commonly attempt by the players from the area between the broken

line and the base line in presence or absence of defensive players of an opponent and particularly from the backcourt position (Skoufas *et al*., 2003).

The shot power in team handball conditioned by the distance and hand action time on a ball. The greater the distance that the hand on the ball covers in the time unit the stronger the shot will be performed (Wagner *et al*., 2010). The name of shots has been derived from the way the players move on the court and the position of his/her body to the ground. In team handball, shooting is the concluded action in an attacking movement.

2.14 Basic type of shot in team handball

Shooting in team handball are perform in specific conditions, with in the presence of the opposite team players and while observing playing regulations. Their selection and execution therefore depend mostly on the situations in the match (Pori, Boni & Sibila, and 2005:40).

There are four basic shots in team handball.

1. Set shot is the most natural of all shooting actions and is simply the overhand pass thrown hard. Overhand pass thrown hard.

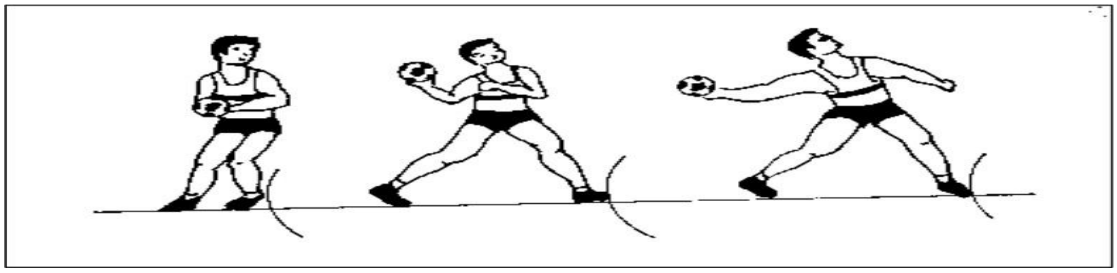


Figure 4: Set shot

Adopted from Czerwinsk and Taborsky (1947)

2. Jump shot is the most the basic type of shot in team handball. Developing the ability to jump and shoot over the defense, as well as jumping inside the goal area, will make you a more effective scoring threat (Hartz, 2018).

Figure 5: High or vertical jump shot

Adopted from Czerwinsk and Taborsky (1947)

Long Jump shot It is a basic frequent method of completing pure goal situations. It creates a good way for a player to get out of a defenders range and to approach the opponent goal as nearly as possible (IstvanJuhász *et al*., 2015). Here, three steps and take off is essential to increase the angle of shooting. According to Czerwinsk and Taborsky (1947) states that for a long jump shot the best take-off angle is 45 degree so that a player covers the greatest distance.

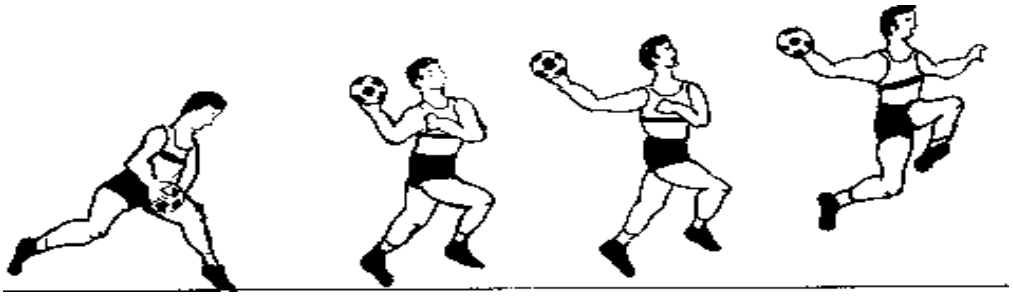


Figure 6: Long jump shot

Adopted from Czerwinsk and Taborsky (1947)

3. Wing shot is the jump shot performed at a difficult shooting angle. It is the jump shot performed at difficult shooting angles. Mostly left and right wing players use it. Good wing players improve the effectiveness of a team's offense and scoring ability by making the full width of the court useful. In doing so, this type of shot have four phases: the approach, the plant, the jump, and the shoot (Clanton & Dwight, 1997).

Figure 7: Wing shot

Adopted from Czerwinsk and Taborsky (1997)

4. Fall shot is the key technique of the pivot runner. It allows you to receive the ball around the 6m line and shot without using three steps while shooting. The player must be able to select and execute the appropriate shot as the opportunities present themselves no matter what position they play.

In team handball, shooting to score goals is one of the most important aspects of the game. In order for a shot to be successful, it must have maximum ball velocity and precision for an element of surprise for the goalkeeper (Wagner & Muller, 2008).

Right-handed players should perform shooting from the left side position is better. Left-handed players should perform shooting from the right side position is better. When in the air, the player performs jump shots (Hartz, 2018).Left- handed players should perform shooting from the right side position is better. When in the air, the player performs jump shots (Hartz, 2018).

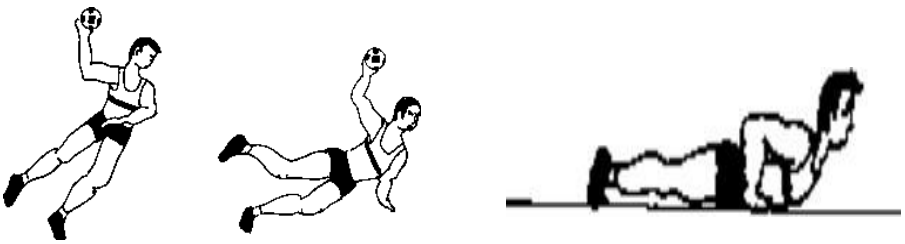


Figure 8: Falling shot

Adopted from Czerwinsk and Taborsky (1947)

2.15 Performance of shooting in team handball players

Shooting is the end action of attacking system. It is a basic element determines the scores and it decide the winning team. While shooting the muscles of the upper limbs, lower limbs, pelvic and trunk are extremely engage. Shooting performed similarly to passing, but in shooting, there is a stronger action of the trunk and upper limbs. The shooting power conditioned by the distance and hand action time on a ball. The greater the distance that the hand on the ball covers in the time unit the stronger the shot will be performed (Clanton & Dwight, 1997). As the end, aim of the handball game is to score more goals from the opponent. Shooting performance is an important key skill for success in handball, with the effectiveness of a shoot affected by two aspects: throwing velocity and throwing accuracy (Hermassi, Chelly, Fathloun, and Shephard, 2010).

2.16 Shooting accuracy and its importance in handball

Shooting accuracy defined as the amount of variability of player's movement end in the target area (Schmidt & Weisberg 2004). To perform good throwing accuracy, players should possess a proper technique characterized by an optimal coordination and timing of consecutive actions of body segments together with good levels of muscle strength and power in both, upper and lower limbs (Marques, van den Tillaar, Vescovi, &Gonzalez-Badillo, 2007).

Shooting performance depends largely on the accuracy and speed of a ball (Gorostiaga *et al.*, 2004). Shooting the ball with high speed is not only enough to score a goal but also accuracy is essential. Therefore, Accuracy and ball speed in handball are regard as basic parameters of shooting performance. Shooting the ball in to the corners side is one of the important principles of shooting. Shooting performance is important for success and result in competitive team handball (Gorostiag et al, 2005). Wagner & Muller, (2008) Stated that, in team handball, shooting on goal is one of the basic important aspects of the

game. To increase the ball velocity, the internal shoulder rotation angular velocity at ball release, maximal elbow extension and the timing of the maximal pelvis angle are important contributors (Wagner & Muller, 2008). In competitive team handball, shooting a ball at the goal is the culmination of an attacking phase. Success or failure depends on whether a team attains its ultimate aim, that of scoring a goal. Shooting efficiency is the base to winning or losing a game and has been the subject of various studies (Garcia *et al*., 2011). Van den Tillaar and Ettema (2003; 2006) analyzed the team handball players are trained to shoot very accurately at a relatively high ball velocity .Based on the above explanation shooting performance depends largely on the shooting accuracy and ball velocity.

CHAPTER THREEE

3. RESEARCH METHODS

3.1 Geographical location of the study area

This study was conducted at Amahara National regional state, west Gojjam zone Quarit district Gebezemariam town. It is far from Finoteselam, which is the administrative center of the west Gojjam zone by 56 km, from Bahir dar, which is the administrative city of Amahara regional state by 82 km, and from Addis Abeba, which is the capital city of Ethiopian by 431 km. Administratively the woreda was divided into thirty-three kebeles. According to the Amahara plan commission ,(2011) population prediction the District has a total population, of 137,610 total population which is 15,823 lives in urban, 121,787 live in rural and from the total population 41,671 were youths lives in both urban and rural. The major portion of the study area is 63 % weinadega, 1.28% kola, 35.72% dega. The absolute location of Quarit district is $10^0$47' 00"-11^0 8'30'' north latitude, and $37^0$13'30"-$37^0$39'30"longitude east. The study area is bordered by Degadamot in the southeast, Jabi Tehnan in the southwest, sekela in the West, Illimana Denisa in the north and gonj kolela in the northeast. The map of the study area shown as follows.

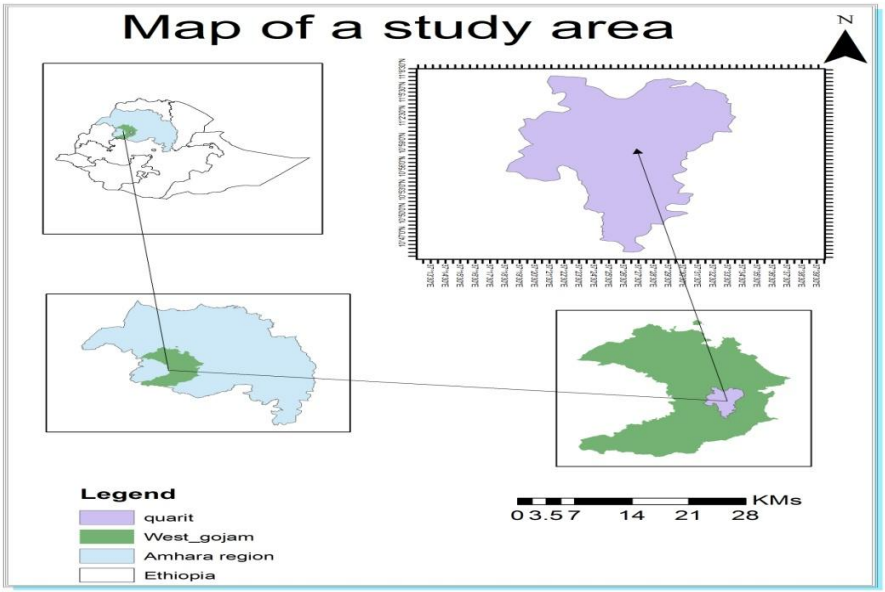


Figure 9 map of a study are

3.2 Research Approach

The present study would use a quantitative type of research approach because; this type of research approach would be used for testing objective theories by examining the relationship among variables. These variables, in turn, can be tested, typically on instruments, so that numbered data collected and analyzed using statistical procedures (Creswell, 2012).

3.3 Research design

The main objective of this study was to evaluate the effect of calisthenics exercise on some selected physical fitness qualities and shooting performance of the Gebezemariam male handball team players. To attain this objective, experimental method of research was employ, because it is helpful to know the effect of independent variable on dependant variable by test players selected physical fitness qualities and shooting performance within pre-test and post- test and also this design is the best way to construct cause and effect relation among variables. Experimental research design is the only ways of research that can reliably test hypothesis and show cause and effect relation (Kothari, 2004). The layout for this study was described as follows

Table 1: The Study Design Layout

No	Treatment	Calisthenics exercise
1	Frequency	3 days/week
4	Intensity	Moderate to high
5	Duration of whole training	12 weeks
6	Duration of training/session	50-60 minutes/session
7	Time of training	Tuesday and Thursday morning 1:00 -2:00am and Sunday afternoon11:00-12:00pm
8	Days of training	Tuesday , Thursday and Sunday

3.4 Population, sample and sampling technique

. The study was conducted at Gebezemariam male handball team players. So the target population of this study was all- male handball players in which they are participating actively and frequently in the 2013 competition season at the Gebezemariam male handball team. The total numbers of players found on this team were 26. The population's numbers in the team were little; so, the researcher was taken all players as a sample by utilizing a comprehensive sampling technique. And also the researcher uses a Simple random sampling technique to assign experimental and control groups because the subjects are homogenized. 13 subjects are randomized to the experimental group and the other 13 subjects were randomized to control group. Finally, the experimental group (n=13) underwent 12-week calisthenics exercise 3 sessions per week, each lasting from 50-60 mint in addition to the regular handball training. The process of randomization was as follows. First, the participants were asked to make a circle, and then the researcher stands at the center of the circle. Then, the researcher pivots three times in the position, and points to one of the research participants to determine the starting point and assign as number one and continue up to number 26 in the clockwise direction. Finally, study participants number one and two are expected to choose the lottery, which was put on the table, and grant to the researcher, which is composed as a control and experimental group. Each even number between 1to26 was assigned as an experimental group and every odd number was assigned as a control group of the study.

3. 5 Criteria for selection of subjects

Inclusion criteria

Before the start of data collection, the researcher asked the participant about their health status and willingness to participate in the study, based on this Player, who were actively participating in the team in 2013 E.C, have no previous health problems and voluntary with the informed consent were taken as a subject

Exclusion criteria

Players who not willingness to provide informed consent, bad habits and those taking medications, and have a previous health problem that are unable to cope up with the training program were not having participated in this study as a subject.

3.6 Source of data

To achieve the objective of the study, the researcher collected an adequate amount of data regarding the effect of calisthenics exercise on handball player's physical fitness and shooting performance. So the primary data were taken from Gebezemariam male handball player's through pre and posttests.

3.7 Study variables

In this study, there are three variables: one independent variable (calisthenics exercise), two dependent variables the first one is (physical fitness qualities) and the second one is (shooting performance). Therefore, the intention of this study was to investigate the effect of calisthenics exercise on some selected physical fitness qualities and shooting performance of the Gebezemariam male handball team players.

3.8 Instrument of data collection

The investigator has collected quantitative data through the appropriate physical fitness and shooting performance test such as 30 m speed run test for speed, push up test for muscular endurance, pull up test for muscular strength, vertical jump and standing long jump test (explosive power), eye- hand coordination test for coordination and shooting performance test. Before the experimental groups are going to the calisthenics exercise, a pretest was taken from both control and experimental groups. Posttest was also taken from both groups after 12 weeks to calisthenics exercise of an experimental group

3.8 Training procedures

In this study, the experimental group had engaged through training activities of select calisthenics exercise in addition to the regular handball training like squat jump, push up, pull up, dig, foot taps, opposite arm swing ,etc. Therefore, all subjects had taken a pre-test firstly, for the selected physical fitness qualities such as;30-meter sprint, push up, pull up, vertical, jump long jump, eye- hand coordination test and shooting performance and

later has given a crucial training program three times in a week lasting about 50_60 minute span of 12 weeks. Therefore, the researcher had a prepared training session plan for experimental players in addition to the normal training plan. However, both groups of players undergo the normal training program that is prepared by a coach it could show in the part of the study. Finally, all subjects had taken a posttest, and then differentiate the effect of trained and non-trained subjects with the selected physical qualities and shooting performance.

3.9 Procedures for administration of tests

The researcher was followed standard procedures for testing the selected variables and registering the score in the fitness record sheet under the direct supervision of subjects. In order to evaluate the effect of calisthenics exercise on selected physical fitness qualities and shooting performance, all pretest measurements have performed before the commencement of the 12-week calisthenics exercise program while post-testing were performed immediately after the completion of the program. The participants were performed enough a warming up and stretching exercises before tests. The testing session consisted of warm-up and test interspersed with rest. Before testing subjects given practice, trials to become familiar with the testing procedures and all measurements were explained and demonstrated.

3.9.1 Evaluating Speed

30-meter sprint test

Objective: To monitor the development of the athlete's maximum sprint speed.

Required apparatus

To undertake this test, the researcher was required Flat non-slip surface, measuring, tape, Cones, Stopwatch, and assistant

How to conduct the test

- This test had required the athlete to sprint as fast as possible over 30 meters
- The athlete done warms up for ten minutes

- The assistant marks out a 60 meters straight section with cones placed the start point, the middle, and the finish point.
- On a signal of "On your mark–Set–GO "sprint to the other cone as quickly as possible.
- The test comprises of 3 x 30m runs from a standing start and with a full recovery between each run.
- The athlete uses the first 30m to build up to maximum speed and then maintains the speed through to 60m.
- Rerecord the time of players to complete the first 30m and the whole 60m.
- To determine the athletes 30m sprint time subtract the time for the first 30m from the time for the whole 60m.

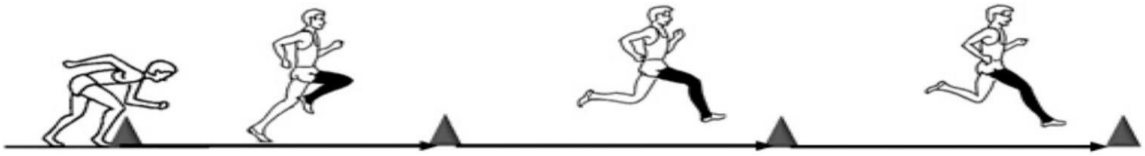


Figure 9: 30-Meter Sprint Test

Source: Peter J L Thompson the Official IAAF Guide To Coaching Athletics, (2000)

3.9.2 Evaluating muscular Endurance

The Push-Up Test

Objective: Use to measure muscular endurance.

Required equipment

To undertake this test, the researcher was required a floor, assistance, stopwatch, recored sheet and pencil

How to conduct the test

- The athlete conducts warms up for 5 minutes.
- Give yourself from 2-to 3-minute recovery period after the warm-up and prepare to start the test.

- Start by positioning yourself on the ground in a push-up position. Your hands should be approximately shoulder width any of our legs extended in a straight line with your weight placed on your toes.
- Lower your body until your chest touches the ground and raises yourself back to the up position. It is important to keep your back straight, and lower your entire body to the ground as a unit.
- Count push-ups and assist in the timing of the test (testdurationis60 seconds).
- On the command "go," start performing push-ups. Your partner counts your pushups aloud and informs you of the amount of time remaining in the test period (e.g.,at15 second intervals)
- Remember only those push-ups that are performed correctly were counted toward your total; therefore, use the proper form and make every push-up count.

Scoring: Record the number of correctly completed push-ups within one minute.

Figure 10: push up test

(Devinder k. Kansal, 2008)

3.9.3 Evaluating muscular strength

The pull-up test

Purpose: Use to measure muscular strength.

Required equipment

To undertake this test, the researcher was required overhead bar**,** assistance, recored sheet ,and pencil

How to conduct the test

- First of all an athlete conducts warms up for 5 minutes
- Then athletes grasp the overhead bar using either overhand grip or underhand grip, with the arms fully extended.
- The subject then raises the body until the chin clears the top of the bar,
- Then lowers again to a position with the arms fully extended.
- The pull-up performs in a smooth motion. Jerky motion, swinging the body, and bending the legs is impossible. As many full pull-ups as possible are performed.
  Scoring: The total number of correctly completed pull-ups recorded as a score.

Figure 11: pull up test

Source .Thakur R, *et al.*, (2016)

3.9.4 Evaluating Explosive power

Explosive power was evaluating using vertical and long jump test power.

Vertical jump Test

Objective: Use to monitor the development of the athlete's elastic power in lower extremity.

Required equipment

To undertake this test, the researcher was required wall, assistant, tape measure, and chalk.

How to conduct the test:

- The participant conducts warming-up for 10 minutes.
- The participant chalks the end of his fingertips.
- The participants stands side onto the position of the wall, keeping both feet remaining on the ground, reaches up as high as possible with one hand and marks the wall with the tips of the fingers (M1)
- The participants from a static position jumps as high as possible and marks the wall with the chalk on his fingers (M2)
- The assistant tests and records the distance between M1 and M2
- The participant repeats s the test three times.
  Scoring: the assistant calculate recorded the highest distance jump from the three trials and take it.

:

Figure 12: Vertical Jump Test

Source: Sergeant Jump Test (Sergeant, 1921)

Standing long jump test

Objective: Use to monitor the development of the athlete's elastic leg power.

Required equipment

To undertake this test, the researcher was required long jump pit, meter and assistance.

How to conduct the test:

- The participants were conducted a warm up for ten minutes.
- Participants jump as far as possible.

- The participants were began the test on the signal.
- The athlete places their feet over the edge of the takeoff line.
- The athlete leans forward, swings their arms backwards, and jumps horizontally as far as possible, jumping with both feet.
- The start of the jump was from a static position. Passing the takeoff line was not allowed. In this test, three trials were allowed.
- After completing the assistant test, the distance covered was measured from the edge of the take-off line to the nearest point of contact.

Figure 13: Standing long jump Test

Meseret T, (2018)

3.9.5 Evaluating coordination

Eye- hand coordination test

Objective: Use to measure the coordination between aye and hand

Required apparatus

To undertake this test, the researcher was required**:** Stopwatch, lime, well, Tennis ball, portable score sheet and pencil

How to conduct the test:

- Mark a line two meter away from the wall.
- Participants start the test from starting line.

- On the signal of start Participants throws the ball against the well and catches it with the other hand.
- The process continues for 30 seconds and then after 30second and the subject stop and recorded the number of correctly made catches.
- Three trials were given and recorded the best trial was recorded in which maximum catches were correctly taken.

Figure 14: Eye- hand coordination test

Devinder k.Kansal, (2008)

3.10 Evaluating shooting performance

Shooting performance for handball players was evaluated using shooting score and shooting accuracy test.

Shooting score test

Objective: Use to measure the shooting ability in team handball.

Required equipment

To undertake this test, the researcher was required: a marked level floor or ground with a smooth surface, a standard inflated Handball, rope or string, measuring tape, score card and pencil.

How to conduct the test:

- first of all a goal post was divided in 3 parts, 40cm in lift and right side and the middle part.
- All part was assigned a certain number of points reflecting the difficulty of throwing the ball into that area.
- 5 points awarded for both lift and right side & 0 points awarded in the remaining part of the goal post. For each Players10 jump shot was given.
- Out of 10 jump shots, players were asked to attempt four jump shoot from Centre Back, three jump shot attempt from Left in and three jump shot attempt from Right in.
- All shoots must be made from behind the 9- meter line.
- No points are scored if ball hits the court surface before it reaches the goal.
- Outside shoots are counted as attempts.

Scoring: The score for ten shoots is the sum of points awarded on each shoot or attempt.

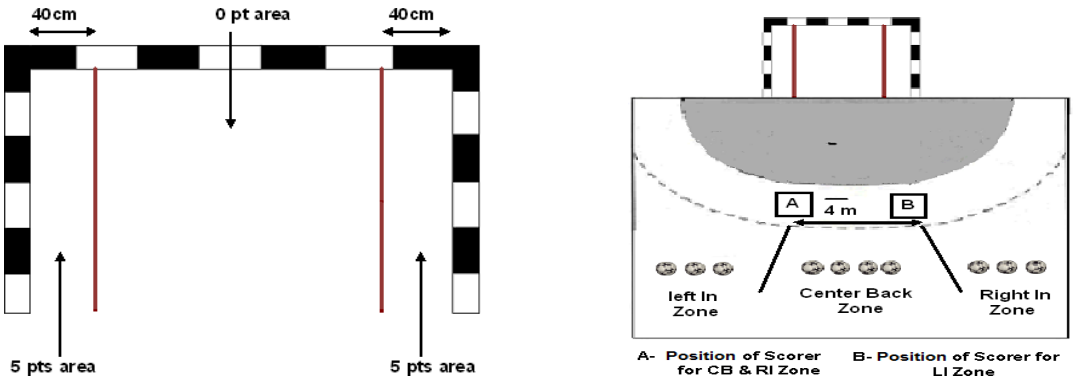


Figure 15: jump shoot test

Adopted from Kangane, (2005)

Shooting accuracy test

Objective : Use to measure the accuracy shooting.

Equipment required

To undertake this test, the researcher was required Standard handball, goal and record sheet.

How to conduct the test:

- Players performed a warm-up for 10 minutes with jogging and throwing drills.
- Four squares (50x50 cm) on the four corners of the goal angles was design for shooting accuracy test.
- These targets are chosen as the extreme points in the goal area and hence the targets most likely to give rise to differences in movement form (Bourne et al, 2011). Targets are labeled: top right, top left, bottom right, and bottom left. The player with handball, stand behind a throwing line on the handball court.
- On the signal of "go", the player throw the ball at the target, using one arm throw.
- The players was instruct to shoot as much as they could and try to hit four different targets with a total of 60 shots, 20 shots from each shooting distances: 6m, 7m and 9m. Players was supposed to attempt 20 shoot from 9 meter 20 shot from 7 meter penalty line and 20 shot from 6 meter goal line at the target. The throw had to be completely executed with the use of the dominant arm.

Scoring: The score is the sum of points scored on each target.

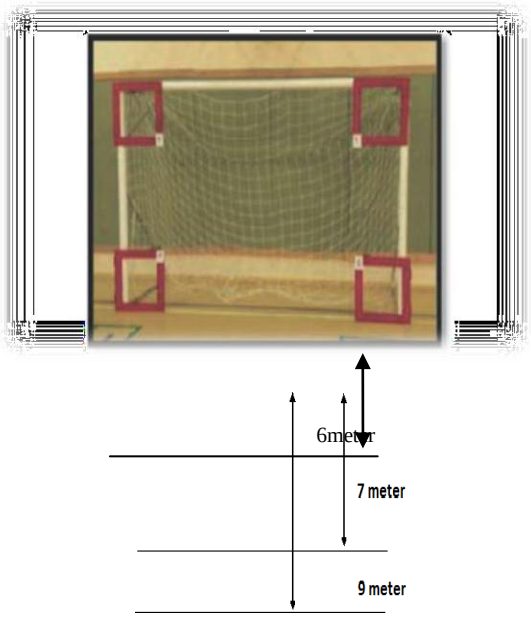


Figure 16: Shooting accuracy test

Adopted from Kangane, (2005)

3.11 Training Protocol

Calisthenics exercise was given to the experimental group for twelve weeks a total of three days per week, namely Tuesday, Thursday morning and Sunday afternoon, each *lasting 50 to 60 minutes*. A total of 36 days would be given in three-month (February, March and April/ 2013) for training sessions in which 60 minutes were allotted for each session. The experimental group was performing the following calisthenics exercise in addition to their normal training. These calisthenics exercises were given to the research participants for twelve weeks. These include Foot tape, jumping squats, and depth pushup; incline push up, decline push up diamond pushups Single leg vertical jumps, split squat jump, top jump, pull up dig, and clapping push-ups and so on.

3.12 Methods of Data Analysis

The data gathered from both an experimental and control group through selected physical fitness qualities, shooting performance tests was analyzed and interpreted to compare the

physical fitness, and shooting performance change showed among the experimental and control group. Descriptive statics were presented. In order to evaluate whether there is significant or not, among groups prior and immediately after the exercise, the researcher was used paired t-test. Moreover, the researcher used SPSS software version 23 to run the aforementioned statistics and the level of significance was set at 0.05.

3.13 Reliability of a test

Test reliability was assured by establishing a quality and essential equipments, and reliability of a test and trainee's reliability. The researcher had a number of practice sessions in the testing procedures with the guidance of the respective experts in order to ensure the uniformity and reliability of the testing technique. The researcher took all the test for the study with the assistance of professional experts.

3.14 Ethical Considerations

Ethical Considerations were specified as one of the most essential parts of the research. In the present study, the following ethical issues were taken to account. In the beginning of the research, the researcher obtained permission from the coach, sport office. The study participates was having clear information about the purpose of the study, the procedure to be used, the potential benefits and the possible risks of participation in this study was explain and write consent was given to the participant. The protection of the privacy of research participants had to be ensured. An optimal level of confidentiality of the research data should be ensured. Besides, the anonymity of individuals participating in the research had to be ensured. Likewise, any deception or exaggeration about the aims and objectives of the present research was avoided and affiliations in any form, sources of funding, as well as any possible conflicts of interests, were declared. Furthermore, any type of communication in relation to the research should be done with honesty and transparency, any type of misleading information, as well as representation of primary data findings in a biased way, was avoided.

CHAPTER FOUR

4 RESULTS AND DISCUSSIONS

4.1 Introduction

Under this chapter the researcher focus on the analysis of pre and posttest data collected from control (n=13) and experimental (n=13) groups under the study. Moreover, the researcher describes the demographic characteristics of the participant's age, weight, height and training age. The objective of this study was to investigate the effect of 12-week Calisthenics exercise on selected physical fitness qualities and shooting performance at Gebezemariam male handball players. The selected physical fitness components of this study were speed, muscular endurance, muscular strength, power, coordination and shooting performance. Shooting score test from the distance of 9m and shooting accuracy test from the distance of 6m, 7m and 9m were used to measure shooting performance. Pre-test and post-tests were taken from both experimental and control groups before and after 12 weeks Calisthenics exercise intervention, and the scores were recorded. The collected data were analyzed using paired t-test to analyze pre-test and post-test results of experimental and control groups.

4.1 Results of the Study

Table: 2 Demographic characteristics of participants

Group	N	Sex	Age	Height	Weight	Playing experience
			Mean ± S.D	Mean ± S.D	Mean ± S.D	Mean ± S.D
Experimental Group	13	Male	21.08 ± 2.84	1.69 ± .034	56.69± 4.97	2.23 ± 1.09
Control Group	13	Male	21.46±2.93	1.69±.032	57.31± 5.105	2.23± 0.83

As depicted in table 2 above, descriptive characteristics of 26 study participants from a Gebezemariam male handball team of age (EG=21.08±2.84, CG=21.46±2.93) height (EG=1.69±0.03, CG=1.69±0.03) weight (EG=56.69±4.97, CG= 57.31±5.10) and training age (EG=2.23±1.09, CG=2.23±0.83). Participants were relatively had the same age, height, weight and training age.

Table: 3 Descriptive Statistics of physical fitness qualities

	GROUPS			
	EG		CG	
	Mean± Std. Deviation		Mean± Std. Deviation	
Fitness variable	PT	POT	PT	POT
30 meter sprint	5.238±0.3525	4.954±0.378	5.023±0.3632	5.277±0.3609
Muscular endurance	41.69±5.513	57.08±6.184	40.15±5.914	40.62±5.723
Muscular strength	8.85±1.908	16.38±3.280	9.54±2.876	9.46±2.332
Vertical jump	42.38±1.758	45.69± 1.702	42.1538±2.076	42.539±2.145
long jump	2.73 ±0.347	3.1154± 0.358	2.7231±0.2833	2.8077±0.259
Coordination	22.27 ±3.193	27.31±3.199	21.92±2.629	21.31±1.974

Key: - EG=Experimental group, CG= Control group, PT= pre test, POT= post test

The above table shows the pre and posttest results of flying 30m sprint for both experimental and control groups.

As we see from the table the pre test score of EG were found to be 5.238±0.3525 and the CG pre test score found to be 5.023±0.3632. But after 12 week calisthenics exercise given to EG, the mean score of 30m sprint score for EG has a great change from pre to post test. But the mean value of CG stays very close from pre to post test.

As the table reveals, 30m sprint score of EG found 4.95±0.378 where as CG found 5.277±0.3609 after calisthenics exercise. In the muscular endurance, the pre test score of EG was found to be 41.69±5.513 and CG found 40.15±5.914.The post test score of EG found to be 57.08±6.184 whereas, CG found to be40.62±5.723.

The above table also shows analyzed data of muscular strength. The pre test score of EG were found to be 8.85±1.908 where as the CG pre test score found to be 9.54±2.876. The posttest score of the EG were16.38±3.280 where as CG were found to be 9.46±2.332. The result indicated that the mean value of EG muscular strength before giving calisthenics exercise was lower than that of after calisthenics exercise. In case of vertical jump, the pre test score of EG was found to be42.38±1.758 and CG found42.1538±2.07550. The post test score of EG found to be 45.69± 1.702whereas, CG found to be42.5385±2.14536.. In case of standing long jump, the pre test score of EG was found to be 2.73 ±0.347 and CG found2.7231±0.28330. The posttest score of EG found to be3.1154± 0.35788whereas, CG found to be2.8077±0.25968. In case of coordination, the pretest score of EG was found to be 22.27 ±3.193 and CG found21.92±2.629. The posttest score of EG found to be 27.31±3.199 whereas, CG found to be 21.31±1.974.

Table 4: Paired sample t-test results of fitness variables for the two groups of pre and posttest.

		Paired differences						
					95 % Confidence interval Of the Difference			
Variable	Subjects	MD	.STA	Std. Error Mean	Lower	Upper	DF	Sig.(2tailed)
30-Meter Sprint	EG PT- POT	0.2846	0.3913	0.1085	0.0482	0.5210	12	0.022
	CG PT-POT	-0.2538	0.5410	0.1500	-0.5808	0.0731	12	0.116
M. Endurance	EG PT-POT	-15.385	5.501	1.526	-18.709	-12.061	12	0.000
	CG PT-POT	-0.462	2.402	0.666	-1.913	0.990	12	0.502
M. Strength	EG PT-POT	-7.538	2.025	0.562	-8.762	-6.314	12	0.000
	CG PT-POT	0.077	1.891	0.525	-1.066	1.220	12	0.886
Vertical jump	EG PT-POT	-3.308	2.016	0.559	-4.526	-2.089	12	0.000
	CG PT-POT	-0.38462	1.93815	0.5375	-1.55583	0.78659	12	0.488
Long jump	EG PT-POT	-0.38462	0.20755	0.05756	-0.51004	-0.25919	12	0.000
	CG PT-POT	-0.08462	0.17723	0.04915	-0.19171	0.02248	12	0.111
Coordination	EG PT-POT	-4.538	3.431	0.951	- 6.612	-2.465	12	0.000
	CG PT-POT	0.615	1.710	0.474	-0.418	1.649	12	0.219

KAY- EG=Experimental group, CG= Control group, PT= pre t test, POT= posttest, M. endurance= muscular endurance, M. Strength=muscular strength MD=mean difference, STA=Standard deviation, DF= degree of freedom.

The above table reveals the test of significance differences of the two groups (EG and CG) of pre and posttest results. According to the data presented in the table, the pre and posttest result of 30-Meter Sprint showed a statistically significant difference in EG. The result suggests that EG significantly decrease a time (MD=0.2846, SD=0.3913, p=0.022) when exposed to 12 weeks calisthenics exercise than CG (MD=-0.2538, SD=0.5410, p=0.116). The table also shows that EG significantly improved muscular endurance performance (MD=-15.385, SD = 5.501, p=0.000) after 12 weeks calisthenics exercise. But no significant difference was observed in CG (MD=-0.462, SD=2.402, p=0.502).

Table 6 above also displays the test of significance differences of the two groups (EG and CG) pre and posttest muscular strength results. According to the data presented in the table, the pre and post test muscular strength showed a statistically significant difference in EG (MD=-7.538, SD=2.085, p=0.000) when exposed to 12 weeks calisthenics exercise than CG (MD = 0.077, SD =1.891, p=0.886). The table shows, the pre and post test result of vertical jump a statistically significant difference in EG. The result suggests that EG significantly improved vertical jumping performance (MD=-3.308, SD=2.016, p=0.000) when exposed to 12 weeks calisthenics exercise than CG (=-0.38462, SD=1.93815, p=0.488). The table also shows that EG significantly improved long jumping performance (MD=-0.38462, SD = 0.20755, p=0.000) after 12 weeks calisthenics exercise. But no significant difference was observed in CG (MD=-0.08462, SD=0.17723, p=0.111). Moreover, the above the table presented the pre and post test data result of coordination test showed a statistically significant difference in EG. The result suggests that EG significantly increased coordination performance (MD=4.538, SD=3.431, p=0.000) when exposed to 12 weeks calisthenics exercise than CG (MD=0.615, SD=1.710, p=0.219).

Table: 5 Descriptive Statistics of performance variables

Performance Variables	GROUPS			
	EG		CG	
	Mean± Std. Deviation		Mean± Std. Deviation	
	PT	POT	PT	POT
Shooting score(9m)	23.85±5.460	34.23±6.071	25.38±6.911	26.15±5.460
6m shooting accuracy	10.15±2.512	10.85±2.410	10.00±1.958	10.62±1.758
7m shooting accuracy	9.69±2.057	11.08±2.216	8.85±1.739	9.54±1.613
9m shooting accuracy	7.92±2.178	10.62±2.399	8.23±1.739	8.54±1.984

Key: - EG=Experimental group, CG= Control group, PT= pretest, POT= posttest.

As we see from table, 5 the pre test score of EG were found to be 23.85±5.460 and the CG pre test found to be 25.38±6.911. But after 12 week calisthenics exercise given to EG, the mean score of shooting score for EG has a great change from pre to post test. But the mean value of CG stays very close from pre to post test. As shown from table 5 reveals, shooting score of EG found 34.85± 6.071 where as CG found 26.15±5.460 after calisthenics exercise.

In addition to shooting score, the above table shows analyzed data of shooting accuracy from 6m, 7m and 9m distance. Accordingly, the pretest score of EG from 6m distance found to be10.15±2.512 and the CG pre test score found to be 10.00±1.958. But after 12 week calisthenics exercise given to EG, shooting accuracy score of EG found to be 10.85±2.410 whereas, CG found 10.62±1.758. From 7m distance, EG scored 9.69±2.057 and CG scored 8.85 ±1.739 before. But after calisthenics exercise given to EG the score of EG found 11.08±2.216 whereas, CG found to be9.54±1.613. In case of 9m distance, EG pre-test score found to be 7.92±2.178 and CG scored 8.23±1.739. The posttest score of EG found to be 10.62±2.399 whereas, CG found to be 8.54± 1.984.This indicates that, there was mean difference between the post and pre tests, yet it is impossible to tell here

if the differences are statistically significant. Hence, a paired sample t-test comparing the pretest and posttest scores of the variables and which was computed to determine whether this number rivals statistical difference between shooting score and accuracy of the handball players. The paired t- test result was presented in the table as follows.

Table 6: Paired sample t-test results of performance variables for the two groups of pre and posttest

			Paired difference						
					95 % Confidence Interval of the Difference				
Variables	Subjects		MD	TD	Std.Error or Mean	Lower	Upper	DF	Sig (2tailed)
(9m) Shooting score	EG	PT-POT	-10.385	3.203	0.888	-12.320	8.449	12	0.000
	CG	PT-POT	-0.769	4.935	1.369	-3.752	2.213	12	0.584
6m Shooting accuracy	EG	PT-POT	-0.692	0.947	0.263	-1.265	0.120	12	0.022
	CG	PT-POT	-0.615	1.121	0.311	-1.293	0.062	12	0.071
7m Shooting accuracy	EG	PT-POT	-1.385	1.193	0.331	-2.105	0.664	12	0.001
	CG	PT-POT	-0.692	2.550	0.624	-2.052	0.668	12	0.289
9m Shooting accuracy	EG	PT-POT	-2.692	1.843	0.511	-3.806	1.578	12	0.000
	CG	PT-POT	-0.308	1.702	0.472	-1.336	0.721	12	0.527

KAY- EG=Experimental group, CG= Control group, PT= pre t test, POT=pos test, MD= mean difference, STA=Standard deviation, DF= degree of freedom

The above table shows the test of significance differences of the two groups (EG and CG) of pre and posttest results. According to the data presented in the table, the pre and posttest result of shooting scores from 9m showed a statistically significant difference in

EG. The result suggests that EG significantly improved shooting performance when measured in shooting scores from 9m (MD=-10.385, SD=3.203, p=0.000) when exposed to 12 weeks calisthenics exercise than CG (MD=-0.769 SD=4.935, p=0.584).Hence, (P <0.05) Post-training shooting scores from 9m was significantly improved than pre-test scores for the EG. But no significant improvement was observed in CG (p>0.05)

The above table also displays the test of significance differences of the two groups (EG and CG) of pre and post test results of shooting accuracy from 6m, 7m and 9m. According to the data presented in the table, the pre and post test result of shooting accuracy from 6m for the EG showed a statistically significant difference (MD=-0.692, SD=0.947, p=0.022). Hence, (P<0.05) posttest score was significantly increased than pretest score for the EG. But, no significant difference was observed in 6m shooting accuracy score of CG between pre- and post testing (MD=-0.615, SD=1.121, p=0.071). Similarly, the pre and posttest result of shooting accuracy from 7m for the EG showed a statistically significant difference (MD=-1.385, SD=1.193, p= 0.001), significant at 0.05. But, no significant difference was observed in CG between pre- and post testing (MD= -0.692, SD=2.250, p=0.289). 9m shooting accuracy also showed significant difference from pre to post test in EG (MD=-2.692, SD=1.843, p=0.000). But, no significant difference was observed in CG between pre- and post testing (MD=-0.308, SD=1.702, p=0.527). Hence, (P <0.05) Post-training shooting scores from 9m was significantly improved than pre-test scores for the EG. But no significant improvement was observed in CG (p>0.05). The results indicate that the applied training protocol caused a significant improvement in total and relative shooting accuracy from all distances in EG.

4.3 Discussions

The main aim of the present study was to find out the effect of calisthenics exercise on some selected physical fitness qualities and shooting performance at Gebezemariam male handball team Players. The major fitness qualities assessed in this study were 30m sprint test, muscular endurance, muscular strength, power and coordination. Because these are some of the most important components to be trained for the handball players. In addition to the fitness qualities, the researcher assessed the shooting performance because it is one of the basic technical skills of handball player. The tests used to calculate the pre test

value and the post training values of the fitness variables are 30m sprint test, push up test, pull up test, vertical jump test, standing long jump test. Moreover, the researcher used 9m shooting score test and 6m, 7m and 9m shooting accuracy test for shooting performance of handball players.

The participants participated during the testing period and cooperated for the success of collection of essential data. The experimental group underwent the 12-week calisthenics exercise program as per the training schedule prepared by the investigator while the control group was not allowed to participate in any of the selected calisthenics exercise programs. Experimental group were oriented not to start any additional programs throughout the 12-week period and only perform activities of normal daily living. Before to the study, procedures and guidelines had oriented orally and Subjects were agreeing to participate. The result of the present study shows that experimental group had significantly improved the selected dependent variable, namely speed, muscular endurances, muscular strength, power, co- ordination and shooting performance than the control group. The finding of the present study in each variable is discussed as follow.

The effect of calisthenics exercise on sprint performance

The finding of the present study reveals that calisthenics exercise has had a significant effect on the sprint performance. The result suggests that a significant enhancement in sprint performance was shown by EG (MD=0.2846, SD=0.3913, p=0.022 than CG (MD= -0.2538., SD=0.5410, p=0.116.The redaction of time spent in covering 30m distance were showing improvement of sprinting performance in EG. It shows that after 12 weeks calisthenics exercise handball players reduced 30m sprint time by 0.2846 second lower than the pre test time. So, this finding was found to be significant ($p<0.05$). But in CG the pre and post test result did not indicate any statistically significant reduction ($p>0.05$). Hence, the researcher rejected null hypothesis at 0.05 level of confidence.

This result is in accordance with the findings of Srivastava R, (2016), who studied on effects of 12 weeks Pilate, calisthenics and combined exercise on selected physical fitness skill. The result indicated that, calisthenics exercise showed significant effect on

sprint performance of the athlete. The result also supported by the finding of Abebaw Degu, (2018), who studied on effects of 12 week calisthenics circuit training program on selected physical fitness variables. The results indicate that calisthenics exercise had a positive effect on developing sprint performance of the athlete. The finding of the current study also matched with the finding of Adeniji, (2007), who studied on the effects of circuit calisthenics training on Speed and Power. The findings of this study show that the calisthenics circuits training on speed were significantly better for experimental group. Moreover, Sudarson, R, (2019), who studied on the effect on plate, calisthenics and polymeric exercise on physical performance of volley ball player. The result indicated that, calisthenics exercise showed significant effect on sprint performance of the volleyball player. The finding of the present study was in agreement with Kumar, (2016), who studied on eight weeks progressive training of physical fitness training program has significant improvement on speed, power. The practice of progressive training program improved the speed, explosive power, endurance and strength.

The effect of calisthenics exercise on muscular endurance

The finding of the current research reveals that calisthenics exercise has a significant effect on the muscular endurance of Gebezemariam male handball team players. The result suggests that a significant enhancement of muscular endurance was shown by EG (MD=15.385, SD=5.501, p=0.000) than CG (MD=-0.462, SD=2.402, p=0.502). The EG performed calisthenics exercise three days a week in addition to a handball technical trainings. After 12 week calisthenics exercise, EG shows that an improvement in their muscular endurance. The number of push up performed in one minute increased by 15.385. This finding was found to be significant ($p<0.05$). Increased the numbers of push up performed in one minute were indicate improvement of muscular endurance. The above table 4 shows that the improvement of muscular endurance, because there was increase the number of push up performed in one minutes resulting from 12 weeks of calisthenics exercise. But in CG the pre and post test result did not shows any statistically significant enhancement ($p>0.05$). Hence, the researcher rejected null hypothesis at 0.05levelofconfidence.

This result is in agreement with the findings of Srivastava, R, (2016), who studied on effects of 12 weeks Pilate, calisthenics and combined exercise on selected physical fitness skill. The result indicated that, calisthenics exercise showed significant effect on sprint performance of the athlete. This result also supported by the finding of Thakur.R, et al., (2016), who studied with the effect of calisthenics and non calisthenics exercise on physical fitness component. The result indicated that, calisthenics exercise program might be help full for sustainable development of muscular strength From the finding of Donahoc-Fillnore, (2002), is stated that varied package of physical training had significant changes in muscular endurance than the control group. A similar finding has been reported by Sekendi.z, (2006).

The effect of calisthenics exercise on muscular strength

The finding of the current research showed that calisthenics exercise has had a significant effect on the muscular strength performance among Gebezemariam male handball team players. The result suggests that a significant enhancement of muscular strength was shown by EG (MD=7.538, SD=2.025, p=0.000) than CG (MD=0.077, SD=1.891, p=0.886). The EG engaged in calisthenics exercise program in addition to their regular training program three days a week each lasting from 50 to 60 minutes. After 12 weeks calisthenics exercise program, EG shows that an improvement in their muscular strength. The number of pull up performed in one times increased by 7.538. This finding was found to be significant ($p<0.05$).). Increased the numbers of pull up performed in one times were indicate improvement of muscular strength. Table 4 shows the enhancement of muscular strength, because there was increase the number of pull up resulting from 12 week of calisthenics exercise. But in CG the pre and post test result did not show any statistically significant enhancement ($p>0.05$). Hence, the null hypothesis was rejected at 0.05 level of confidence.

This result is in agreement with the findings of Srivastava R, (2016) who studied on effects of 12 weeks Pilate, calisthenics and combined exercise on selected physical fitness skill. The result indicated that, calisthenics exercise showed significant effect on muscular strength performance of the athlete than the control group. This result also

supported by the finding of Thakur.R, et, al (2016) who studied on the effect of calisthenics and non calisthenics exercise on physical fitness component. The result indicated that, calisthenics exercise program might be help full for sustainable development of muscular strength. A similar finding has been reported by Donahoc-Fillnore (2002), who stated that varied package of physical training had significant changes in muscular strength than the control group .The some finding also presented by Sekendi.z, (2006), The result proved that calisthenics exercise is an effective method for improving agility performance of handball players.

The effect of calisthenics exercise on power

The findings of the study revealed that calisthenics exercise had a significant effect on the vertical and standing long jump of male handball team players and. The result suggests that a significant increase in a vertical jump performance was reflected by EG (MD=3.308, SD=2.016, p=0.000) than CG (MD =0.38462, SD=1.93815, p=0.488). The EG engaged in calisthenics exercise program in addition to their regular training program three days a week each lasting from 50 to 60 minutes. After 12 weeks calisthenics exercise program, EG shows that an improvement in their vertical jump capacity. It was observed that after 12 weeks calisthenics exercise program the EG jumped 3.308 cm higher than the pretest score. This finding was found to be significant ($p<0.05$). Similarly, long jump capacity was significantly increased from pre to post test in EG (MD=0.38462, SD=0.20755, p=0.000). But, no significant change were observed in CG (MD=0.08462, SD =0.17723, p=0.111). As indicated in table 4, the mean value of long jump test was (3.308 and 0.38462) for pre and posttest respectively. When we compare the mean value of pretest result with posttest result 0.37917cm increments was observed. This finding was also found to be significant ($p<0.05$). But, in CG the pre and post test result did not undergo any statistically significant changes. This result indicated the effective change was observed on players‟ power because of calisthenics exercise. Hence, the null hypothesis was rejected at 0.05 level of confidence.

This result of power variables discussed above was in agreement with Sudarson R, (2019), who studied on the effect on plate, calisthenics and polymeric exercise on

physical performance of volleyball players. The result stated that calisthenics exercise had significant changes in power than the control group. This result of power variables discussed above also agreement with Mitchell , (1999), stated that varied package of physical training had significant changes in power than the control group. Likewise, Srivastava R ,(2016) conducted a study on effects of 12 weeks Pilate, calisthenics and combined exercise on selected physical fitness skill. The result indicated that, calisthenics exercise showed significant effect on coordination performance of the athlete than the control groups.

The effect of calisthenics exercise on coordination

The finding of the study showed that has calisthenics exercise has a significant effect on the coordination of handball player. The result suggests that a significant improvement in coordination performance was shown by EG (MD=4.538, SD=3.431, p=0.000than CG (MD=0.615, SD=1.710, p=0.219). Increased the number of correctly catch a tennis ball in 30 second were indicate improvement of coordination performance in EG. It was observed that after 12-week calisthenics exercise handball players increased the number of correctly catch by 0.2917 higher than the pre test time. So, this finding was found to be significant ($p<0.05$). But in CG the pre and post test result did not undergo any statistically significant reduction ($p>0.05$). Hence, the researcher rejected null hypothesis at 0.05 level of confidence.

The result of the present study is in agreement with the findings of Srivastava .R, (2016), who studied on effects of 12 weeks Pilate, calisthenics ,and combined exercise on selected physical fitness skill. The result indicated that, calisthenics exercise showed significant effect on coordination performance of the athlete than the control group. Kaya *et al*., (2012) who, study have reported a similar finding on the effect of calisthenics and Pilates exercise on coordination and proprioception in adult women. The result indicated that, calisthenics exercise calisthenics exercise is more likely to improve coordination. The finding of suggest that calisthenics exercise may be useful for individual who require improved coordination. This result also accordance with Thakur.R *et al*., (2016), who studied on the effect of calisthenics and non-calisthenics on physical fitness component.

The result indicated that, calisthenics exercise program might be help full for sustainable development of muscular strength.

The effect of calisthenics exercise on shooting performance

The findings of the study revealed that there were significant differences before the exercise and after 12 week of calisthenics exercise on players shooting performance when evaluating in shooting scores from 9m distance. The result suggests that EG significantly improved shooting score (MD= 10.385, SD=3.203, p=0.000). Hence, (P <0.05) Post-training shooting performance was significantly improved in shooting score from 9m distance than pre-test values for the EG. But in CG no significant differences were found (MD=0.769, SD=4.935, p=0.584), not significant at 0.05 level of confidence. As the data (table 3) showed the mean values of the shooting score were23.85 before the calisthenics exercise, which was improved to 34.23 after 12 week of calisthenics exercise, this means the shooting score performance of EG increased by 10.38 point after 12 week . But calisthenics exercises the pre and post test scores of CG stay very close, 25.38 and 26.15 pre and post test respectively. The increment of the rate of the scores in EG was one indicator of the improvement of the players shooting performance. The reason behind this change was the calisthenics exercise they were engaged. Hence, the researcher rejected null hypothesis at 0.05 level of confidence.

This result was in accordance with the findings of Yilkal, C. (2020) effects of strength training on shooting performance and some selected physical fitness variables among Gebezemariam male handball players. The result stated that strength training had significant changes in shooting scores than the control groups. Likewise, Sherif Ali and Ahmed Mohamed, (2010) conducted a study on effects of strength training on improving the shooting performance of junior handball players. The result showed a significant change in EG ($p<0.05$). But in control group there were no significant differences between pretest and posttest results. This finding is also in agreement with Emel Cetin and Yeliz Ozdo (2012) who is finding on the effects of 12 week strength training on the jumping throw performance in young handball team players showed positive significant improvement in their shooting performance.

In terms of shooting accuracy, there was significant improvement between the pre and posttest results of shooting accuracy from 6m, 7m and 9m in EG. But in CG accuracy did not undergo any statistically significant changes from all distances. The result suggests that EG significantly improved shooting accuracy from 6m (MD=0.692, SD=0.947, p=0.022). Hence, (P <0.05) Post-training shooting performance was significantly improved in shooting accuracy from 6m distance than pre-test values for the EG. But in CG no significant differences were found (MD=0.615, SD=1.121, p=0.071), not significant at 0.05 level of confidence. As the data (table 5) shows, the mean values of 6m shooting accuracy were 10.15 before the calisthenics exercise, which was increased to 10.85 after 12-week calisthenics exercise, which means the players, obtained 0.7 more points in accuracy after 12-week calisthenics exercise. But the pre and post test scores of CG stay very close, 10.00 and 10.62 pre and post test respectively.

The findings of the study revealed that had calisthenics exercise an effect on 7m shooting accuracy of male handball players. The result suggests that EG significantly improved shooting accuracy from 7m (MD=1.385, SD=1.193, p=0.001). Hence, (P <0.05) Post-training shooting performance was significantly improved in shooting accuracy from 7m distance than pre-test values for the EG. But in CG no significant differences were found (MD=-0.692, SD=2.550, p=0.289), not significant at 0.05 level of confidence. As the data (table 5) showed, the mean values of 7m shooting accuracy were 9.69 in before, which are increased to 11.08 after 12 week of calisthenics exercise, which means the players obtained 1.385 more points in accuracy after 12 week of calisthenics exercise. But the score of mean value of CG is 8.85 and 9.54 pre and post- test respectively. The finding of the current research revealed that has a calisthenics exercise significant effect on 9m shooting accuracy of male handball players. The result suggests that EG improved significantly from 9m shooting accuracy. (MD=2.692, SD=1.843, p=0.000) Hence, (P <0.05) Post-training shooting performance was significantly improved in shooting accuracy from 7m distance than pre-test values for the EG. But in CG no significant differences were found (MD=0.308, SD=1.702, p=0.527). not significant at 0.05 level of confidence. As the data (table 5) showed the mean values of 9m shooting accuracy were 7.92 in before the calisthenics exercise, which was increased to 10.62 after 12 week of calisthenics exercise, this means 9m shooting accuracy performance of EG increased by

2.7 points after 12 week of calisthenics exercise. But the score of CG stay very close, 8.23 and 8.54 pre and post test respectively. Hence, the researcher rejected a null hypothesis at 0.05 level of confidence.

The finding of shooting accuracy discussed above was in accordance with Meseret T, (2019), who studied on the effects of resistance training on selected physical fitness qualities and shooting accuracy at Debire brihan university Handball team players. The result stated that résistance training had significant changes in shooting accuracy than the control group The result of the present study indicate that a combination of calisthenics exercise with handball specific shots significantly enhanced maximal and specific-explosive strength of arms and legs and this improvement should give players an advantage in throwing accuracy (Hermassi S, 2011). The finding of the present study also agree with the findings of Nabeel Kahdem, Hrebid ,and Sarab Shaker, (2015) who investigated effects of developing explosive calisthenics strength & power training on shooting accuracy in juniors‟ handball.

Moreover, many researchers have investigated shooting performance, and a physical fitness quality on handball was found to be the most significant factor affecting the throwing ability. In such a study, it was found out that the body flexors (abdominal muscles: rectus abdominals, external and internal oblique muscles) have a significant role in the determination of muscle strength and throwing action (Eliasz, 1998); a significant difference was found between maximal ball speed and other throw analyses during a cross-step throw -in. It was determined that the motor skill factors, the body's total muscle strength, the power of the body flexors and the angular speed of the maximal arm (shoulder joint) were definitely effective over the ball speed in the shooting techniques analyzed (Tillaar & Ettema, 2003 ;Campos *et al*., 1994.). Trainers should take into account these characteristics and a training program should organize to improve the properties

CHAPTER FIVE

5. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary

The objective of this study was to investigate the effect of calisthenics exercise on some selected physical fitness qualities and shooting performance at Gebezemariam male handball team Players. For this purpose, the researcher reviewed the available literatures to decide the focus of the study and methodologies. In order to attain the effect calisthenics exercise on specific physical fitness qualities and shooting performance in team handball in case of Gebezemariam male handball team players the researcher were formulated the following specific research objectives.

1. To examine the effects of 12 week's calisthenics exercise on the running speed of handball players.
2. To examine the effects of 12 week's calisthenics exercise on the muscular endurance of handball players.
3. To examine the effects of 12 week's calisthenics exercise on the muscular strength of handball players.
4. To examine the effects of 12 week's calisthenics exercise on the explosive power of handball players.
5. To examine the effects of 12 week's calisthenics exercise on the coordination of handball players.
6. To examine the effects of 12 week's calisthenics exercise on the shooting performance of handball players.

Based on this specific objective, the hypotheses were formulated. Subjects for the study were 26 males who are participating in Gebezemariam male handball team player. Subjects were grouped into experimental and control group by using simple random sampling. The experimental group performed 12 weeks of additional calisthenics exercise. A control group did not perform the selected calisthenics exercise. Nevertheless, they did perform as equal as

normal training activities to the experimental players for the regular handball-training program. All participants participated in all physical qualities tests and performance: speed, muscular endurance, muscular strength, explosive power, coordination and shooting performance tests. Both had taken pre and post testing. Experimental method employed to collect available data used to analyze the change mean scores to experimental pre- post values and control for pre- post values. Fitness profiling had achieved by means of a battery of tests. The data were gathered from both groups results as in the form of pretest and posttest method had been organized using appropriate and relevant statistical method of analysis. Paired statistic t-test, which assists to come up with findings had used. Generally, as study revealed that calisthenics exercise has been a significant effect on handball to improve their physical fitness and shooting performance. In paired statistic t-test, the data were analyzed and, the following major findings were investigated.

- The finding of this study implies that 30m sprint time was significantly reduced in EG after twelve week of calisthenics exercise, but no significant differences were found between pre to post test in CG.
- The finding of this study indicated that muscular endurance was significantly improved in EG as a result of 12 week of calisthenics exercise. In CG no significant change was observed.
- The finding of this study indicated that muscular strength was significantly improved in EG because of 12 week of calisthenics exercise. In CG no significant change was observed.
- The Finding of this study showed significant improvement of vertical jump performance in EG after exposed 12 weeks of calisthenics exercise. But no significant improvement was found in CG.
- The finding of this study showed standing long jump performance was significantly improved in EG after exposed 12 week of calisthenics exercise. In CG no significant change was found in pre to post test.
- The finding of this study showed coordination skill was significantly improved in EG after exposing 12 week of calisthenics exercise. In CG no significant change was found in pre to post- test.

- The finding of this study showed shooting score performance was significantly improved in EG after exposed 12 week of calisthenics exercise. In CG no significant change was found in pre to post- test.
- The finding of this study showed that shooting accuracy from distance 6m, 7m and 9m was significantly improved in EG after the exposure of 12 week of calisthenics exercise. In CG no significant change was found in pre to post- test

5.2 Conclusion

Based on the results of the data analyzed, the following basic points were stated as a conclusion. The main conclusion to be drawn from the results of the experimental statistics is that Twelve week of calisthenics exercise has significant effects on reducing sprint time of handball players.

- Twelve week of calisthenics exercise has greater significantly in improving the muscular endurance of handball players.
- Twelve week of calisthenics exercise has greater significantly in improving muscular strength of handball players.
- Participation in regular calisthenics exercise has greater improvement in the coordination performance of handball players.
- Twelve weeks calisthenics exercise has greater significantly in improving muscular endurance of handball players.
- Twelve week of calisthenics exercise has greater significantly in improving the muscular endurance of handball players.
- Twelve week of calisthenics exercise had a positive effect on the improvement of shooting performance of handball players.

5.3 Recommendations

The objective of the current study was to examine the effect of callisthenic exercise on some selected physical fitness qualities and shooting performance in team handball in the case of Gebezemariam handball players. Based on the conclusions drawn in light of the research findings, the following basic point would be recommended:

- As noted in the results of the present study, calisthenics exercise is more effective to enhance physical fitness qualities and shooting performance. So, coaches and handball players are highly recommended to include this training in their training program.
- Trainers should be focus on developing speed, muscular endurance, muscular strength explosive power, and coordination for their main role in enhancing the physical and skill performance of handball players.
- In addition to the technical training, physical training is important to enhance overall performance related to team handball games. So, for good enhancement players in team handball should involve in programming calisthenics exercise.
- The study was conducted only to investigate the effects of calisthenics exercise on some selected physical fitness variables (speed, muscular endurance, muscular strength, power, coordination), and shooting performance. So, it is recommended for other with other physical fitness qualities and handball skill.
- Calisthenics exercise can be recommended as a mode of training to enhance the physical fitness quality and shooting performance of handball players.
- Training program should design to improve the physical and skill performance of handball players.
- Further, similar research may be undertaken on female handball players and on other team sports.
- Further studies may be necessary to examine the effect of calisthenics exercise training on physical motor fitness variables for different age groups

REFERENCE

Adeniji, B. A (2007). Comparative Effects of Circuit Training Program on Speed and Power of Pre and Post-MonarchialGirls.Physical and Health Education Department, Federal College of Education, Osiele, Abeokuta, Ogun State,Nigeria, Journal of Sport Behavior,5: 35- 42.

Alegre, L. Jiménez, F., Gonzalo- Orden, J. M.,Martín-Acero, R., & Xavier, A. (2006). Effects of dynamic resistance training on fascicle length and isometric strength. *Journal of Sports Sciences, 24*(5), 501–508.

Arschel, M. H., Freedson, J., Hamill, K., Haywood, M., Horvat, S., & Plowman, A.(1991). Dictionary of the Sport , and Exercise Sciences.

Arto Starck, 2011, *Coaching manual for Helsinki Giants handball club*.

Baechle, TR, and Earle, RW. *Essentials of strength training and conditioning.* (3rd ed.) Champaign, IL: Human Kinetics; 2008.

Baker, D. (2001). Acute and long-term power responses to power training: Observations on the training of an elite power athlete *Strength and Conditioning Journal*,*23* (1),47https://doi.org/10.1519/15334295(2001)023<0047:AALTPR>2.0.CO;2biomech anical characteristics in handball with the use of technical means.

Beecher, C. Physiology and calisthenics for schools and families. New York: Harper & Bros., 1856; 1856

Bompa, T. O., & Haff, G. (2009). *Per iodization: theory and methodology of training* (5th ed.).Champaign, IL: Human Kinetics.

Boreham, C. (2006). The physiology of sprint and power training. In *The Physiology of Training*(pp.117134).Retrievedfromhttps://linkinghub.elsevier.com/retrieve/pii/B9780 443101175500118.

Buchheit, M., Mendez-Villanueva, A., Quod, M., Quesnel, T., & Ahmaidi, S. (2010). Improving Acceleration and Repeated Sprint Ability in Well-Trained Adolescent Handball Players:

Bulletin of the Moscow State Regional University (Natural sciences), (3), 98–113. https://doi.org/10.18384/2310-7189-2016-3-98-113 Michalsik, L. B. (2018). On-Court Physical Demands and Physiological Aspects in Elite Team Handball.

Campos, J., Navarro, E., Vera, P., & Llobregat, R. (1994). Evaluation of kinematic parameters of javelin throwers in relation to performance. The set of three-dimensional data of the movement. Proceeding of the 12th International Symposium on Biomechanics in Sports, 360-362

Can, I. (2017). Comparison of power, velocity and force parameters during loaded squat jump exercise in the handball and arm wrestling players. *Journal of Education and Training Studies*, *5*(12), 92. https://doi.org/10.11114/jets.v5i12.205

Cardinale, M. (2014). Strength training in handball. *As petar Sports Medicine Journal*, *3*,130–134

Choo, C. H., & Ng, W. N. (2021). Complete Pectoralis Major Tendon Rupture in a Calisthenics Athlete: A Case Report. *Malaysian Orthopaedic Journal*, *15*(1), 124

Clanton, R., & Dwight, M.(1997). *Team handball: Steps to success.* Champaign, IL: Human Kinetics

Corbin, C.B. (2006). *Concepts of physical fitness. Active life styles for wellness*. 13th edition. New York: McGraw-Hill

Corvino, M., Vuleta, D., & Sibila, M. (2016). Analysis of load and players ´effort in 4vs4 small-sided handball games in relation to court dimensions. *Kinesiology*, *48*(2), 213–222.

Creswell, John W. (20120. Planning, conducting and evaluating quantitative and qualitative research.4th edition.

Cushion, C. (2010). Coach behavior. *Sports coaching: Professionalization and practice*, 43-61.

Czerwinsk, J,, & Taborsky, F.(1947). *Handball basics: Methods/tactics/techniques*: European handball federation. Australia. Gutheil –Schoder. Czerwinski, J., & Taborsky, F. (1997

David Goldsmith(2010).Physical performance characteristics of American sport academy.

Dawes, J., & Roozen, M. (Eds.). (2012). *Developing agility and quickness*. Champaign, IL:Human Kinetics

Dollman,J.,Norten, K. & Noreten,L (2005). Evidence for secular trend in children Physical Activity behavior, British journal of sports sciences.

Donahoe-Fillmore, B. K. (2002). Pediatric Curriculum Content in Entry-Level Physical Therapist Education [dissertation]. *Cincinnati, OH: Union Institute and University*.

Dwight, M.p. (1997). *Team handball steps to Success*. Human Kinetics Publishers, Inc., USA.

Eler, N., & Eler, S. (2018). 2D: 4D, Lateralization and Strength in Handball Players.

Eliasz J. (1998). The relationship between throwing velocity and motor ability parameters of the high-performance handball players.

Emel CetinYeliz Ozdol 2012, Jump shot performance and strength training in young team handball players.

Federation WSWaC. World Street Workout and Calisthenics Federation 2011. Available from: http://www.wswcf.org/

Garzón, M. J. (2009). The Alpha Health Related Fitness Test Battery for Children and Adolescents Test Manual. School of Medicine, University of Granada. Clanton, R.E.

Gist NH, Freese EC, Ryan TE, Cureton KJ. Effects of low-volume, high-intensity whole-body calisthenics on army ROTC cadets. Mil Med. 2015 May; 180(5): 492-498

Gorostiaga EM, Granados C, Ibanez J, Izquierdo M. Differences in physical fitness and throwing velocity among elite and amateur male handball players. *Int J Sports Med, 2004; 26(3) Journal of Education and Training Studies*, *6*(5), 170. https://doi.org/10.11114/jets.v6i5.3220.

Gorostiaga EM,Granados C,Ibanez J,Izquierdo M. Difference in physical fitness and throwing velocity between élite and amateur hand ball player. Int J sport med,2005;26:225-232.

Gorostiaga, E.M., Granados, C., Ibanez, J. and Izquierdo, M. (2005) Differences in physical fitness and throwing velocity among elite and amateur male handball players. *International Journal of Sports Medicine 26, 225-23*

Haskell, W.L., & Kiernan, M. (2000). Methodological issues in measuring physical activity and physical fitness when evaluating the role of dietary supplements for physically active people. The American Journal of Clinical Nutrition, *72*(2), 541-550. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/10919958

Hermassi, S., Aouadi, R., Khalifa, R., van den Tillaar, R., Shephard, R. J., & Chilly, M. S.(2015). Relationships between the Yo-Yo Intermittent Recovery Test and anaerobic performance tests in adolescent handball players. *Journal of Human Kinetics*, *45*(1).https://doi.org/10.1515/hukin-2015-0020

Hermassi, S., Chelly, M.S., Tabka, Z., Shephard, R.J. and Chamari, K. (2011) Effects of 8-week in-season upper and lower limb heavy resistance training on the peak power, throwing velocity, and sprint performance of elite male handball players. *Journal of Strength and Conditioning Research 25, 2424-2433*

Hermassi, S., van den Tillaar, R., Khlifa, R., Chelly, M. S., & Chamari, K. (2015). Comparison of in-season-specific resistance vs. a regular throwing training program on throwing velocity, anthropometry, and power performance in elite handball players: *Journal of Strength and Conditioning Research*, *28*(8), 2105–2114.https://doi.org/10.1519/JSC.0000000000000855

Hoff, J., & Almasbakk, B. The effects of maximum strength training on throwing velocity and muscle strength in women's team-handball players. *Journal of Strength & Conditioning Research, 9(4), 1995*

Hornstrup, T., Wikman, J. M., Fristrup, B., Póvoas, S., Helge, E. W., Nielsen, S. H.Krustrup, P. (2018). Fitness and health benefits of team handball training for young Un trained women—A cross-disciplinary RCT on physiological adaptations and motivational aspects. *Journal of Sport and Health Science*, *7*(2), 139–148.https://doi.org/10.1016/j.jshs.2017.09.007

Huseaien, S. A. H., Ivanov, V. A., & Vyaltsev, A. S. (2016). Control of the International hand ball federation. (.2014)Hand ball. History and stories. Retrived 15th April 2018, from http://techcrunch.comhttp://ihf.inf/uplod/book/issue0001/indx.htm/.

International Handball Federation. (2014). Rules of the game. Retrieved February 19, 2018, fromhttp://www.ihf.info/upload/PDF-Download/rules_english.pd

Joris H, Edwards VM, Van Ingen Schenau GJ, Kemper HCG. Force, velocity and energy flow during the Journal of Sports Science & Medicine. Vol.6 supple mentum 10, 2007.

Kamar, A. (2008). Talent, skill and performance tests in sports. Ankara: Nobel.

Karcher, C. & Buchheit, M. (2014). On-Count Demands of Elite Handball, with Special Reference to Playing Positions. *Sport Medicine, 44(6*

Kaya, D. O., Duzgun, I., Baltaci, G., Karacan, S., & Colakoglu, F. (2012). Effects of calisthenics and pilates exercises on coordination and proprioception in adult women: a randomized controlled trial. *Journal of sport rehabilitation*, *21*(3), 235-243.

Kothari, C.R.(2004). *Research Methodology: Methods and Techniques.(*2nd ed.). New Delhi: New Age International Publishers.

Kraemer, W. J., & Fleck, S. J. (2007). *Optimizing strength training: designing nonlinear per iodization workouts*. Human Kinetics.

Krishnan K, Arumugam C. The effect of callisthenic and dumbbell exercise on muscular strength endurance and flexibility of rural schoolchildren, 2013

Kvorning, T (2006.). Strength training in team handball. Communication to the 5th International Conference on Strength Training.

Lees A, Nolan L. The biomechanics of soccer: *a review. J Sports Sci 1998.*

Little, T. & Williams, A. G. (2005). Specificity of Acceleration, Maximum Speed, and Agility in Professional Soccer Players. *Journal of Strength and Conditioning Research, 19(1*

Marques MC, Van den Tillaar R, Vescovi JD, González-Badillo JJ. Relationship between throwing velocity, muscle power, and bar velocity during bench press in elite handball players. *Int J Sports Phys Perform, 2007; 2(4*).

Marques, M. C. (2010). In-Season Strength and Power Training for Professional Male Team Handball Players: *Strength and Conditioning Journal*, *32*(6), 74–81.https://doi.org/10.1519/SSC.0b013e3181fbec32

Marques, M. C., & González-Badillo, J. J. In-season resistance training and detraining in professional team handball players. *Journal of Strength & Conditioning Research, 20(3),2006.*

Massuca, L. M., Fragoso, I., & Teles, J. (2014). Attributes of top elite team-handball players. *Journal of Strength and Conditioning Research*, *28*(1), 178–186.https://doi.org/10.1519/JSC.0b013e318295d50e .

Matthys, S. P. J., Vaeyens, R., Vandendriessche, J., Vandorpe, B., Pion, J., Coutts, A. J,Philippaerts, R. M. (2011). A multi disciplinary identification model for youth handball. *European Journal of Sport Science*, *11*(5), 355–363. https://doi.org/10.1080/17461391.2010.523850

Meseret, t. (2019). *effects of resistance training on selected physical fitness qualities and shooting accuracy among Debre Brihan university handball player* (doctoral dissertation).

Michalsik, L. B. (2018). On-Court Physical Demands and Physiological Aspects in Elite Team Handball. In L. Laver, P. Landreau, R. Seil, & N. Popovic (Eds.), *Handball Sports*

Milanese C,piscitelli F,Lampis C, Zancarano C. effect of competitive season on anthropometry and three comparatment body compostion in female body composition in female hand ball player. Biol sport 2012 .29:199-204

Mohamed, H., Vaeyens, R., Matthys, S. Multail,M. LefevreJ.,Lenoir,M.,&Philppaerts, R. (2009). Anthropometric and performance measures for the development of a talent detection and identification model in youth handball. *Journal of Sport Science,* 27, 257– 266.

Mohamed, K. A., Basfar, A. A., Al-Kahtani, H. A., & Al-Hamad, K. S. (2009). Radiolytic degradation of Malathion and lindane in aqueous solutions. *Radiation physics and chemistry*, *78*(11), 994-1000.

Mueller, M. J., & Maluf, K. S. (2002). Tissue adaptation to physical stress: a proposed "Physical Stress Theory" to guide physical therapist practice, education, and research. *Physical therapy*, *82*(4), 383-403

Murphy, A. J., Lockie, R. G. & Coutts, A. J. (2003). Kinematic Determinants of Early Acceleration in Field Sport Athletes. *Journal of Sport Science Medicine*

Nabeel Kahdem Hrebid aSarab Shaker, 2015 effect of developing Explosive strength and power and on shooting accuracy in juniors‟ handball. *The Swedish Journal of Scientific Research ISSN: 2001-9211.Vol. 2. Issue 8. August. 2015*

Newton, R. U., & Dugan, E. (2002). Application of strength diagnosis. *Strength and Conditioning Journal*, *24*(5), 50–59. https://doi.org/10.1519/00126548-200210000-00014.

Night, K., Knight, K. L., & Draper, D. O. (2012). *Therapeutic modalities: the art and science*. Lippincott Williams & Wilkins.

Organization WC World Calisthenics Organization 2012.Available in http://www.worldcalisthenics.org/

Perrottet, T. (2004). *The Naked Olympics: the true story of the ancient games*. Random House.

Rajeev Srivastava, D. Sakthignanavel, Effect of Pilates Exercise Calisthenics Exercise and Combination Of Pilates And Calisthenics Exercise On Flexibility & Strength Of School Boys. IJMESS: 2013:2(2):75-77.

Rajeev Srivastava, Effect Of Pilates, Calisthenics And Combined Exercises On Selected Physical Motor Fitness is, 1ST edition Isara Publications. 2016, New edition

Rivilla-Garcia, J., Grande, I., Sampedro, J. & van den Tillaar, R. (2011). Influence of opposition on ball velocity in the handball jump throw

Robert Wood, (2008). First Published, training for sport & an article about training for fitness Components for soccer

Sabido, R., Hernández-Davó, J. L., Botella, J., & Moya, M. (2016). Effects of 4-Week training intervention with unknown loads on power output performance and throwing velocity in junior team handball players. *PLOS ONE*, *11*(6)e0157648. https://doi.org/10.1371/journal.pone.0157648.

Sabido, R., Hernández-Davó, J. L., Botella, J., & Moya, M. (2016). Effects of 4-Week training intervention with unknown loads on power output performance and throwing

Sands, W. A. (2007). *Principles and practice of resistance training*. Human Kinetics

Santos EJ, Janeira MA (2008). Effects of complex training on explosive strength in adolescent handball players.

Sargent, D.A. (1921) the Physical Test of a Man. American Physical Education Review, 26, P. 188-194 Sciences, 17(2), 17–25.

Schmidt, R.A., Wrisberg, C.A. (2004). *Motor learning and performance:* A problem-based learning approaches (3rded). Human Kinetics, Champaign, IL.

Schwarzenegger, A., & Dobbins, B. (1998). *The new encyclopedia of modern bodybuilding*. Simon and Schuster.

Seil, R., Rupp, S., Tempelhof, S., & Kohn, D. (1998). Sports injuries in team handball. *The American journal of sports medicine*, *26*(5), 681-68.

Shahbazi, M., Rahimizadeh, M., Rajabi, M. R., & Abdolmaleki, H. (2011). Mental and physical characteristics in Iranian men's handball National Team, winner of silver medal in Asian games-2010. *Procedia - Social and Behavioral Sciences*, *30*, 226227 https ://doi.org/ 10.1016/ j.sbspro. 2011.10.443

Sherif Ali Taha Yahia and Ahmed Mohamed Zaki Hasaballa, 2012 Effect of Ballistic Speed Strength Training on Shooting in Egyptian National Giants' Handball Team Players.

Smith, D. J. (2003). A framework for understanding the training process leading to elite performance. *Sports medicine*, *33*(15), 1103-1126 Speed versus Sprint Interval Training. *International Journal of Sports Physiology and Performance*, *5*(2), 152–164. https://doi.org/10.1123/ijspp.5.2.152

Srivastava, R. (2016). Effect of Pilates, Calisthenics and Combined Exercises on Selected Physical Motor Fitness.

Sudarson, R. (2019). *Effects of Pilates, Calisthenics and Polymeric Training on Physical Performance of Volleyball Players: A Comparative study* (Doctoral dissertation, KG College of Physiotherapy, Coimbatore).

Swenson, R. (2014). *Margin: Restoring emotional, physical, financial, and time reserves to overloaded lives*. Tyndale House.

Tanwar, B. (2013). Prediction of playing ability of university level handball players in relation to their motor ability and kinthropometric variables. *International Journal of Social Science & Inter disciplinary Research*. Vol.*2*(1). Available at :*indianres earchjournals.com 172*.

Taylor, J. L., Amann, M., Duchateau, J., Meeusen, R., & Rice, C. L. (2016). Neural Contributions to Muscle Fatigue: From the Brain to the Muscle and Back Again. *Medicine & Science in Sports & Exercise*, *48*(11), 2294–2306.

Thakur, R., & Vidhale, S. G. effect of calisthenics and non-calisthenics exercises on physical fitness.

Tillaar V.D., Ettema G. (2003) Influence of instruction on velocity and accuracy of over arm throwing, *Percept Mot. Skills., Apr;96(2).*

Van den Tillaar, R. (2004). Effect of different training program on the velocity of over arm throwing. *Journal of Strength and Conditioning Research, 18,* 388–396 velocity in junior team handball players. *PLOS ONE, 11*(6), e0157648 https://doi.org/10.1371/journal.pone.0157648.

Vijayaragavan, R., & Perumal, V.(2016). Effect of balance exercise program on static balance of male handball players at school level. *International Journal of Physical Education, Sports and Health*, *3*(6), 285-288.

Wagner, H., Finkenzeller, T., Wurth, S., & Duvillard, S. P. von. (2014). Individual and team Performance in team-Handball: A Review. *Sports Science & Medicine*, *13*(4), 808–816

Wagner, H., Finkenzeller, T.,Würth,S., & von Duvillard ,S. P.(2014). Individual and team performance in team handball: A review. 13(4), 808- 816. Retrieved from http://www.researchgate.netJournal- of –sports- science- medicine.

Wagner, H., Müller, E. (2008). The effects of differential and variable training on the quality parameters of a handball throw. *Sports Biomechanics. 7(1).* García M, Alcaraz PE, Ferragut C, Manchado C, Abraldes JA, Rodríguez N, Vila H. Body composition and throwing velocity in elite female handball players. *Culture, Ciencia y Deport, 2011; 17: 129-135*

Wagner, H.,Fuchs,P.X.,&Duvillard,S.P.von. (2017). Specific physiological and biomechanical performance In elite, sub-elite and in non-elite male team handball

players. *The Journal of Sports Medicine and Physical Fitness*, (1-2) https://doi.org/10.23736/S0022-4707.16.06758-X

Wallace, M. B., & Cardinale, M. (1997). Conditioning for team handball. *Human Kinetics*, 7–12.

Wilmore, J.H., & Costill, D.L.(2002). *Physiology of sport and exercise* (2nded.). Illinois: Campaign Human Kinetics.

Wondemu & Damene. (2004). foot ball performance, thesis with specific reference to the national Team of Ethiopia Addis Ababa University (UN published)

Yilkal, c. (2020). *effects of strength training on shooting performance and some selected physical fitness variables among Addisalem male handball players* (doctoral dissertation).

Zaffagnini, S., Raggi, F., Silvério, J., Espregueira-Mendes, J., di Sarsina, T. R., & Grassi, A. (2016). General prevention principles of injuries. In *Prevention of Injuries and Overuse in Sports* (pp. 39-55). Springer, Berlin, Heidelberg.

Ziv, G., & Lidor, R. (2009). Physical characteristics, physiological attributes, and on-court performances of handball players. *European Journal of Sport Science*, *9*(6)37386.https ://doi.org/https: //doi.org/ 10.1080/17461390903038470

APPENDIXES

Appendix A. Twelve Week calisthenics exercise Program for Experimental Group

For February month

Week one

Day	Phase	Exercise	Intensity	Set	Rep.	Rest b/n set sec	Rest b/n exercise in sec	Duration in minutes
Tuesday (morning)	Warming up exercise	Walking, harmonized movement of hands and legs jogging, running, coordinated arm to leg movements and stretching	Moderate					10
	Main part	-jumping jacks -Alternative toe taps - incline push up - Australian pull up -Bench dips	high	2 2 3 3 3	10sec 10sec 10 10 8	30sec 30sec 40sec 40sec 40sec	1minte	45
	Cooling down	-light movements -static stretching	low					5
	Warmi	Walking, harmonized	Moderate					10

Thursday (morning)	ng Up exercise	movement of hands and legs jogging, running, coordinated arm to leg movements and stretching						
	Main Part	-split squat jump -double jump with swinging arms - incline push up -regular pushup -chain biceps pull up	High	2 2 3 3 3	10sec 10sec 10 10 8	30sec 30sec 40sec 40sec 40sec	1 minute	45
	Cooling down	-light movements -static stretching	Low					5
Sunday (after	Warming up exercise	Walking, harmonized movement of hands and legs jogging, running, coordinated arm to leg movements and stretching	Moderate					
	Main Part	-Jumping jacks -Alternative toe tabs -pike push up - regular pull up - straight dips -Heel teach	High	3 3 3 2 2 3	6sec 6sec 10 8 6 10sec	30sec 30sec 30sec 40sec 40sec 30sec	1 mint	45

noon)	Cooling down	-light movements -static stretching	Low					5

Week two

Day	Phase	Exercise	Intensity	Set	Rep.	Rest b/n set sec	Rest b/n exercise in sec	Duration in minutes
Tuesday (after Noon)	Warming up exercise	Walking, jogging, running, coordinated arm to leg movements and stretching	Moderate					10
	Main part	- Long jump without stop -Squat body weight -pike push up - explosive pull up -dips -Heel teach	High	3 3 3 2 2 3	6sec 6sec 10 6 6 10sec	30sec 30sec 30sec 40sec 40sec 30sec	1 mint	45
	Cooling down	-light movements -static stretching	Low					5

Thursday (morning)	Warming Up exercise	Walking, jogging, running, coordinated arm to leg movements and stretching	Moderate					10
	Main Part	- Opposite arm swing - squat single leg -squat jump -decline push up -Pull up -digs	High	3 3 3 3 3 3	10sec 6sec 10sec 6 5 5	45sec 45sec 45sec 45sec 45sec 45sec	1minit	45
	Cooling down	-light movements -static stretching	Low					5
Sunday (after noon)	Warming up exercise	Walking, jogging, running, coordinated arm to leg movements and stretching	Moderate					10
	Main Part	-Opposite arm swing - long jump without stop -squat single lag -decline push up -Pull up - straight digs	High	3 3 3 3 3 3	10sec 10sec 8sec 8 8 6	45sec 1minit 45sec 45sec 45sec 45sec		

	Cooling down	-light movements -static stretching	Low					

Week three

Day	Phase	Exercise	Intensity	Set	Rep.	Rest b/n set sec	Rest b/n exercise in sec	Duration in minutes
Tuesday (after Noon)	Warming up exercise	Walking, jogging, running, coordinated arm to leg movements and stretching	Moderate					10
	Main part	-Opposite arm swing -Split squat jump -Diamond push up -Pull up - straight digs	High	3 3 3 3 3	10sec 8sec 6 8 6	30sec 45sec 45sec 45sec 45sec	1minit	45
	Cooling down	-light movements -static stretching	Low					5

Thursday (morning)	Warming Up exercise	Walking, jogging, running, coordinated arm to leg movements and stretching	Moderate					10
	Main part	- jumping jacks 90 degree -Long jump without stop -alternative jump -diamond push up -pull up -Straight dips	High 3	3 3 3 3 3	6sec 10sec 10sec 8 8	45sec 45sec 45sec 45sec 45sec	1minit	45
	Cooling down	-light movements -static stretching	Low					5
Sunday afternoon	Warming up exercise	Walking, jogging, running, coordinated arm to leg movements and stretching	Moderate					10minit
	Main Part	- jumping jacks 90 degree -Long jump without stop -alternative jump -diamond push up -pull up - straight dips	High	3 3 3 3 3 3	8sec 10sec 10sec 8 8 8	45sec 30sec 30sec 45sec 45sec 45sec	1minit	45minit
	Cooling down	-light movements -static stretching	Low					1minit

Week four

Day	Phase	Exercise	Intensity	Set	Rep.	Rest b/n set sec	Rest b/n exercise in sec	Duration in minutes
Tuesday (after Noon)	Warming up exercise	Walking, jogging, running, coordinated arm to leg movements and stretching	Moderate					10minit
	Main part	- reversed jumping jacks -Long jump without stop -foot taps -clamping push up -pull up - straight dips	High	3 3 3 3 3	6sec 10sec 10sec 6 10 8	45sec 30sec 30sec 45sec 45sec 45sec	1minit	45minit
	Cooling down	-light movements -static stretching	Low					5minit
Thur	Warming Up exercise	Walking, jogging, running, coordinated arm to leg movements and stretching	Moderate					10minit

s day (morning)	Main Part	- reversed jumping jacks -Long jump without stop -foot taps -clamping push up -pull up -dips	High	3 3 3 3 3 3	6sec 10sec 10sec 6 8 8	45sec 30sec 30sec 45sec 45sec 45sec	1minit	45minit
	Cooling down	-light movements -static stretching	Low					5minit
Sunday afternoon	Warming up exercise	Walking, jogging, running, coordinated arm to leg movements and stretching	Moderate					10minit
	Main Part	-Single squat jump -Long jump without stop -opposite arm swing -decline push up -Pull up - straight digs	High	3 3 3 3 3 3	8sec 10sec 10sec 8 8 6	45sec 30sec 30sec 45sec 45sec 45sec	1minit	45minit
	Cooling down	-light movements -static stretching	Low					5minit

March

Week one

Day	Phase	Exercise	Intensity	Set	Rep.	Rest b/n set sec	Rest b/n exercise in sec	Duration in minutes
Tuesday (after Noon)	Warming up exercise	Walking, jogging, running, coordinated arm to leg movements and stretching	Moderate					
	Main part	-Single squat jump -Long jump without stop -opposite arm swing -decline diamond push up -Pull up -digs	High	3 3 3 3 3 3	10sec 10sec 10sec 5 10 10	30sec 30sec 30sec 45sec 30sec 30sec	1minint	45minit
	Cooling down	-light movements -static stretching	Low					5minit
Thur	Warming Up exercise	Walking, jogging, running, coordinated arm to leg movements and stretching	Moderate					10minit

s day (morning)	Main Part	-Single squat jump -Long jump without stop -opposite arm swing -decline diamond push up -Pull up -digs	High	3 3 3 3 3 3	30sec 30sec 30sec 6 12 10	30sec 30sec 30sec 45sec 30sec 30sec	1minit	45minit
	Cooling down	-light movements -static stretching	Low					5minit
	Warming up exercise	Walking, jogging, running, coordinated arm to leg movements and stretching	Moderate					10minint
	Main Part	-side to side jump squat -Kneeling jump -double jump with swinging arms -pull up -clapping push up	High	3 3 3 3 3	10sec 10sec 10sec 12 10	30sec 45sec 30sec 30sec 30sec	1minit	45minit

Week two

Day	Phase	Exercise	Intensity	Set	Rep.	Rest b/n set sec	Rest b/n exercise in sec	Duration in minutes
Tues	Warming up exerci	Walking, jogging, running, coordinated arm to leg movements and stretching	Moderate					10minit

day (Morning)	se							
	Main part	-Top jumps -Long jump without stop -Foot tap -Pull up -diamond push up	High	3 3 3 3 3	10sec 12sec 12sec 12 10	10sec 10sec 10sec 12 10	30sec 30sec 45sec 30sec 30sec	45minit
	Cooling down	-light movements -static stretching	Low					5minit
Thurs day (morning)	Warming Up exercise	Walking, jogging, running, coordinated arm to leg movements and stretching	Moderate					10minit
	Main part	-Reversed jumping jacks -Long jump without stop -Single lag squat -Pull up -Diamond push up	High	3 3 3 3 3	10sec 12sec 10sec 3 3	45sec 30sec 45sec 12 10	1minit	45minit
	Cooling down	-light movements -static stretching	Low					5minit
Sunday after noon	Warming up exercise	Walking, jogging, running, coordinated arm to leg movements and stretching	Moderate					1minit

	Main part	-Top jumps -Alternating toe taps -Side to side squat jump -Straight dips -Explosive push up	High	3 3 3 3 3	12sec 12sec 10sec 10 12	30sec 30sec 30sec 45sec 45sec	1minit	45minit
	Cooling down	-light movements -static stretching	Low					5minit

Week three

Day	Phase	Exercise	Intensity	Set	Rep.	Rest b/n set sec	Rest b/n exercise in sec	Duration in minutes
Tuesday (after Noon)	Warming up exercise	Walking, jogging, running, coordinated arm to leg movements and stretching	Moderate					10minit
	Main part	-Pistol squat -Kneeling jump -Opposite arm swing -Pull up -Diamond push up	High	3 3 3 3 3	10sec 10sec 12sec 12 10	45sec 45sec 30sec 30sec 30sec	1minit	45minit
	Cooling down	-light movements -static stretching	Low					5minit
Thurs day	Warming Up	Walking, jogging, running, coordinated arm to leg movements and stretching	Moderate					10minit

(morning)	exercise							
	Main part	-Jumping jump 90 degree -Long jump without stop -Alternating jump -pull up -decline diamond push up	High	3 3 3 3 3	10sec 14sec 10 14 10	45sec 45sec 30sec 45sec 45sec	1minit	45minit
	Cooling down	-light movements -static stretching	Low					
Sunday (afternoon)	Warming up exercise	Walking, jogging, running, coordinated arm to leg movements and stretching	Moderate					
	Main part	-Set up squat jump -long jump without stop -Foot tape -Straight dips -pull up	High	3 3 3 3 3	10sec 14sec 15sec 12 12	45sec 30sec 30sec 45sec 45sec	1minit	45minit
	Cooling down	-light movements -static stretching	Low					5minit

Week four

Day	Phase	Exercise	Intensity	Set	Rep.	Rest b/n set sec	Rest b/n exercise in sec	Duration in minutes
Tuesday (after Noon)	Warming up exercise	Walking, jogging, running, coordinated arm to leg movements and stretching	Moderate					10minit
	Main part	-Pistol squat -Kneeling jump -Opposite arm swing -Pull up -Diamond push up	High	3 3 3 3 3	10sec 10sec 12sec 14 14	45sec 45sec 45sec 45sec 45sec	1minit	45minit
	Cooling down	-light movements -static stretching	Low					5minit
Thurs day (morning)	Warming Up exercise	Walking, jogging, running, coordinated arm to leg movements and stretching	Moderate					
	Main part	-Jumping jump 90 degree -Long jump without stop -Alternating jump -pull up -decline diamond push up	High	3 3 3 3 3	12sec 15sec 15sec 15 12	45sec 45sec 30sec 45sec 45sec	1minit	45minit
	Cooling	-light movements -static stretching	Low					5minit

	down							
Sunday (afternoon	Warming up exercise	Walking, jogging, running, coordinated arm to leg movements and stretching	Moderate					10minit
	Main part	-Set up squat jump -long jump without stop -Foot tape -Straight digs -pull up	High	3 3 3 3 3	10sec 15sec 15sec 15 15	45sec 30sec 30sec 30sec 30sec	1mimit	45minit
	Cooling down	-light movements -static stretching	Low					5minit

For April month

Week one

Day	Phase	Exercise	Intensity	Set	Rep.	Rest b/n set sec	Rest b/n exercise in sec	Duration in minutes
Tues	Warming up exercise	Walking, jogging, running, coordinated arm to leg movements and stretching	Moderate					10minit

day (after Noon)	Main part	-Toe jumps -Opposite arm swing -Long jump without stop -Pull up -Decline clumping push up	High	3 3 3 3 3	45sec 45sec 45sec 18 12	45sec 45sec 45sec 45sec 45sec	1minit	45minit
	Cooling down	-light movements -static stretching	Low					5minit
Thurs day (morning)	Warming Up exercise	Walking, jogging, running, coordinated arm to leg movements and stretching	Moderate					10minit
	Main part	-Top jumps -Long jump without stop -Foot taps -Straight digs -Clamping push up	High	3 3 3 3 3	10sec 15sec 15sec 15 15	45sec 45sec 45sec 45sec 45sec	1minit	45minit
	Cooling down	-light movements -static stretching	Low					5minit
Sunday(afternoon)	Warming up exercise	Walking, jogging, running, Coordinated arm to leg movements and stretching.	Moderate					10minit
	Main part	-Double jump with swing arm -Long jump without stop -Single lag squat -Pull up	High	3 3 3 3	10sec 15sec 15sec 18	45sec 45sec 45sec 45sec	1minit	45minit

		-Decline push up		3	20	45sec		
	Cooling down	-light movements -static stretching	Low					5minit

Week two

Day	Phase	Exercise	Intensity	Set	Rep.	Rest b/n set sec	Rest b/n exercise in sec	Duration in minutes
Tuesday(afternoon)	Warming up exercise	Walking, jogging, running, coordinated arm to leg movements and stretching	Moderate					
	Main part	-Top jumps -Long jump without stop -Foot taps -Straight digs -Clamping push up	High	3 3 3 3 3	15sec 15sec 15sec 15 18	45sec 45sec 45sec 45sec 45sec	1minit	45minit
	Cooling down	-light movements -static stretching	Low					5minit
Thurs day (mor	Warming Up exerci	Walking, jogging, running, coordinated arm to leg movements and stretching	Moderate					10minit

ning)	se							
	Main part	-Top jumps -Long jump without stop -Foot taps -Straight digs -Clamping push up	Hig h	3 3 3 3 3	15sec 15sec 15sec 15 18	45sec 45sec 45sec 45sec 45sec	1minit	45m init
	Cooli ng down	-light movements -static stretching	Lo w					5mi nit
Sun day after noon	Warm ing up exerci se	Walking, jogging, running, coordinated arm to leg movements and stretching	Mo dera te					
	Main part	-Toe jumps -Opposite arm swing -Long jump without stop -Pull up -Decline clumping push up	Hig h	3 3 3 3 3	15sec 15sec 18sec 20 12	45sec 45sec 45sec 45sec 45sec	1minit	45m init
	Cooli ng down	-light movements -static stretching	Lo w					5mi nit

Week three

Day	Phase	Exercise	Inte nsit y	S e t	Rep.	Rest b/n set sec	Rest b/n exercis e in sec	Dura tion in min utes

Tuesday (morning)	Warming up exercise	Walking, jogging, running, Coordinated arm to leg movements and stretching.	Low					10minit
	Main part	-Toe jumps -Opposite arm swing -Long jump without stop -Pull up -Decline clumping push up	High	3 3 3 3 3	15sec 15sec 20sec 20 15	45sec 45sec 45sec 45sec 45sec	1minit	45minit
	Cooling down	-light movements -static stretching	Low					5minit
Thursday (morning)	Warming Up exercise	Walking, jogging, running, coordinated arm to leg movements and stretching	Moderate					10mint
	Main part	-Foot tap -Long jump without stop -Reversed jumping jacks -Archer pull up -Archer push up	High	3 3 3 3 3	15sec 15sec 15sec 8 8	45sec 45sec 45sec 45sec 45sec	1minit	45minit
	Cooling down	-light movements -static stretching	Low					5minit
Saturday (after	Warming up exercise	Walking, jogging, running, coordinated arm to leg movements and stretching	Moderate					10minit

noon)	Main Part	-Kneeling jump -Foot taps -Long jump without stop -Pull up -Dip push up	Hig h	3 3 3 3 3	15sec 15sec 15sec 20 20	45sec 45sec 45sec 45sec 45sec	1minit	45m init
	Cooli ng down	-light movements -static stretching	Lo w					5mi nit

Week four

Day	Phase	Exercise	Inte nsit y	S e t	Rep.	Rest b/n set sec	Rest b/n exercis e in sec	Dura tion in min utes
Tues day (mor ning)	War ming up exerc ise	Walking, jogging, running, Coordinated arm to leg movements and stretching.	mo dera te					10m init
	Main part	-Split squat jump -Side to side squat jump -Archer straight dips -Archer pull up -Decline clamping push up	hig h	3 3 3 3 3	15sec 15sec 6 6 10	45sec 45sec 45sec 45sec 45sec	1minit	45m init
	Cooli ng down	-light movements -static stretching	Lo w					5mi nit
Thur s day	Warm ing Up	Walking, jogging, running, coordinated arm to leg movements and stretching	Mo dera te					10m init

(morning)	exercise							
	Main Part	-Long jump without stop -Heel teach -Top jump -Decline diamond push up -Archer push up	High	3 3 3 3 3	15sec 15sec 10sec 18 15	45sec 45sec 45sec 45sec 45sec	1minit	45minit
	Cooling down	-light movements -static stretching	Low					5minit
Sunday (after noon)	Warming up exercise	Walking, jogging, running, coordinated arm to leg movements and stretching	Moderate					10minit
	Main Part	-Long jump without stop -Heel teach -Top jump -Decline diamond push up -Archer push up	High	3 3 3 3 3	15sec 15sec 10sec 18 12	45sec 45sec 45sec 45sec 45sec	1minit	45minit
	Cooling down	-light movements -static stretching	Low					5minit

Appendix B: Profile of participants

A. Experimental Group

No	Age	Height(m)	Weight(kg)	Playing experience in (year)
1	18	1.68	52	1
2	24	1.70	60	2
3	25	1.67	56	2
4	24	1.71	65	3
5	25	1.74	59	5
6	24	1.69	64	3
7	19	1.70	55	2
8	20	1.66	52	2
9	20	1.71	53	3
10	19	1.62	55	2
11	18	1.64	52	1
12	20	1.75	63	2
13	18	1.64	51	1

B. Control Group

No	Age	Height(m)	Weight(kg)	Playing experience in (year)
1	25	1.69	53	2
2	19	1.73	60	2
3	24	1.71	64	3
4	24	1.70	61	2
5	25	1.76	65	3
6	19	1.68	57	2
7	18	1.65	51	2
8	25	1.70	63	4
9	18	1.67	50	1
10	23	1.65	54	2
11	21	1.68	59	3
12	20	1.66	56	2
13	18	1.71	52	1

Appendix C: Demographic characteristics of the study participants

Group	N	Sex	Age	Height	Weight	Playing experience
			Mean ± S.D	Mean ± S.D	Mean ± S.D	Mean ± S.D
Experimental Group	12	Male	20.6 ± 3.2	1.69 ± 0.04	56.9 ± 5.16	2.08 ± 0.9
Control Group	12	Male	21.08±3.26	1.68 ± 0.05	57.5 ± 5.3	2.17 ± 0.7

Appendix D: Pre and Post test result of physical fitness variables for experimental group players

No	Physical fitness variable											
	Speed		Muscular endurance		Muscular strength		Power				Coordination	
	30m sprint test		Push up test		Pull up test		Vertical long test		Long jump test		Eye- hand coordination test	
	Pre test	Post Test	Pre test	Post test	Pre test	Post test	Pre test	Post test	Pre test	Post test	Pre test	Post test
1	5.1	4.7	36	53	8	15	41.00	46.00	2.70	3.10	20	26
2	5.2	4.3	39	49	9	14	42.00	47.00	3.00	3.40	25	25
3	4.8	5.0	51	61	11	20	41.00	47.00	2.80	3.20	30	31
4	5.4	5.3	48	59	6	13	43.00	48.00	2.70	2.90	25	26
5	5.6	4.7	41	57	7	16	46.00	47.00	3.40	3.50	35	27
6	4.8	5.0	43	63	5	11	42.00	44.00	3.10	3.40	25	30
7	5.7	4,9	41	65	9	17	41.00	43.00	2.20	2.80	22	30
8	5.5	5.1	33	59	9	16	42.00	44.00	2.70	2.90	20	25
9	5.1	4.7	36	50	10	20	45.00	47.00	2.30	2.50	29	27
10	5.7	5.6	45	63	11	19	44.00	45.00	2.70	3.20	20	25
11	4.7	4.5	49	62	9	12	43.00	46.00	2.90	3.30	20	21
12	5.5	5.5	37	45	10	19	40.00	47.00	2.80	3.70	26	29
13	5.0	5.1	43	56	11	21	41.00	43.00	2.20	2.60	22	33

Appendix E: Pre and Post test result of physical fitness variables

for Control group players**.**

No	Physical fitness variable											
	Speed		Muscular endurance		Muscular strength		Power				Coordination	
	30m sprint test		Push up test		Pull up test		Vertical long test		Long jump test		Eye- hand coordination test	
	Pre test	Post test	Pre test	Post test	Pre test	Post test	Pre test	Post test	Pre test	Post test	Pre test	Post test
1	4.9	4.8	43	45	4	6	43.00	44.00	2.40	2.80	23	21
2	4.8	5.2	40	37	10	9	40.00	42.00	2.80	3.00	20	19
3	5.2	5.4	52	49	15	13	44.00	45.00	2.50	2.60	22	23
4	4.7	5.6	37	41	9	7	45.00	44.00	3.20	3.20	21	20
5	4.2	5.7	31	29	9	11	41.00	39.00	3.00	3.10	23	21
6	5.3	5.8	47	49	13	9	42.00	45.00	2.50	2.70	24	22
7	4.9	5.2	45	42	12	13	41.00	40.00	3.10	2.90	21	20
8	5.7	5.3	38	39	6	7	39.00	41.00	2.60	2.50	28	25
9	5.0	5.1	34	35	8	7	44.00	40.00	2.50	2.70	19	18
10	5.4	5.2	38	41	9	10	43.00	44.00	2.70	2.60	20	22
11	5.1	5.7	45	46	10	9	42.00	43.00	2.50	2.40	19	22
12	5.0	4.6	35	37	11	12	45.00	45.00	3.10	3.20	25	24
13	5.1	5.0	37	38	8	10	39.00	41.00	2.50	2.80	20	20

Appendix F: Pre and Post test result of Shooting score and shooting accuracy for experimental Group

No	Shooting Performance							
	Shooting Score		Shooting Accuracy					
			6m		7m		9m	
	Pre test	Post test	Pre test	Post test	Pre test	Post test	Pre test	Post test
1	20	30	9	9	10	13	6	8
2	25	35	15	14	13	14	7	13
3	30	40	9	11	8	9	10	11
4	25	35	7	8	10	11	9	11
5	35	45	13	14	12	13	10	12
6	25	30	10	11	9	8	7	10
7	30	45	8	9	7	9	5	8
8	20	30	11	11	9	10	8	14
9	25	35	11	12	13	14	12	13
10	20	30	9	10	9	10	8	9
11	20	35	8	7	8	12	8	13
12	15	30	14	15	11	13	9	10
13	20	25	8	10	7	8	4	6

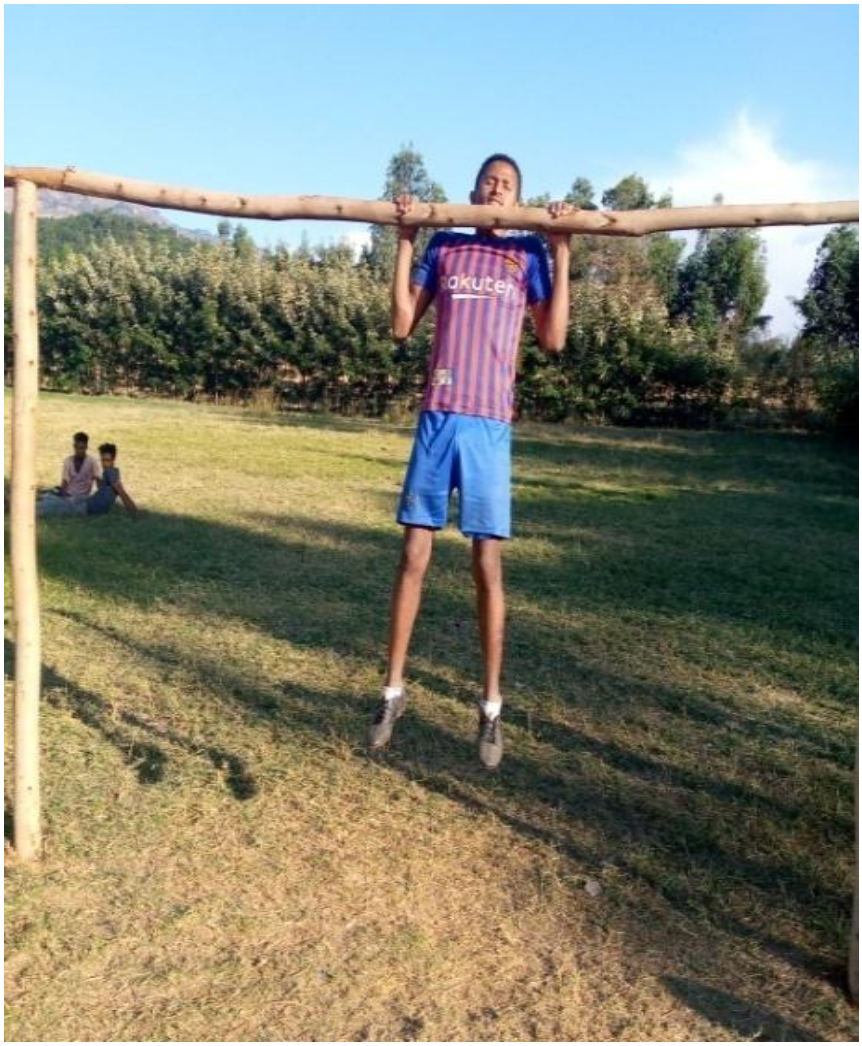
Appendix G: Pre and Post test result of Shooting score and shooting accuracy for control Group

No	Shooting Performance							
	Shooting Score (point)		Shooting Accuracy					
			6m		7m		9m	
	Pretest	Post test	Pre test	Post test	Pre test	Post test	Pre test	Post test
1	25	30	12	13	8	10	8	10
2	30	35	11	12	10	11	6	9
3	20	25	14	13	7	9	9	6
4	30	25	8	8	11	12	8	6
5	35	30	7	8	9	8	7	7
6	15	20	10	12	7	9	9	8
7	30	25	8	10	8	8	7	8
8	35	30	11	9	8	11	8	9
9	15	20	11	11	12	10	10	9
10	20	25	1o	11	7	12	7	7
11	25	20	11	12	9	7	10	11
12	30	35	9	10	12	9	12	13
13	20	20	8	9	7	8	6	8

Appendix H. Pictures during speed test

Appendix I. Pictures during muscular endurance test

Appendix J . Pictures during muscular strength test



Appendix K. Pictures during power test

Appendix L. pictures during coordination test

Appendix M. Pictures during shooting performance test