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EFFECTS OF RESISTANCE TRAINING ON SELECTED PHYSICAL FITNESS QUALITIES AND SHOOTING ACCURACY AMONG DEBRE BRIHAN UNIVERSITY HANDBALL PLAYER

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BAHIR DAR UNIVERSITY

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APPROVAL PAGE

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MASTER OF SCIENCE

As member of the examining board of final M.Ed., Open defense we certify that we have read and evaluated this thesis prepared by **Meseret Tadesse**. Entitled with **"EFFECTS OF RESISTANCE TRAINING ON SELECTED PHYSICAL FITNESS QUALITIES AND SHOOTING ACCURACY AMONG DEBRE BRIHAN UNIVERSITY HANDBALL PLAYER''** and recommended that it is accepted as fulfilling the thesis requirement for the Degree of Master of Education in Teaching Physical Education.

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DEDICATION

This study is dedicated to my: precious family; Tadesse Zenebe, Asnakech Gissa and Tibebu Girma for their continuous, honest support and prayer all the time.

DECLARATION OF AUTHORSHIP

I, hereby that this thesis for the partial fulfillment of the requirement for the Degree of Masters of Education in teaching physical education on the title of **"EFFECTS OF RESISTANCE TRAINING ON SELECTED PHYSICAL FITNESS QUALITIES AND SHOOTING ACCURACY AMONG DEBRE BRIHAN UNIVERSITY HANDBALL PLAYER''** 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.

Mr. Meseret Tadesse

Place: Bahir Dar University

Signature:-……..

Date:……

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Abbreviations

1 RM Repetition maximum

ACSM American Collage of Sport Medicine

CG Control group

DBU Debre Birhan University

EG Experimental group

MD Mean difference

POT Post test

PT Pre test

SD Standard division

ABSTRACT

Resistance training is a general term used to describe a number of different training goals such as training for improved performance, hypertrophy and increased fitness for a variety of sports. The purpose of this study was to investigate the effect of 12 week resistance exercise training on selected physical fitness variables (muscle strength, explosive power, running speed and shooting accuracy) of male handball players of Debre Birhan University. Experimental design was conducted among 24 under-graduate male players, with age group between 19 – 22 years were selected by convenience sampling technique from Debre Birhan University male handball players. The selected subjects were divided into 2 groups (control and experimental groups) randomly, each group consisting of 12 players. The experimental group underwent 12 weeks planned resistance exercise training program, three days per week and the duration was 40 minutes while, the control group continued with their regular training. Pre-test and post tests were conducted on the selected physical fitness variables such as 1RM test, vertical and broad jump test, 30 meter speed test and shooting accuracy test, each subject was tested at the same time of day. The data collected from the study subject was analyzed using SPSS software version 23.0 by paired t-test with level of significant 0.05. The results showed resistance Exercise training significantly improved muscle strength, explosive power, running speed and shooting accuracy in Experimental Group at ($p<0.05$). No significant differences were found in all of the variables in Control Group ($p>0.05$). Based on this finding, it can be concluded that 12 weeks resistance exercise training has positive effect on improvement of physical fitness and shooting accuracy variables. These data suggest that 12-week resistance training, when incorporated into a regular training session, can provide greater physical fitness variables improvements for male handball players.

CHAPTER ONE

INTRODUCTION

1.1. Background of the study

Team handball is a complex sport game which is determined by the individual performance of each player tactical components and interaction of the team. From a physical point of view, handball is an intermittent and vigorous contact sports game that requires high-intensity efforts in a short period of time, where players jump, run, and throw the ball at high velocities, followed by low-intensity or rest moments movements (Michalsik et al., 2012).

Handball is a strenuous contact sport that places emphasis on running, jumping, sprinting, throwing, hitting, blocking, and pushing (Gorostiaga et al., 2006). In addition to technical and tactical skills it has been argued that muscular strength and power are the most important factors that give a clear advantage in elite competitions (Marques and Gonza ´lez-Badillo, 2006).

As an Olympic team sport it is important to have the suitable body size, highly developed motor skills such as speed, agility, strength, explosive power, endurance and technical skills for success at elite levels in team handball (Gorostiaga, Granados, Ibanez, & Izquierdo, 2005; Moham, 2009; Saeterbakken, Tillaar, & Seiler, 2011).

Resistance training is a specialized method of physical conditioning that involves the progressive use of a wide range of resistive loads, different movement velocities and a variety of training modalities including weight machines, free weights (barbells and dumbbells), elastic bands and others (Faigenbaum & Myer, 2010; Ratamess, 2009). RT has been shown to be effective for improving muscle strength, power output, and muscle mass for handball players (Cadore et al., 2014;). Resistance training has been shown to improve a variety of performance- and skill-related variables (Stone, et al., 1991.). Improvements in performance can include increased muscular strength, power, and both low- and high-intensity exercise endurance (McGee, Jesse, Stone, and Blessing. 1992, Paavolainen,, et al. 1999., Robinson, et al 1995.). Studies shows that changes in strength, power, and endurance factors as a result of resistance training are related to improved measures of athletic performance, such as the vertical jump, sprint times, distance-running times, and agility (Paavolainen, et al 1999., Wilson, et al 1993, Harris, et al 2000).

Resistance training, also known as strength training, has been growing in popularity in recent years. Resistance training is a form of physical activity that has been traditionally perceived as a component of training programs limited to athletic individuals and competitive weightlifters seeking to improve performance. Extensive research reveals that resistance training is an effective method for improving muscular strength, endurance, and power and the health status of both athletes and non-athletes individuals. (Cornelissen, et al, 2011). Also, it is a vital part of a balanced physical activity routine that includes aerobic and flexibility activities. (The U.S. Department of Health and Human Services. 2008).

Throwing velocity, throwing accuracy, and explosive power of both the upper and lower limbs are the main determinants of handball performance (Fleck and Kraemer 2004). Physical quality factor can be improved by training, particularly resistance programs designed to enhance strength and power in both the upper and lower limbs performance (Van Muijen et al. 1991, Åstrand et al. 2003). Strength is an essential function of the human body, which can manifest itself in various ways, depending on individual conditions and objectives used to perform different actions or exercises (Siff, 2004).

Through both muscle hypertrophy and neural adaptations, the force-generating ability of muscle increases by resistance training. (Moritani 1992) Strength is often an important parameter in sport performance, in particular during explosive actions. Overarm throwing is a typical example of an explosive action where both speed and strength play an important role. Classic studies by (Moritani 1992) and Kaneko et al (1983) show that resistance training improves both strength and maximum movement speed the amount of which depends on the training conditions. Thus, to improve overarm throwing performance, in accordance with Kaneko's studies, different training forms can be categorized under the principles of overload by resistance or by velocity of the exercise.(Van den Tillaar R 2004). The reality in Debre Birhan university handball players shows low performance in muscle strength, speed, power and shooting accuracy. Because of these players showed limitations on their physical fitness qualities and shooting accuracy when the researcher observes in their regular training. The researcher thought that if the number of sessions given in a week was increased with contents of resistance exercise, it would have influence on physical fitness qualities and shooting accuracy otherwise the situation made players to have poor physical fitness qualities and shooting accuracy. Due to this the aim of the

study was to investigate the changes in explosive power, throwing accuracy, speed and physical quality resulting from resistance training on male players.

1.2. Statement of the problem

Resistance training has been shown to improve strength, power and speed in a number of athletic populations. In addition to improving these physical qualities, resistance training also has significant benefits for athletes in terms of increasing muscle mass and decreasing risk of injury. The ultimate goal of athlete preparation is to maximize performance during competition. For those athletes who are not specifically strength athletes involved in sports such as football (soccer), rugby, handball and basketball, the question can be asked as to whether resistance training provides significant benefits to match performance. (Gabbett, Kelly, Pezet, 2007; Sheppard, Cronin, Gabbett, McGuigan, Etxebarria, Newton 2008). According to Gorostiaga (1999) the game of the handball is very complex requiring speed, strength, skill and stamina. Team-handball players have to coordinate their movements well for running, jumping, pushing, change of direction and team-handball skills such as passing, catching, throwing, checking and blocking.

Ball games like basketball, soccer and team handball are very popular sports in the world that includes a lot of different movements requiring sprinting, agility, power, strength and aerobic fitness (Lidor, Argov, Daniel, 1998, Mohamed et al 2009). There are a lot of ways to improve these motor abilities, but resistance training with free weights has been shown to be positive for power/jumping (Tsimahidis et al 2010) and throwing (Hoff, Almåsbakk, 1995).

Many research studies shows the effect of different training for the development of physical fitness qualities but now a day's few studies were done specifically on the area of resistance exercise training on selected physical fitness quality variables and throwing accuracy. (Marques and González Badillo, 2010), (Gorostiag, 2005), (Kawamori & Haff, 2004). Today, most coaches and players awareness of resistance training can positively affect physical fitness qualities. Unfortunately, they do not highly engage in resistance training and their physical fitness quality, especially skill related fitness quality, which they are expected to achieve, is poor. Studies showed that the importance of resistance exercises for the development of all physical fitness qualities but no research is conducted on Debre Brihan university male handball player's

to determine the effect of resistance training on their physical fitness qualities and shooting accuracy. To the knowledge of the researcher, Debre Brihan university male handball players have fitness problem and shooting accuracy. Despite the existing fitness and throwing accuracy of the players, the effort made by the coaches for the improvement and development of physical fitness quality of players is less. Therefore, this study was investigated the effect of three month regular resistance training on selected physical fitness qualities such as strength, power, running speed and shooting accuracy of Debre Berhan university male handball players.

1.3. General objective

This study was designed to investigate the effect of resistance exercise on physical quality and shooting accuracy of Debre Brihan university male handball players.

1.3.1. Specific objectives

The specific objectives of this study were:-

1. To evaluate the effect of resistance training on muscle strength.
2. To examine the effect of resistance training on explosive power.
3. To measure the effect of resistance training on speed.
4. To explore the effect of resistance training on shooting accuracy.

1.4. Hypotheses

The study attempted to test the following hypotheses.

1. $H_{1.1}$: resistance training would have significant effect on muscle strength of handball players.

$H_{0.1:}$ resistance training would have no significant effect on muscle strength of handball players.

2. $H_{1.2}$: resistance training would have significant effect on explosive power of handball players.

$H_{0.2}$: resistance training would have no significant effect on explosive power of handball players.

3. $H_{1.3}$: resistance training would have significant effect on speed of handball players.

$H_{0.3}$: resistance training would have no significant effect on speed of handball players.

4. $H_{1.4}$: resistance training would have significant effect on shooting accuracy of handball players.

$H_{0.4}$: resistance training would have no significant effect on shooting accuracy of handball players.

1.5. Significance of the Study

The main benefit of any research is the increase in knowledge, the study which carried out by one researcher may be further studied and would be studied by others many times which is the increase in knowledge upon a specific issue. Generally, this study will have the following significances.

- Helps to improve muscle strength, speed, shooting accuracy and explosive power of players
- It motivates and encourages players to engage in resistance training to increase their physical fitness.
- It provides meaning full information for players who involves on resistance training program for the improvement of selected physical fitness variables.
- Help coaches to know further about the effect of resistance training and the methods of increasing physical qualities and Provide to assess and compare the performance of their players.
- It will serve as an important resource for those who want to pursue similar studies.

1.6. Delimitation of the Study

The study is designed to investigate the effects of resistance exercise in Debere Birhan university male handball players. This study was delimited in the following areas.

- Subjects were selected at Debere Birhan university male handball players age ranged between 19 to 22 years.
- Selected physical quality variables were strength measured using 1RM test, power measured using vertical and long jump test and speed measured using 30 meter running test and shooting accuracy used to measure shooting performance.
- The time of training was limited to three days per week and 60minutes per sessions. The study was conducted in the academic year of 2018-2019G.C

- ❖ All the subjects had only a maximum of 1 years of prior handball experience.

1.7. Limitations of the Study

The subjects that were undertaken may not have previous knowledge about resistance training in a regular basis. Some of the tests were limited to specific tests that are easily monitored and administered in the player's context.

1.8. Operational Definitions of Key Terms

- **Resistance training:** any exercise that causes the muscles to contract against an external resistance with the expectation of increases in strength, tone and mass. ACSM (2002)
- **Muscle strength:** the ability to produce high peak rates of force development. (Schmidtbleicher. 1992)
- **Explosive power:** is the highest peak power output one is capable of generating under a given set of conditions. (Brindell *et al.*. 1999).
- **Effect:** something brought about by a cause or an agent; result
- **Speed:** is the ability to cover a distance quickly. (Little & Williams 2005).
- **Shooting accuracy:** Shot or throw is the culmination of offense aimed at scoring a goal. (Pori, Boni and Sibila, (2005).

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 The Concept of Physical Fitness

Physical fitness has defined by many scholars in different literature. Baltimore et al.., (1995), defined physical fitness as, the ability of the body to perform moderate to vigorous levels of physical activity without undue fatigue and capability of maintaining such abilities throughout the life. American College of Sports Medicine has also defined physical fitness as a set of characteristics (i.e. the work capacity of heart and lungs, the strength and endurance of muscles and the flexibility of joints) that relate to the ability to perform physical activities (Singh et al., 1999). Physical fitness is associated with a person´s ability to work effectively, enjoy leisure time, be healthy, resist hypo kinetic diseases or conditions, and meet emergency situation (Corbin et al., 2006). So, it is the basic requirement of life, which is achieved through participating in regular movement.

Although physical fitness is influenced by genetics and environmental factors, physical exercise is one of the main determinants (Andersen, 2003). Physical educators classify physical fitness as skill related (related to sport performance) and health related fitness (associated with disease prevention and health promotion) which includes components such as cardio-respiratory endurance, muscular strength and muscular endurance, body composition and flexibility (Hawley, 2001).

2.2. Benefits of physical fitness

Physical fitness includes physical abilities such as body composition and neuromuscular coordination, cardiovascular capacity, stamina, speed, flexibility and overall strength. Physical fitness contributes a lot to maintain an optimal state of health. Among the many benefits, it prevents the occurrence of a variety of diseases, develops a capacity to fight infections and certain other diseases, and helps to prevent many of the major cardio vascular disease. Moreover, physical fitness is responsible for ;the postponement of the process of aging. A healthy body

contributes a lot for a healthy mind. Physical fitness prevents mental disease by facilitating a sound psychological state (Corbin, 1997).

2.3. Skill related physical fitness

Sports more than any other type of physical activity, requires skill and skill related physical fitness. Skill related physical fitness is also sometimes referred to as motor fitness or sports fitness. Through people possess skill related fitness in varying degrees; great athletes are likely to be above average in most, if not all, aspects. Indeed, exceptional athletes must be exceptional in many areas of skill related fitness. Different sports require different skills, each of which requires varying degrees of skill related fitness. In physical Education the Fitness components on athlete to succeed in the aspiration level of achievement. The major parameters of fitness are more effective in a modern performance. (Bouchard, C., & Shephard, R.J. (1994)

The skill-related components of physical fitness relate specifically to skills that are used in sports, and often (not always) combine other components of fitness. For example, power is strength at speed; and agility is a combination of power and balance. In relation to performance and movement efficiency, usually, the skill-related components of physical fitness are required in order to perform the skill well. From those:

2.3.1. Strength

Muscle strength is defined as the ability to produce force. While a minimal amount of strength is needed for normal daily activities, the demands of certain sports require well-developed strength. In some sports strength is needed just as a basic component of fitness, while in other sports (e.g., weightlifting) strength is the main outcome variable which determines success or failure in competition. Strength can be increased by systematic resistance training using either specially designed machines or free weights (Stone et al. 2000a). The manifestation of an athlete's strength depends on muscle morphology and the motor system (Enoka 1988). Strength can be increased without any change in muscle size, but it is always dependent on changes in the neural system (Carroll et al. 2001). Increases in strength are transferred to sporting performances in varying amounts. For example, a weight-training program increased squat one-repetition maximum (1 RM) by 21% and this increase in strength was accompanied by improvements in vertical jump performance (21%) and sprinting speed (2.3%) (Young 2006).

Also strength can be defined as the amount of force that a muscle can apply in a given contraction. The key to making your muscles stronger is working them against resistance, whether that be from weights or gravity. If you want to gain muscle strength, try exercises such as lifting weights or resistance exercises. More weight with less repetition will promote muscular strength. Ask a professional for help before beginning a strength training program. Safety first! See this website as a guide for different strategies. Frequency: 2-3 times a week Intensity: For general strengthening, choose a weight you can lift safely 8-12 times. Reps and sets should be determined based on your goals. Anaerobic activities such as weight lifting are good to develop muscular strength and endurance. More weight less repetition to develop strength.

2.3.2. Speed

Speed consists of a number of components (Cronin & Hansen 2005; Delecluse et al. 1995), all of which are independent qualities: acceleration speed, maximum speed, and speed endurance. Performance in the 10-m sprint is influenced by acceleration speed, while performance in the 40-m sprint is dependent on both acceleration speed and maximum speed (Delecluse et al. 1995). Most sports and activities require some form of speed. Even long distance running often requires a burst of speed to finish the race ahead of your competitors. Speed is defined as the ability to move a body part quickly. Speed is not always about how quickly you can move your whole body from A to B. It also relates to body parts. For example, when playing golf, the speed of your arms and upper body in creating the swing are vital in driving the ball over a long distance. Speed can be improved by increasing the power to weigh ratio. Plyometric training (i.e., counter-movement jumps or loaded squat jumps) is effective for improving speed (Cronin & Hansen 2005).

2.3.3. Explosive Power

Muscle power, which is a function of the interaction between force of contraction and the speed of contraction, is associated with the explosiveness of the muscle. The relationship between force and speed of contraction and the subsequent point at which peak power occurs varies between athletes (Jennings et al. 2005). For example, peak power occurs at 50–70% of the maximum weight that can be lifted for one repetition for the squat and at 40–60% of 1 RM for the bench press (Siegel et al. 2002). A fundamental way of increasing muscle power is to increase maximal

strength, particularly in untrained athletes (Stone et al. 2000a). Explosive power is one of the essential factors for skillful athletes, which enables them to achieve their peak jump height. However many explosive movements require little time. Therefore, obtaining maximum muscle strength from the major groups of the lower limp for explosive power needs resistance training exercise (Lehnert and Lamrova, 2009, Markovic, 2007). Studies indicate that the primary effect of ballistic training is an increased rate of force production and velocity of movement, whereas traditional heavy-weight training primarily increases maximum strength (Hakkinen, 1994, Harris, et al 2000, McBride, et al 1999, Sale, 1988.).

In untrained subjects, heavy weight training can produce a rightward shift and beneficial effects in the entire force–velocity curve (Hakkinen, 1994, Stone, et al 1998.). However, improvements in strength, power, and measures of athletic performance resulting from combination and sequenced training (strength ≥ power ≥ speed) may be superior to those from either heavy resistance training or high-speed resistance training alone (Hakkinen, 1994, Medvedev, et al 1981., Stone, 1993). A recent longitudinal study of American collegiate football players (Harris, Stone, Bryant, Proulx, and Johnson, 2000). indicated that a combination (heavy training followed by combination training) produces superior results in measures of maximum strength and measures of athletic performance, such as the vertical jump, standing long jump, and 10-yd shuttle run, compared with continuous high-velocity or heavyweight training. These data strongly indicate that power and speed of movement specificity (as well as appropriate variation) are necessary considerations in the formulation of training programs leading to increased power and speed of movement.

2.4. The Concept of resistance training

Resistance training is designed to improve muscular fitness by exercising a muscle or a muscle group against external resistance (ACSM 2002 Definition).

Resistance training using near one-repetition maximum (1RM) weigh at low velocity has been found to improve the muscle's ability to generate force, but the increase in strength may not be effective at velocities that simulate the speed of sport performance (Peterson, Alvar, and Rhea, 2006.). Essentially, high-resistance exercise leads to increases in power (through increases in force production), but maximal gains are inhibited without training specific to movement velocity.

To maximize athletic performance, athletes must increase strength in the hip, knee, and ankle joints and improve the rate of force development. Training with low resistance (30–50% of 1RM) at high velocity results in an increase in the rate of force development, and the gains in strength compare with the speed of sport performance and result in more powerful, explosive movements (Newton, et al.., 1999., Thompson, et al.., 2007.).;

High-intensity, intermittent team sports such as water polo, handball, football and hockey require athletes to have well developed speed, muscular strength and power, agility, and maximal aerobic power. (Reilly and Gilbourne, 2003). Studies of team-sport athletes have consistently shown higher skilled players to have superior speed, muscular power, and maximal aerobic power than their lower skilled counterparts. (Gabbett, et al 2009, Montgomery, 2006)

Resistance training is a type of physical exercise specializing in the use of resistance to induce muscular contraction which builds the strength, anaerobic endurance, and size of skeletal muscles. When properly performed, strength training can provide significant functional benefits and improvement in overall health and well-being, including increased bone, muscle, tendon, and ligament strength and toughness, improved joint function, reduced potential for injury, (Shaw, Shaw, (2014). Increased bone density, increased metabolism, increased fitness (Shaw, (2005). and improved cardiac function. Training commonly uses the technique of progressively increasing the force output of the muscle through incremental weight increases and uses a variety of exercises and types of equipment to target specific muscle groups. Strength training is primarily an anaerobic activity, although some proponents have adapted it to provide the benefits of aerobic exercise through circuit training.

2.5. Benefits of resistance training

Ball sports like basketball, soccer and team handball are very popular sports in the world that includes a lot of different movements requiring sprinting, agility, power, strength and aerobic fitness (Lidor, Argov, Daniel. (1998), Mohamed et al 2009). There are a lot of ways to improve these motor abilities, but resistance training with free weights has been shown to be positive for power/jumping (Tsimahidis et al 2010) and throwing (Hoff, Almåsbakk B. (1995). However, several weight training programs had ambiguous results upon sprinting, repeated sprinting, agility and aerobic fitness performance (Yamamoto, et al 2008). Theoretically, the purpose of weight training is to increase the strength of the muscles, thereby changing the force-velocity relationship

(Kaneko, Fuchimoto, Toji, Suei (1983). By increasing the strength of the muscles, it is plausible to increase the performance in sprinting, jumping and throwing due to increased maximal force, which would make it easier to throw, jump or sprint with the same absolute weight after training.

Resistance training can be effective in the development of muscular strength, muscular endurance, and muscular mass, in a broad range of people, including women and older adults. As older adults age, they lose muscle mass and quality (less strength for the same muscle mass), a condition known as sarcopenia. Resistance training can help slow down the loss of muscle mass by continually rebuilding muscles. Resistance training also enhances muscle strength, which protects joints and improves stability and balance, reducing the risk of falls.

Regular resistance training will increase muscle and bone strength, as well as bone density, leading to strong bones and more protection against fall fractures. Resistance training programs designed for older adults, such as Stay Strong Stay Healthy (University of Missouri, Extension) also support a better quality of life by promoting independence and contributing to the maintenance of functional abilities Ball, et al (2013).

2.6. Resistance Training Principles

"The act of resistance training, itself, does not ensure optimal gains in muscle strength and performance" (Kraemer & Ratamess 2004). The key to successful resistance training is an appropriate program design. To obtain the best results, one has to consider the science behind exercise prescription and also take a practical approach. To perform this process efficiently one has to consider the following training variables: the exercise and workout structure, mode of resistance training, exercise intensity, rest intervals and frequency of training, volume of training, speed of movement, and progression. It is the correct manipulation of these training variables that optimize the resistance training outcomes.

2.6.1. Exercise and workout structure

There are three main types of strength training programs: total body workouts, upper body/lower body split programs, and muscle group split programs (American College of Sports Medicine 2002; Kraemer & Ratamess 2004). The total body workout is a commonly used approach that incorporates 1–2 exercises for each main muscle group covering the whole body in one session. The upper body/lower body split program is also a favored program design that focuses on training either the upper body or lower body on alternate days. The muscle group split approach is mainly used for people who wish to maximize hypertrophy of selected muscle groups. The choice of program depends on individual requirements and objectives (Kraemer & Ratamess 2004). The advantage of training using a split program routine is that one can select a wider range of exercises which allows more focus on specific muscle groups than with the total body workout approach (American College of Sports Medicine 2002; Kraemer & Ratamess 2004). The split-program approach also allows a higher frequency of resistance training, but still provides adequate recovery periods for specific muscle groups during a training cycle (Pearson et al. 2000).

2.7. Resistance Training Methodologies

First we will cover the different methodologies of resistance training. Training in repetition ranges (rep ranges) is a commonly practiced method of resistance training. Depending on the client's goal, the rep range will change. If the client is seeking to gain size and strength the 4-6 rep range should be utilized. Risk for injury is more prevalent in this rep range, so any joint pain or discomfort should be monitored and a routine revision should be made to prevent further damage. The 12-15 rep range allows for strength and size gain while building greater energy stores in the muscle. The 20-25 rep range allows for the body to build mitochondria, improving muscle endurance, and expends stored glycogen to promote fat loss during recovery (National Federation of Professional Trainers, 2008).

2.8. Strength and power

A positive influence of strength and power on ball velocity in the team-handball throw was also found in several studies (Chelly et al., 2010; Debanne and Laffaye, 2011; Granados et al., 2007; Marques et al., 2007). Gorostiaga et al. (2005) suggested that higher values of maximal strength and muscle power would give a clear advantage to sustain the forceful muscle contractions during team-handball specific movements

Strength and power training is therefore important to improve performance in team-handball. To increase strength and power, different dynamic strength and power exercise over training periods between 6 and 12 weeks were employed in several training studies (Gorostiaga et al., 2006; Hermassi et al., 2011; Marques and GonzalezBadillo, 2006; Marques et al., 2007). Thorlund et al. (2008) examined acute fatigue-induced changes in muscle mechanical properties and neuromuscular activity in elite team-handball players following a simulated team handball game and found a significant decrease in single joint isometric muscle strength and power from pre to post test. Michalsik and Aagaard (2014) analyzed the physical demands in elite male and female and Michalsik et al. (2014b) the technical match characteristics in elite male team-handball players. They found sex and position specific differences in performing fast breaks (more sprints for wing players), physical confrontations (more for backcourt players and pivots), strength related actions and high intensity running (more for male players) as well as relative work load in competition (more for female players). We therefore recommend that upper and lower limb strength and power are important to increase performance in the team-handball specific movements as well as to prevent a decrease in performance in the later stages during a team-handball game. To optimize team-handball specific strength and power training different demands in sex and playing position have to be considered (Michalsik and Aagaard, 2014; Michalsik et al., 2014b).

Strength is an important motoric feature in handball sports (Iri et al., 2003). Strength training contributes to the increase of muscle power and the development of the capacity of the body's energy production systems. Since handball is a sport with high intensity activities at high speed, success is partly due to muscle strength. Strength training programs should be routinely performed throughout the competition season to obtain muscle strength (Carvalho et al,2014).

2.9. Shooting accuracy

Throwing accuracy and throwing velocity in handball are regarded as basic parameters of performance during competition. Several investigators have studied the relationship between the velocity of movement of the upper limb and accuracy in hitting target. (Tillaar. 2007)

The goal, which is the essential to win in handball, depends on a quality throwing (Joris et all., 1985). Thus, throwing is a crucial skill in handball as it is the case in several other sports branches (Joris et all., 1985; Eliasz 1999). Lack of strength is the main reason why children's shooting performance is not more accurate and successful (Chase et al., 1994; Cleary et al., 2006; Juhasz; Wilson, 1982).

Shooting ability is very important in youth basketball games for three reasons: (a) is the action that directly leads to points, (b) is the action that young basketball players most prefer (Palao et al., 2004), and (c) is one of the aspects from which children claim to derive the most fun and with which they feel best performing (Piñar et al., 2007). Free throw is one of the game situations where shooting is obligatory.

Accuracy and throwing velocity in handball are regarded as basic parameters of performance during competition. Several investigators have studied the relationship between the velocity of movement of the upper limbs and accuracy in hitting the target, which has led to interesting theories (Schmidt, 1982, Eliasz et al., 1990, Hore, 1996).

Throwing performance is important for success and result in handball (Marques and González Badillo, 2010), (Gorostiag, 2005). Players must increase their chances of scoring as fast as possible to score goals. (Gorostiaga, 2005). For an effective throwing, the ball must go at the highest speed and aim at the target. Therefore, players must maintain these two parameters throughout the game (Manchado et al., 2014). While Debanne & Laffaye (2011) indicate that throwing performance depends on the player's arm movement and ability to accelerate the ball and accuracy is required, Tillaar (2009) indicate that throwing performance is dependent on strength and speed, and Wagner & Müller (2008) indicate that maximum throwing speed and throwing accuracy is required. But about throwing performance; it is thought that reaching the goal in handball should include throwing accuracy. The handball's ball is smaller than other team sports' ball. The referee awards a 7-meter throw when a fault obstructs a clear scoring opportunity. Generally, the set shot and the fall shot are used for 7-meter shot. The 7-meter throw is an important part of the game to go scoring (THF, 2010).

There is a close relationship between ball speed and strength. In addition to the importance of the ball speed and strength, throwing accuracy factor sets the score in the handball game (Koç, 2015). It is especially important to develop strength and fitness programs so that the handball players can use their speed, accuracy and performance on the field (Kawamori & Haff, 2004).

CHAPTER THREE

RESEARCH METHODS

3.1 Geographical Location of the Study Area

Debre Berhan or Birhan, formerly spelled Debra-Berhan or Bernam is a city and woreda in central Ethiopia. Located in the Semien Shewa Zone of the Amhara Region, about 120 kilometers north east of Addis Ababa on the paved highway to Dessie, the town has a latitude and longitude of 9°41′N 39°32′E respectively and an elevation of 2,840 meters. It is the administrative center of the Semien Shewa Zone of the Amhara Region. Based on the 2007 national census conducted by the Central Statistical Agency of Ethiopia (CSA), this town has a total population of 65,231, of whom 31,668 are men and 33,563 women. It is located in Amhara Region, North Showa Zone, in the town of Debre Berhan.

The study was conducted at Debre Berhan University, which is located between latitudes of 9° 40´ 46.3440" N and longitude 39° 31´ 57.4320" E at a distance of 120 km and 552 km from Addis Ababa and Bahirdar respectively. The altitude in the campus is 2830 meter above sea level with a mean annual temperature of 14.84°C (FAO, 2006).

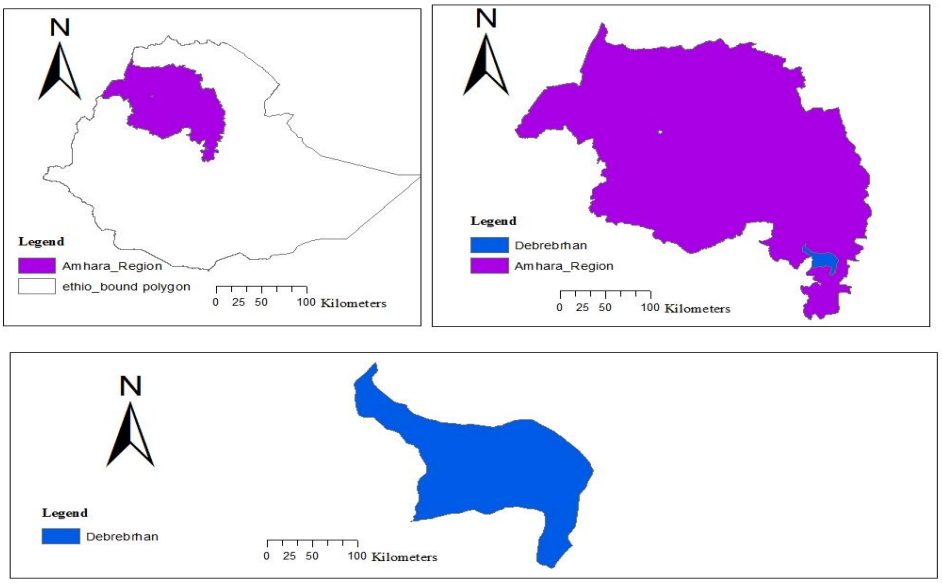

Fig. 1 Map of Debre Brihan
Source: Geographical Information System Software version 10.

3.2. Research design

Depending on the nature and appropriateness of the pre and post test data the research approach designed in this study was employed experimental design, since it helps to measure, assess, evaluate and analyze the effect of resistance training the independent variable on the dependent variables such as accuracy and selected physical fitness.

Table1. The Study design lay out

Treatment	**Resistance training**
Frequency	3 days/week
Total duration	12 weeks
Duration/Session	40-60 minutes
Intensity	Low, Moderate and High
Exercise days	Monday, Wednesday, Friday
Time of training	Afternoon

3.3. Population and Sampling Technique

The study were conducted at Debere Brihan University handball player, since the research is experimental to monitor in training as well as manage in test administrations and data analysis all 24 male players were taken and age ranged 18 to 22 years. In this study comprehensive sampling techniques were applied. 12 subjects were randomized to experimental group. Finally, Experimental group (n=12) underwent 12-week resistance training and other group assigned as a control group (n=12). Both the EG and the CG participated in normal handball training given by the coach and EG take additional resistance training for 12 weeks, 3 days per week and 40 minute per session.

3.4. Source of Data

Primary data were collected from the results of test given from pre to post test of both Experimental and control group.

3.5. Data collection Instruments

Quantitative data were collected through the appropriate Physical fitness test measures such as, curl up test for strength, 30 m running test for speed, vertical and long jump for power test and target shoot test for accuracy. Before the experimental groups were going to resistance training, the pretest was taken from both control and experimental groups. Posttest was also taken from

both groups after resistance training programs for experimental groups completed. In order to collect the data necessary for analysis, the researcher was used physical fitness test. The use of appropriate tests helped to collect data from selected physical fitness variables. For the success of the study necessary materials and facilities such as cones, stop watch, whistle, record sheets and measuring tape (meter) were used. The detail of each data collecting tests and procedures are discussed as follows:

3.6. Procedures for administration of fitness tests

3.6.1. Speed test (30 Meter running Test)

The objective of this test is to monitor the development of the athlete's maximum speed. This test was requiring 400m track – 60m marked section on the straight, Cone to mark 30m point, Stop watches and Assistant.

How to conduct the test

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. The assistant should record the time for the athlete to complete the First 30m and Whole 60m. To determine the athletes flying 30m time subtract the time for the first 30m from the time for the whole 60m. The result is analyzed by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

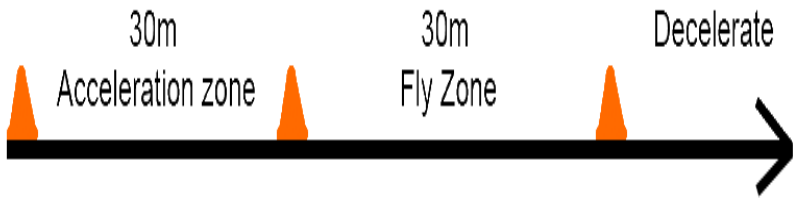

Fig. 2 30 meter dash test IAAF guide to coaching Athletics, 2000

3.6.2. Power test (vertical Jump Test)

The objective of this test is to monitor the development of the athlete's explosive power. These tests were requiring wall, 1 meter tape measure, Chalk and assistant.

How to conduct the test

The athlete chalks the end of his fingertips, stands side onto the wall, keeping both feet remaining on the ground, reaches up as high as possible with one hand and marks the wall with the tips of the fingers (M1), from a static position jumps as high as possible and marks the wall with the chalk on his fingertips (M2). The coach measures the distance from M1 to M2. The test can be performed as many times as the athlete wishes. Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

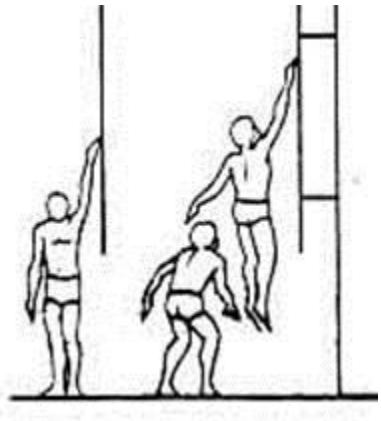

Fig. 3 shows the Vertical jump test

3.6.3. Standing Long Jump Test (Broad Jump)

The objective of this test i**s** to measure the explosive power of the legs. This test will requires tape measure to measure distance jumped, non-slip floor for takeoff, and soft landing area preferred. The takeoff line should be clearly marked.

How to conduct the test

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

backwards. The measurement is taken from take-off line to the nearest point of contact on the landing (back of the heels). Record the longest distance jumped in centimeters.

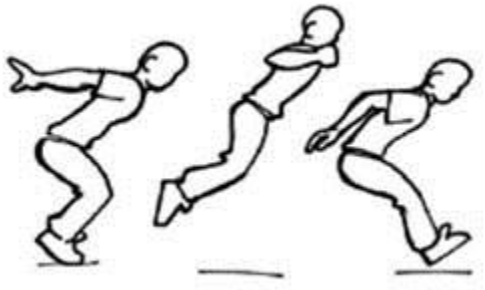

Fig. 4 shows the broad jump test of stability.

3.6.4. 1 RM test (Bench Press Test)

The objective of this test is to evaluate an athlete's upper body strength. This test will require bar bell and weights, Bench and Assistant.

How to conduct the test

Load the bar bell with a weight close to your one repetition maximum load, Conduct as many bench presses you can before failure, Assistant to act as a spotter for the athlete and count the number of successful bench presses.

Fig. 5 1RM test

3.6.5. Shooting accuracy test

After a general warming up of 15 minutes, throwing performance will be tested in an overarm throw towards a target at 7 m distance.

The athletes performed a standing throw with keeping the front foot on the floor after three strides. The subjects throw two times. The instruction was throwing as fast as possible aiming at a target of 60x60 cm positioned in a handball goal. Throws, which would be placed inner side of target, are recorded as accurate.

Fig. 6 shooting accuracy test

3.7. Methods of Data Analysis

The data was collected through fitness tests like 30m run test for speed, vertical and horizontal jump for power, 1RM test for strength and shooting accuracy for shooting performance and the collected data were analyzed and interpreted in to a meaningful idea using computer in order to compare selected physical fitness variable and shooting performance changes observed among groups. Data was analyzed using computerized statistical package software SPSS version 23. The paired t-test was used to compare the pre training and post training data. The level of significance was set at 0.05.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1. Introduction

This chapter deals with the analysis of pre and post test data collected from randomly selected experimental (n=12) and control (n=12) groups under the study. The purpose of this study was to investigate the effect of 12 week resistance training on selected physical fitness qualities and throwing accuracy of handball players at Debre Brihan University. Resistance training was given for 12 consecutive weeks. Pre-test and post-tests were taken from both experimental and control groups before and after 12 weeks of resistance training 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.

4.2. Results of the Study

4.2.1. Characteristics of study participants and physical fitness variables

Table 2: Characteristics of the study participants

Group	N	Age		Height		Weight	
		Mean	S.D	Mean	S.D	Mean	S.D
Experimental Group	12	20.67	0.985	1.6433	0.04638	53.99	4.933
Control Group	12	20.25	0.965	1.6917	0.05474	54.00	1.287

As shown from above Table 2 Descriptive characteristics of 24 study participants from Debre Birehan University male handball players mean of age (EG=20.67, CG=20.25) height (EG=1.6433, CG=1.6917) and weight (EG=53.99, CG= 54.00). Subjects were relatively had the same age, height and weight at the beginning of aerobic exercise.

Table 3: Paired sample statistics of Vertical Test results

V jump		Mean	N	Std. Deviation	Std. Error Mean
EG	PT	44.6667	12	7.08819	2.04618
	POT	60.1667	12	7.67325	2.21508
CG	PT	43.5000	12	5.76037	1.66287
	POT	43.9167	12	5.58339	1.61179

***Key**: EG=Experimental group, CG= Control group, PT= pre t test, POT= posttest, VJ=Vertical jump.*

The above table shows the pre and post test results of vertical jump for both experimental and control groups. As shown in the table the pretest means of EG was found to be 44.6667 with a standard deviation of 7.08819 and the CG pretest mean found to be 43.5000 with a standard deviation of 5.76037. But after resistance training given to EG, the mean score of vertical jump test of EG has a great change from pre to post test. But the mean value of CG vertical jump test stay very close from pre to post test. As the above table reveals, vertical jump score of EG found 60.1667 with a standard deviation of 7.67325 whereas CG found 43.9167 with a standard deviation of 5.58339 after training. This result shows different results from pre to post test. But we cannot say the result is statically significant unless the pre and post test scores of the groups computed to examine whether these results show statistically significant difference or not. Thus, the comparison of these results was presented under paired t test.

Table 4: Paired sample statistics of Long jump tests result

L jump		Mean	N	Std. Deviation	Std. Error Mean
EG	PRT	216.75	12	31.389	9.061
	POT	262.25	12	25.723	7.426
CG	PRTT	217.92	12	25.586	7.386
	POTT	218.58	12	25.794	7.446

***Key**: EG=Experimental group, CG= Control group, PT= pre t test, POT= posttest, VJ=Long jump.*

The above table shows the pre and post test results of long jump for both experimental and control groups. As shown in the table the pretest means of EG was found to be 216.75 with a standard deviation of 31.389 and the CG pretest mean found to be 217.92 with a standard

deviation of 25.586. But after resistance training given to EG, the mean score of long jump test of EG has a great change from pre to post test. But the mean value of CG long jump test stay very close from pre to post test. As the above table reveals, long jump score of EG found 262.25 with a standard deviation of 25.723 whereas CG found 218.58 with a standard deviation of 25.794 after training. This result shows different results from pre to post test. But we cannot say the result is statically significant unless the pre and post test scores of the groups computed to examine whether these results show statistically significant difference or not. Thus, the comparison of these results was presented under paired t test.

DESCUSTION

Kalapotharakos et al., (2007) evaluated the effects of 10 weeks of moderate resistance strength training on muscle strength and jump performance. Muscle strength and vertical jump performance improved after short-term moderate resistance strength training. An increase in maximal strength is usually connected with an improvement in relative strength and, therefore with improvement of power abilities. A significant relationship has been observed between 1RM and acceleration and movement velocity (Hoff and Helgerud, 2004).

Resistance exercise training affects the muscle strength and power in players. This suggests that the continuation of a strength training program is essential for the maintenance of muscle strength, functional performance. Resistance training with free weights has been shown to be positive for power/jumping (Tsimahidis et al 2010) and throwing (Hoff, Almåsbakk B. (1995). This finding also agreed with the finding of Tsimahidis et al., (2010) on effect of a 10-week heavy resistance combined with a running training program on the strength, running speed (RS), and vertical jump performance of young basketball players. Therefore, obtaining maximum muscle strength from the major groups of the lower limp for explosive power needs resistance training exercise. (Lehnert and Lamrova, 2009, Markovic, 2007). Studies indicate that the primary effect of ballistic training is an increased rate of force production and velocity of movement, whereas traditional heavy-weight training primarily increases maximum strength (Hakkinen, 1994, Harris, et al 2000, McBride, et al 1999, Sale, 1988.). As a result, improvement of the rate of this data was one indicator of the enhancement of the participant's in explosive power. The reason behind this change was resistance exercise training that they were participating in well-designed training program.

Table 5: Paired sample statistics of 1RM tests result

1RM		Mean	N	Std. Deviation	Std. Error Mean
EG	PT	41.67	12	7.487	2.161
	POT	49.17	12	5.149	1.486
CG	PT	40.00	12	5.641	1.628
	POT	39.75	12	5.496	1.587

***Key**: EG=Experimental group, CG= Control group, PT= pre t test, POT= posttest, 1RM=Repetition Maximum.*

The above table shows the pre and post test results of 1RM for both experimental and control groups. As shown in the table the pretest means of EG was found to be 41.67 with a standard deviation of 7.487 and the CG pretest mean found to be 40.00 with a standard deviation of 5.641. But after resistance training given to EG, the mean score of 1RM test of EG has a great change from pre to post test. But the mean values of CG 1RM test stay very close from pre to post test. As the above table reveals, 1RM score of EG found 49.17 with a standard deviation of 5.149 whereas CG found 39.75 with a standard deviation of 5.496 after training. This result shows different results from pre to post test. But we cannot say the result is statically significant unless the pre and post test scores of the groups computed to examine whether these results show statistically significant difference or not. Thus, the comparison of these results was presented under paired t test.

DESCUSTION

Sentija, et al., (2009) examined the studies exploring the influence of resistance training on strength in men have produced inconsistent results. Kalapotharakos et al., (2007) proved that moderate resistance strength training on muscle strength and jump performance. Muscle strength and vertical jump performance improved after short-term moderate resistance strength training. Planned resistance training affects the muscle strength and power in players. This suggests that the continuation of a resistance training program is essential for the maintenance of muscle strength, functional performance. In addition, Hoff J, (1995) found that the transfer of training to a slower (more resistance) version of the same movement exceeds the transfer to a faster version. As a result, improvement of the rate of this data was one indicator of the enhancement of the participant's in muscle strength. The reason behind this change was resistance exercise training that they were participating in well-designed training program.

Table 6: Paired Samples Statistics of 30 meter test result

Speed		Mean	N	Std. Deviation	Std. Error Mean
EG	PT	2.7450	12	.69832	.20159
	POT	2.3075	12	.54933	.15858
CG	PT	2.9342	12	.77171	.22277
	POT	2.9050	12	.75847	.21895

***Key**: EG=Experimental group, CG= Control group, PT= pre t test, POT= posttest, 30 M=30 meter speed test*

The above table shows the pre and post test results of 30 M for both experimental and control groups. As shown in the table the pretest means of EG was found to be 2.7450 with a standard deviation of .69832 and the CG pretest mean found to be 2.9342 with a standard deviation of .77171. But after resistance training given to EG, the mean score of 30 M test of EG has a great change from pre to post test. But the mean values of CG 30 M test stay very close from pre to post test. As the above table reveals, 30 M score of EG found 2.3075 with a standard deviation of .54933 whereas CG found 2.9050 with a standard deviation of .75847after training. This result shows different results from pre to post test. But we cannot say the result is statically significant unless the pre and post test scores of the groups computed to examine whether these results show statistically significant difference or not. Thus, the comparison of these results was presented under paired t test.

DESCUSTION

Results seem in accordance with Gorostiaga et al. (2006), who noted a significant enhancement (p , 0.001) of running speed after heavy lower limb resistance training; Certainly, data indicate that a combination of strength, handball technique, and competitive skills training significantly enhanced running speed(Delecluse et al. 1995).). The increased sprinting ability is likely of major importance to successful play. Speed consists of a number of components (Cronin & Hansen 2005; Delecluse et al. 1995), all of which are independent qualities: acceleration speed, maximum speed, and speed endurance. Performance in the 10-m sprint is influenced by acceleration speed, while performance in the 40-m sprint is dependent on both acceleration speed and maximum speed. Cronin & Hansen (2015) suggested in their study related with male hand

ballers that by applying regular resistance training could improve players running speed and maximal upper body strength.

Table 7: Paired Samples Statistics of Shooting accuracy test result

Accuracy		Mean	N	Std. Deviation	Std. Error Mean
EG	PT	5.00	12	1.477	.426
	POT	7.25	12	1.215	.351
CG	PTT	4.67	12	1.435	.414
	POTT	4.67	12	1.435	.414

***Key**: EG=Experimental group, CG= Control group, PT= pre t test, POT= posttest, A= Shooting Accuracy.*

The above table shows the pre and post test results of 1RM for both experimental and control groups. As shown in the table the pretest means of EG was found to be 5.00 with a standard deviation of 1.477 and the CG pretest mean found to be 4.67 with a standard deviation of 1.435. But after resistance training given to EG, the mean score of shooting accuracy test of EG has a great change from pre to post test. But there were no change in mean values of CG shooting accuracy test. As the above table reveals, shooting accuracy score of EG found 7.25 with a standard deviation of 0.754where as CG found 4.67 with a standard deviation of 1.044 after training. This result shows different results from pre to post test. But we cannot say the result is statically significant unless the pre and post test scores of the groups computed to examine whether these results show statistically significant difference or not. Thus, the comparison of these results was presented under paired t test.

DESCUSTION

Results are in accordance with Gorostiaga et al. (2010), who noted significant enhancement of standing handball throwing accuracy after 6 weeks of heavy upper limb resistance training. The present study data indicate that a combination of resistance training 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, hitting, blocking, pushing, and holding Hermassi S, (2011). Lachowetz et al. (1998.) reported an increase in ball throwing after a resistance training program (2.4%). After 10 weeks of RT, McEvoy and Newton (1998) observed significant increments in throwing accuracy by 2.0% (p 0.05) in an experimental group

(ballistic resistance training), although not in a power training control group. In both studies, results were less pronounced compared to the present study (4% after 6 weeks; p 0.001). In addition, Newton and McEvoy (1994) showed that heavy Resistance Training for the upper body extremities helped improve Ball Throwing but that more specific Resistance Training, i.e., medicine ball throwing. According to the authors, medicine ball throwing was insufficiently specific with regard to movement patterns.

Hermassi and colleagues (2015) suggested in their study related with male hand ballers that by applying health ball throwing program could improve the ball throwing accuracy and maximal upper body strength. It is seen that after 8 weeks of training, the players in the endurance training group increased their throwing accuracy, maximal strength and muscle mass, in the group with regular throwing training only maximal force and muscle volume of the players increased, and there was no significant change in the control group**.** Kawamori & Haff (2004) concluded that it is important for handball players to develop strength and fitness programs in order to use these parameters effectively. The studies showed that regular resistance training increased the throwing strength and speed.

Table 8: The mean difference values and significance level of each variable

Variables	Subjects	paired differences				T	sig. (2-tailed)
		Mean	Std. Deviation	95% Confidence Interval of the Difference			
				Lower	Upper		
Vertical jump test	EG PT-POT	-15.50000	3.60555	-17.79086	-13.20914	-14.892	.000
	CG PT-POT	-.41667	.79296	-.92049	.08716	-1.820	.096
Long jump test	EG PT-POT	-45.500	11.213	-52.624	-38.376	-14.057	.000
	CG PT-POT	-.667	1.155	-3.013	.067	-2.000	.071
1RM test	EG PT-POT	-7.500	3.371	-9.642	-5.358	-7.707	.000
	CG PT-POT	.250	1.422	-.654	1.154	.609	.555
30M speed test	EG PT-POT	.43750	.25965	.27252	.60248	5.837	.000
	CG PT-POT	.02917	.06921	-.01481	.07314	1.460	.172
Shooting accuracy test	EG PT-POT	-2.250	.754	-2.729	-1.771	-10.340	.000
	CG PT-POT	.000	1.044	-.664	.664	.000	1.000

***Key**: EG=Experimental group, CG= Control group, PT= pre t test, POT= posttest, VJ=Vertical jump, 1RM, repetitive maximum.*

The above table shows the test of significance differences of the two groups (EG and CG) of pre and post test results because of 12 week resistance training. According to the data presented in the table, the pre and post test result of all variable tests showed a statistically significant difference in EG. Hence, ($P < 0.05$) Post-training explosive power, muscle strength, running speed fitness and shooting accuracy was significantly improved than pre-test values for the EG But there was no significant improvement after twelve weeks of resistance exercise training in CG ($p > 0.05$).

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary

The purpose of this study was to evaluate the effect of twelve weeks resistance exercise training on physical fitness quality and shooting accuracy of Deber Birhan University male handball players. For this purpose, the researcher reviewed the available literatures in order to decide the focus of the study and methodologies. Based on the specific objectives of the study, the hypotheses were formulated. In dealing with these basic objectives, the study conducted on Deber Birhan University male handball players. In this study convenience sampling techniques were applied. 12 subjects were randomized to experimental group of resistance exercise training for 3 month and 3 days per week, and 12 subjects serve as control group were attended on regular training which is given from the coach. A pretest and posttest of selected physical fitness tests were taken to gain the necessary information required.

The data were collected by using the appropriate physical fitness quality tests before the starting of 12 week resistance exercise training and after 12week resistance exercise training. Paired T-test was used for comparisons of means and data were analyzed by SPSS version 23 with significance level of 0.05%. Final result of the study summarized and demonstrated that the result of posttest to pretest showed significant improvement in the experimental group in both parameters (muscle strength, explosive power, speed and throwing accuracy) while, in the control group there was not significant improvement shown. Generally the improvement was seen in the experimental group of the study as all variables were tested. As a result we can conclude that 12 week resistance exercises training have a positive effect on athlete's physical fitness qualities.

5.2. Conclusion

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

- ✓ Twelve weeks resistance exercise training has positive effect on improvement of muscle strength.
- ✓ Resistance exercise training significantly increases the explosive power.
- ✓ Twelve weeks resistance exercise training was found effective in significantly improving running speed.
- ✓ Twelve weeks resistance exercise training had impact players shooting accuracy.

5.3. Recommendations

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

- ➢ Considering the importance of resistance exercise training on improving physical fitness variables; sport science coach of DBU should make the exercise as part of their training session for their players regularly.
- ➢ It is expected from DBU sport professionals, sport science teachers and related fields to guide and evaluate the importance of resistance exercise training in improving physical fitness variables for their students and athletes.
- ➢ Since resistance exercise training has a significant effect in improving physical fitness variables sport professionals, coaches as well as players ought to exercise at least for 3 days and above per week with gradual increment of intensity regularly to bring enhancement.
- ➢ Further researches may be conducted on more different types of physical fitness quality variables in relation with different exercises that could improve the performance of sport handball players of DBU.

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Appendix 1: Profile of participants

A. Control group

No	Name of players	Year	Age	Height(m)	Weight(kg)
1	Henok Gebeyehu	2 nd	20	1.67	60.6
2	Biruk Samuel	2 nd	20	1.76	57.7
3	Mezinew Abren	2 nd	19	1.67	61.5
4	Megersa Abdisa	3 rd	21	1.69	51
5	Amanuel Girma	3 rd	22	1.66	51.4
6	Tilahun Kinde	3 rd	21	1.68	48.4
7	Amanuel Bazezew	3 rd	19	1.74	53.3
8	Zemenu Berihanu	2 nd	20	1.63	48.4
9	Eyob Endale	3 rd	21	1.75	58.1
10	Kassahun Melese	2 nd	21	1.78	52.9
11	Kindalem Tsegaye	2 nd	20	1.67	51.2
12	Hagos Hiluf	1st	19	1.60	53.5

B. Experimental group

No	Name of student	Year	Age	Height(m)	Weight(kg)
1	Solomon Zerihun	1 st	20	1.58	54.8
2	Fikre Tesfu	2 nd	20	1.73	65.6
3	Leta Amsalu	1 st	21	1.67	53.4
4	Merga Daba	3 rd	22	1.65	58.5
5	Eliyas Getachew	3 rd	22	1.63	49
6	Bereket Abrham	2 nd	21	1.62	49
7	Adugna Habtamu	3 rd	22	1.61	49.6
8	Amanuel Temesgen	2 nd	20	1.66	55
9	Hinsermu Sakata	1 st	21	1.62	55.7
10	Dobol Chu	2 nd	20	1.66	52.6
11	Getachew Niguse	1 st	20	1.71	56.3
12	Tenaw Abebe	1st	19	1.58	48.4

Appendix 2: Characteristics of the study participants

Group	N	Age		Height		Weight	
		Mean	S.D	Mean	S.D	Mean	S.D
Experimental Group	12	20.67	0.985	1.6433	0.04638	53.99	4.933
Control Group	12	20.25	0.965	1.6917	0.05474	54.00	1.287

Appendix 3: 3 month Training Program for Experimental Group

Table 1: **Training Schedule for First Month (**March**)**

Day	Types of exercise	Time /min during session	Sets - Reps	Intensity	Total Duration
Monday (10:00am-11:00am)	**Warming up** – Walking – stretching	5min 5min		Low to moderate	40:00 minute
	Main part - Push Ups - Crunches - Jumping Jacks	10min 10min	2 x 10 2 x 10 2 x 10		
	Cool down- stretching exercise	10 min			
Wednesday (4:00pm-5:00pm)	**Warming up**- – Walking – stretching	10 min		Low to moderate	40:00 minute
	Main part - Incline Push-ups - Sit Ups and Squat Jumps **Speed exercise** - Knee Highs - Lateral Movement - Bounding	20 min/ 30 sec rest b/n each ex.	2 x 10 2 x 10 2 x 10 Sets 2 2 2		
	Cool down- stretching exercise	10min			
Saturday (10:00am-11:00am)	**Warming up** - Walking - Running - stretching	 5 min 10 min 5 min		Low to moderate	60:00 minute
	Main part- weight training Squat & Press Triceps Extension Bent Row Biceps Curl Squats	30min	2 x 10 2 x 10 2 x 10 2 x 10 2 x 10		
	Cool down- stretching and relaxation exercise	5min 5min			

Table 2: Training Schedule for Second Month (**April**)

Day	Types of exercise	Time/min /session	Set – Reps	Intensity	Total duration
Monday (10:00am-11:00am)	**Warming up** - walking - stretching	 5min 5min		Moderate	60:00 minute
	Main part - Push-ups - Body Builders - Shuttle Run - Lateral Coach Drills	40min/60 sec rest b/n each ex.	3 x 15 3 x 15 3 x 45 sec 3 x 15		
	Cool down- slow stretching and relaxation exercise	5min 5min	Sets 2 2		
Wednesday (4:00pm-5:00pm)	**Warming up** - walking - Running - stretching	 5min 10min 5min		Moderate	60:00 minute
	Main part - Push- ups - Flutter Kicks - Body Builders - Squat Jumps	30min/30 sec rest	3 x 15 3 x 15 3 x 45 sec 3 x 15 3 x 15 3 x 15		
	Cool down- slow stretching and relaxation exercise	5min 5min			
Saturday (10:00am-11:00am)	**Warming up** - walking - stretching	 5min 5min	3 x 15 3 x 15	Moderate	60:00 minute
	Main part - Push-ups - Body Builders - Squat Jumps - 8 Count Push Ups	 8min 7min 8min 7min 4min 8min	3 x 15 3 x 15 3 x 15 3 x 15		
	Cool down- slow stretching and relaxation exercise	5min 5min			

Table 3: Training Schedule for Third Month (**May**)

Day	Types of exercise	Time/min /session	Set - Reps	Intensity	Total duration
Monday (10:00am-11:00am)	**Warming up** - walking - stretching exercise	 5min 5min			
	Main part -Squat & Press - Bent Row - Biceps Curl - Squats	 8min 8min 8min 8min 8min	 3 x 10 3 x 10 3 x 10 3 x 10 3 x 10	High	60:00 minute
	Cool down- stretching and relaxation exercise	5min 5min	3 x 10 3 x 10		
Wednesday (4:00pm-5:00pm)	**Warming up** - walking - stretching exercise	 5min 5min			
	Main part - Push-ups - Mountain Climbers - Body Builders - Jumping Jacks - Squat Jumps	 10min 8min 8min 9min 5min	 3 x 15 3 x 15 3 x 15 3 x 15 3 x 15	High	60:00 minute
	Cool down- stretching and relaxation exercise	5min 5min			
Saturday (10:00am-11:00am)	**Warming up** - slow walking, jogging - stretching exercise	 10min 5min			
	Main part - Push-ups - Squat Jumps - Curl / Press / Extend - Squat & Press - Bent Row	 8min 7min 6min 7min 6min	 3 x 15 3 x 15 3 x 15 3 x 15 3 x 15	High	60:00 minute
	Cool down- stretching and relaxation exercise	5min 5min			

Appendix 4: Physical Fitness Quality Test Result Record Sheet of Subjects

Group _____(control or experimental group)

Name: _____

Initial Height/m: _____

Initial Wight/kg: _____

Age: 19-25

Sex: Male_____

No	Parameters to be measured	Type of Test	Experimental Group		Control Group	
			PT	PoT	PT	PoT
1	Running speed	30 meter test				
2	Explosive Power	Vertical jump board jump test				
3	Muscle strength	1 RM test				
4	Shooting accuracy	Ball throwing accuracy test				

Appendix 5: Pre and Post Test Results of selected physical quality test of Experimental Group

Paired Samples Test

Vjump		Paired Differences					T	Df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
EG	PT – POT	-15.50000	3.60555	1.04083	-17.79086	-13.20914	-14.892	11	.000
CG	PT – POT	-.41667	.79296	.22891	-.92049	.08716	-1.820	11	.096

Paired Samples Test

Ljump	Paired Differences					T	Df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
prt – pot	-45.500	11.213	3.237	-52.624	-38.376	-14.057	11	.000
pret – pott	-.667	1.155	.333	-1.400	.067	-2.000	11	.071

Paired Samples Test

1RM		Paired Differences					t	Df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	PT - POT	-7.500	3.371	.973	-9.642	-5.358	-7.707	11	.000
Pair 2	ptt - pott	.250	1.422	.411	-.654	1.154	.609	11	.555

Paired Samples Test

Shooting accuracy		Paired Differences					t	Df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
EG	PT – POT	-2.250	.754	.218	-2.729	-1.771	-10.340	11	.000
CG	PTT – POTT	.000	1.044	.302	-.664	.664	.000	11	1.000

Appendix 6. Pictures during measurement

Appendices 7 Pre and Post Test Results of power test for both experimental and control group (24)

Power test (vertical jump test in cm)				
No	Experimental Group		Control Group	
	Pre-test	Post-test	Pre-test	Post-test
1	45	55	33	33
2	37	55	43	42
3	43	65	47	49
4	47	62	42	43
5	42	61	45	45
6	45	62	45	44
7	55	68	38	39
8	53	69	52	52
9	44	63	44	45
10	37	49	37	37
11	33	45	43	44
12	55	68	53	54

Appendices 8 Pre and Post Test Results of power test for both experimental and control group (24)

Power test (broad jump test in cm)				
No	Experimental Group		Control Group	
	Pre-test	Post-test	Pre-test	Post-test
1	180	220	195	194
2	181	215	248	247
3	189	209	260	261
4	210	225	260	258
5	223	236	190	193
6	222	238	235	235
7	248	260	180	178
8	241	256	230	232
9	191	203	223	226
10	228	232	210	211
11	230	239	183	185
12	230	342	196	198

Appendices 9 Pre and Post Test Results of 1 RM test for both experimental and control group (24)

1RM test in kilogram				
No	Experimental Group		Control Group	
	Pre-test	Post-test	Pre-test	Post-test
1	50	55	40	40
2	40	40	50	50
3	40	45	50	55
4	50	55	40	40
5	35	40	35	30
6	40	40	40	40
7	40	45	50	45
8	50	55	45	40
9	45	45	35	40
10	50	50	40	40
11	30	35	40	45
12	30	40	40	40

Appendices 10 Pre and Post Test Results of speed test for both experimental and control group (24)

Speed test (30 meter test in seconds)				
No	Experimental Group		Control Group	
	Pre-test	Post-test	Pre-test	Post-test
1	3.22	2.80	3.34	3.30
2	2.12	1.81	3.21	3.25
3	2.25	1.95	1.50	1.45
4	2.86	2.05	3.01	3.00
5	2.20	2.00	4.42	4.40
6	2.15	1.91	2.20	2.18
7	3.04	2.82	2.50	2.50
8	2.17	1.80	3.20	3.25
9	4.45	3.50	2.87	2.91
10	2.52	2.40	3.02	3.00
11	2.56	2.05	2.89	2.92
12	3.40	3.10	3.10	3.08

Appendices 11 Pre and Post Test Results of shooting accuracy for both experimental and control group (24)

Shooting accuracy (7 meter throw)				
No	Experimental Group		Control Group	
	Pre-test	Post-test	Pre-test	Post-test
1	4	7	4	4
2	5	8	6	7
3	6	8	7	6
4	5	8	6	6
5	5	6	4	7
6	4	6	5	6
7	6	8	5	4
8	6	9	4	4
9	8	9	3	5
10	3	6	4	3
11	3	5	6	5
12	4	7	2	3