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Effects of Combined Aerobic And Resistance Training on Some Selected Physicalfitness Variables Among Adet Secondary And Preparatory School Male Basketball

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EFFECTS OF COMBINED AEROBIC AND RESISTANCE TRAINING ON SOME SELECTED PHYSICALFITNESS VARIABLES AMONG ADET SECONDARY AND PREPARATORY SCHOOL MALE BASKETBALL PLAYERS

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AUGUST 2022

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A THESIS SUBMITTED TO THE SCHOOL OF GRADUATE STUDIES OF BAHI R DAR UNIVERSITY SPORT ACADEMYIN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THEDEGREE OF MASTERS OF EDUCATION IN TEACHING PHYSICAL EDUCATION

BY

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Declaration

This is to certify that the thesis entitled **"**EFFECTS OF COMBINED AEROBIC AND RESISTANCE TRAINING ON SOME SELECTED PHYSICALFITNESS VARIABLES AMONG ADET SECONDARY AND PREPARATORY SCHOOL MALE BASKETBALL PLAYERS**"**, submitted in partialfulfillment of the requirements for the degree of Master of education in physical education of Department of sport science, Bahir Dar University, is a record of original work carried out by me and has never been submitted to this or any other institution to get any other degree or certificates. The assistance and help I received during the course of this investigation have been duly acknowledged.

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Name of Advisor	Signature	Date
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APPROVAL OF THESIS FOR DEFENSE

I hereby certify that I have supervised, read, and evaluated this thesis titled "EFFECTS OF COMBINED AEROBIC AND RESISTANCE TRAINING ON SOME SELECTED PHYSICAFITNESS VARIABLES AMONG ADET SECONDARY AND PREPARATORY SCHOOL MALE BASKETBALL PLAYERS**" by Tiru Mesel prepared under my guidance. I recommend the thesis be submitted for oral defense.**

Chair Persons Name	**Signature**	**Date**
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Internal Examiners Name	**Signature**	**Date**
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External Examiners Name	**Signature**	**Date**
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ListofAcronyms

ANRS	AmharaNationalRegionalState
bpm	Beat per minute
CG	Control Group
DHHS	DepartmentofHealthand Human Service
EG	Experimental Group
H_0	Null hypothesis
M	meter
MD	MeanDifference
N	Number
POT	PostTest
PT	Pretest
SD	StandardDeviation
SPSS	StatisticalPackageforSocialSciences

Abstract

Basketball is considered an intermittent high intensity sport that heavily stresses both aerobic and anaerobic metabolic systems. The purpose of this study was to investigate the effect of combined aerobic and resistance training on some selected physical fitness variables among Adet secondary and preparatory school male basketball players.The study employed Experimental research design. 22 male basketball players of Adetsecondary and preparatory school with the age of (EG=19.18±2.316, CG=18.73±0.1.679) were randomly assigned into 2 equal groups. Both the experimental group (EG, n=11) and control group (CG, n =11) participated in the regular basketball training, but only EG performed additional aerobic and resistance training for eight weeks, with 3 sessions per week, each lasting 40 to 60 minutes. Subjects were measured on aerobic fitness, 30m sprint time, vertical jump, , and agility on two occasions first before administration of the training as pre-test and after eight weeks ofthe training as post-test. The data collected from the study subject was analyzed using SPSS version 26 software by paired t-test with level of significant 0.05. The results showed that aerobic and resistance training significantly improved aerobic fitness, explosive power and agility performance in EG at ($p<0.05$). Similarly, sprint time was significantly reduced ($p<0.05$). Butno significant differences were found in all of the variables in CG ($p>0.05$). Based on this finding, it can be concluded that eight weeks aerobic and resistance training has positive effect on improvement of physical fitness variables of basketball players. Therefore, this type of training method is suggested to basketball players and coaches for improving physical fitness and performance skill.

CHAPTER ONE
INTRODUCTION

1.1. Background of the study

Basketball is one of team sport or ball game that is played by two teams of five players each. The aim of each team is to score in the opponents' basket and to prevent the other team from scoring. Basketball was conceived in 1891 by Dr. James Naismith, a physical education instructor at the YMCA College in spring field Massachusetts as a way to condition outdoor athletes during the winter months. His original list of thirteen rules has undergone a century of revision, leading to faster pacing greater athleticism (Griffiths,& Sian, 2010). Today basketball is one of the most popular American sports and one the rest of the world has adopted.

Since June 11, 1961, FIBA Africa has been promoting basketball and implementing capability building programs throughout Africa. FIBA Africa's capability programs include training for coaches, referees, and administrative people. Currently, there are 53 national federations affiliated to FIBA Africa. Among these federations, Egypt; Morocco; Ethiopia; Sudan; Togo; Northern Rhodesia; Sierra Leone; Ghana; Guinea; Libya; Mali and Upper Volta served as the founding member (http://www.sportsknowhow.com).The African Association of basketball Federation was organized at a meeting in Cairo which took place from June 11-14, 1961. During this historical meeting, representatives were presented from the National Basketball Federation of Ethiopia, Ghana, Guinea, Libya, and Egypt (http://www.fiba.com).

Basketball was first introduced in Ethiopia in the year 1946-47 (1939 E.C). It was first played in the TeferiMekonnen (Entoto Comprehensive) and Hailesilasse (KokebeTsebah) secondary schools. It was introduced by physical education teachers who came from Canada. Beginning from 1950-51, basketball became popular in most primary and secondary school of Addis Ababa. To this effect, Addis Ababa Inter-school Association included basketball in the inter-school competition which was held every year during that time. Later on physical education instructors of Addis Ababa University College and other colleges, coupled with members of Juventus club organized the competition programs of basketball in Addis Ababa.

Aerobic training has become increasingly popular in recent decades. Whereas previously aerobic training had been used by a few selected athletes to improve their aerobic fitness, sprinting ability and change of direction, it is now an important component in training for most sports as well as for injury prevention and rehabilitation (Castagna*et al.* 2008).

The game requires a multitude of skills, high levels of concentration and top-tier physical fitness. Aerobic training like jogging, stationary bicycling, jumping rope and swimming are some of the best ways to build your strength and stamina. Basketball players will improve the way their body takes up and uses oxygen so that they'll have the ability to play each game at maximum intensity until the final buzzer sounds.

Basketball is a physically demanding team sport characterized by frequent high-intensity periods of play and changes of activity type every 2-3 seconds (Ben Abdelkrim*et al*. 2007, McInnes*et al*. 1995, Scanlan*et al*. 2011). Neuromuscular abilities (i.e. power, strength, speed) are heavily taxed during basketball matches. Specifically, the jumping performance and the ability to quickly accelerate, decelerate and change direction appear to be key components of competitions (McInnes et al. 1995, Scanlan et al. 2011, Ziv and Lidor 2010). Due to these demands, both aerobic and anaerobic mechanisms are heavily activated to provide energy during basketball (Ziv and Lidor 2009).

Sprinting and Change of direction is a determinant of athletic performance in various sport events (Sheppard and Young, 2006; Spiteri*et al*., 2014). This is also true for basketball, in which the players are repeatedly required to perform rapid accelerations and decelerations with sudden changes in directions in the small playing area (Scanlan*et al*., 2014a) compared to outfield sports such as soccer. Indeed, elite male and female basketball players have been shown to change movement types every 1-3 seconds during a game (Abdelkrim*et al*., 2007; Conte et al., 2015; Scanlan et al., 2015b). Thus, high sprint and change of direction performance is considered a particularly critical physical demand in basketball players (Spiteri*et al*., 2015a; Stojanovic *et al*., 2019a). Therefore, the purpose of this study was to investigate the effect of combined aerobic and resistance training on some selected physical fitness variables among Adet secondary and preparatory school male basketball players.

1.2. Statement of the problem

Basketball is considered an intermittent high intensity sport that heavily stresses both aerobic and anaerobic metabolic systems (Ben Abdelkrim 2007). Although basketball is thought to be mainly dependent on players' anaerobic capacity, high aerobic fitness is also crucial to performance (Castagna*et al*. 2008). Since physical demands in basketball are so diverse, coaches aim to simultaneously optimize physical fitness and neuromuscular strength. Hence, according to Hoffman *et al*. (2014), this provides a complex range of variables to be considered when developing training programs and can often lead to confusion and misuse of training modalities, particularly in the development of aerobic, anaerobic, and technical conditioning. However, the design of such training sessions requires precise knowledge of the physiological qualities associated with different training stimuli. For these reasons, coaches need to design training protocols properly with strong evidence-based support.

Basketball is a game of continuously changing tempo, requiring speed, and acceleration, explosive movements such as rebounding, passing, jump shooting, fast breaks and high speed play. The game also involves skills that must be applied dynamically, explosively and repeatedly (Gore, 2000). So, basketball players must be strong, quick, and agile to effectively block, shoot, or pass the ball. They must be able to accelerate and decelerate quickly and with control, often while dribbling, shooting, or rebounding the ball. They also need to be able to repeat these actions many times with little rest between efforts throughout the game (Jackson & Moeller, 2004). Thus, it is necessary that all of the basic motor skills such as strength, speed, endurance, reaction, mobility, skill and coordination are all together in basketball. Regular practice of coordinated movements can lead to transformations in the skill level of movements related to well-developed motor features (Kilic&Gunay, 2000), which can be achieved by well-planned, scientific, sport-specific training methods.

To become successful, basketball player requires many attributes like cardiovascular endurance, flexibility, muscular strength, endurance, agility, speed, power, coordination, skill and tactical knowledge. However based on the researchers' observation there is lack of physical fitness in Adet secondary and preparatory schoolmalebasketball local project players.The researcher got a chance to observe the level of fitness and their performance of

Adetmalebasketballlocalprojectplayers. When the researcher observed the team training situation trainers have given less attention for players' fitness & players yet not enough to fit to implementing basketball skills efficiently. Because of these reason players showed limitation on their physical fitness and skill performance when the researcher observed in their training program. This really shows there is physical fitness problem of Adetmalebasketball local project players. So, the researcher believes that if the coach gives great attention to combined aerobic and resistance training on their training program, it would have influence on players'physical fitness performance. Due to this, the researcher wanted to investigate effects of combined aerobic and resistance training on some selected physical fitness variables among Adet secondary and preparatory school male basketball players.

1.3Objectives of the study

1.3.1 General objective

The general objective of this study was to investigate the effectofcombined aerobic and resistance training on some selected physical fitness variables among Adet secondary and preparatory school male basketball players.

1.3.2 Specific objectives

The specificobjectives of this research wereas follows:

1. To examine the effect ofcombined aerobic and resistance training on aerobic fitness of basketball players.
2. To determine the effect of combined aerobic and resistance training on speed of basketball players.
3. To measure the effect combined aerobic and resistance training on agility of basketball players.
4. To evaluate the effect combined aerobic and resistance training on explosivepowerof basketball players.

1.4 Hypotheses

The study has attempted to test the following hypotheses.

1. **$H_{0.1}$**: Combined aerobic and resistance trainingdoes not significantly affect aerobic fitness of basketball players.
2. **$H_{0.2}$**: Combined aerobic and resistance trainingwould have no significant effect on speed of basketball players.
3. **$H_{0.3}$**: Combined aerobic and resistance training does not significantly affect agility of basketball players.
4. **$H_{0.4}$**: Combined aerobic and resistance trainingdoes not significantly affectexplosive power of basketball players.

1.5 Significance of the Study

The study intends to signify the following importance:-

- To offer reliable information for coaches, sport experts, and players on the effects of Combined aerobic and resistance training on aerobic fitness, agility, explosive power, and speed of basketball players.
- It motivates and encourages players to engage in aerobic and resistance training to increase their physical fitness.
- Serves as a push power and creating an opportunities for basketball players to play attractive & efficient basketball skills in competitions.
- Provide a proper and fertile ground for basketball coaches to utilize programmed Combined aerobic and resistance training.
- It can serve as a springboard for other researchers who wish to study the problem in greater depth.

1.6 Delimitation of the Study

In research, delimitations address how the study is narrowed in scope (Creswell, 1998). The study was designed to investigate the effectofCombined aerobic and resistance training on some selected physical fitness variables among Adet secondary and preparatory school male basketball players. For this purpose this study was delimited in the following areas.

- The study was delimited to Male basketball team trainees in Adet, Western Gojam Zone onAmhara region.
- Selected physical fitness variables were delimited on aerobic fitness, sprinting, agility and explosive power.
- The time of training wasdelimited to three days per week and 60minutes per sessions for eight weeks.
- The study was conducted in the year of 2021-2022 G.C

1.7 Limitations of the Study

Psychological variables and the related factors of the players, which might have been evolved during game situation, were not controlled. Tests were limited to specific tests that are easily monitored and administered. Food habits and the way of life style, which could influence on the results, could not be controlled by the researcher personally though orientation was given about these aspects to the subjects. The influence of burdens in routine work of the researcher and the trainees had an impact on the results of the study which haven't been considered. In addition to this, unable to control metrological variations such as air temperature and atmospheric pressures during testing periods were the limitations encountered in this study.

1.8. Organization of the study

This study has consists of five chapters. The first chapter deals with the back ground of the study, statement of the problem, hypothesis of the study, objectives of the study, significance of the study, delimitation of the study, limitation of the study, definitions of terms used in the study. The second chapter deals with the review of related literature, and the third chapter deals with the research design and methodology of the study. The fourth chapter deals with presentation, analysis and discussion of the data, and the last chapter five deals with the summary of the findings, conclusion and recommendations of the study.

1.9 Operational definitions of key terms used in the study

Adet: is a town which is found in Amahara regional state west Gojjam zone, YilmanaDensaWoreda.

Aerobic training:aform of physical exercise that combines rhythmic aerobic exercise with stretching and strength training routines with the goal of improving all elements of fitness

Agility: is the ability to stop, start and change the direction of the body or body parts rapidly under control (Baechle1994).

Effect: something brought about by a cause or an agent; result

Power: is the ability to transfer energy explosively into force (USDHHS, 1996).

Resistance training:an exercise that causes the muscles to contract against an external resistance with the expectation of increases in strength, power, or endurance.

Speed: The ability to move as fast as possible

Training: pedagogical process aimed to upgrade or improve the performance of athletes (IAAF Guide to Coaching Athletics 2000).

CHAPTER TWO
REVIEW OF RELATED LITERETURE

2.1 BASIC CONCEPT OF BASKETBALL GAME

The sport of basketball requires specific skills that can be completed under dynamic conditions, in most cases while moving at a high speed or while changing directions. The game is an intermittent team sport, which requires a high level of anaerobic and aerobic fitness (Gruet, &Bieuzen, 2018). As a result, successful basketball athletes tend to possess high strength, power and agility while maintaining a fairly lean body composition. While most of the skill work is performed at a high intensity, a certain level of endurance is important to meet game demands throughout the duration of the contest. In comparison to other team sports, the aerobic demand is less than soccer, but more than baseball and volleyball. While the demands and characteristics of the athletes differ by position, they are not as drastically different as a sport like football (Dascombe, &Reaburn, 2012).

As Latin, Berg, &Baechle (1994), noted, Basketball combines a variety of individual and collective skills that are executed in the context of competitive play. Ideal physique and physiology are not sufficient for excellence in basketball.However, understanding these components and using this knowledge to create training and nutrition plans can benefit athletes of all skill levels. While strength, power and agility may predict success in basketball, the sport does have an endurance component and the aerobic and anaerobic systems contribute to the overall energy demands. Lastly, game and strategic differences in playing style could impact the physiological requirements of the basketball player and should not be discounted (Hoffman, 2003).

2.2 An Overview of Aerobic Training

The American College of Sports Medicine (ACSM) defines aerobic exercise as any activity that uses large muscle groups, can be maintained continuously and is rhythmic in nature (Wahid*et al*., 2016). As the name implies, muscle groups activated by this type of exercise rely on aerobic metabolism to extract energy in the form of adenosine triphosphate (ATP) from amino acids, carbohydrates and fatty acids. Examples of aerobic exercise include cycling, dancing, hiking,

jogging/long distance running, swimming and walking. These activities can best be accessed *via* the aerobic capacity, which is defined by the ACSM as the product of the capacity of the cardiorespiratory system to supply oxygen and the capacity of the skeletal muscles to utilize oxygen(ACSM, 2013).

The criterion measure for aerobic capacity is the peak oxygen consumption (VO_2), which can be measured either through graded exercise ergometer or treadmill protocols with an oxygen consumption analyzer or *via* mathematical formulas. The value of peak VO_2 can be appreciated by a study performed by (Vaitkevicius*et al*., 1993), in which the VO_{2max} was calculated along with other dimensions, to conclude that higher physical conditioning status was directly correlated with reduced arterial stiffness.

2.3 Basic 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).

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 (Sheppard *et al*., 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 (Tipton, 1991).

High-intensity, intermittent team sports such as water polo, basketball, handball, football and hockey require athletes to have well developed speed, muscular strength and power, agility, and maximal aerobic power(Young, 2006). 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, 2007).

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, Tsimahidis, (2014). Increased bone density, increased metabolism, increased fitness 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.

2.4 Aerobic versus resistance training

Aerobic and resistance training produce significantly different or even opposite outcomes. Aerobic training reduces the activity of glycolytic enzymes and increases the number of intracellular energy storages, the activity of oxidative enzymes, the number of capillaries in muscles, and the density of mitochondria (Forssell, 2015). Resistance training, on the other hand, has nearly opposite results to these factors, although both training types increase the number of intracellular energy storages. Moreover, aerobic training mostly maintains or even decreases the size of muscle fibers whereas strength training increases them (Tanaka, &Swensen, 1992). Overall, aerobic training increases aerobic processes, and resistance training increases muscle strength, anaerobic processes, and power production. As Sale, (1992) noted, applying a short but intensive resistance training program (up to 6 weeks) can lead to significant changes in some parameters in strength performance, especially in overall strength and neural adaptation. On the other hand, it is not possible to achieve any significant changes in muscle hypertrophy Sale.

Combining these two training methods, aerobic and resistance training (commonly known as concurrent training), appears to be quite efficient since most of the studies on athletes regarding combined training have led to positive results in both strength and endurance performances (Häkkinen et al., 2003, &Mikkola., 2012 et al., 2012). Carthy*et al*., (1995) noticed in their study that the combined resistance and aerobic training group gained as much strength as the group

that did only strength training; the first group also improved their maximal oxygen uptake as much as the group that did only endurance training. From A Meta-Analysis Examining the Interference of Aerobic and Resistance Exercises, it is known that the total power is the major variable affected by concurrent training, and it does not compromise muscle hypertrophy and maximal strength development Wilson, (2012). However, explosive strength gains may be attenuated Schumann, (2021). Moreover, studies found that combination training positively affects the maximal strength of lower limbs in untrained and moderately trained individuals (Bankers, 2014, &Petré, Hemmingsson, Rosdahl, &Psiland, 2021).

Other studies found potential health benefits on cardiovascular, neuromuscular, hormonal, immunological, virological, and body composition parameters. These changes in the combined training program had more or less the same benefit compared with just one of these individually (Brito, Soares, & Silva, 2019). ACSM, (2011), recommends combining aerobic and resistance training for its advantages in contrast to aerobic training alone. Concurrent training has not been fully investigated, and there are still many questions. According to Methenitis, (2018), the effect of this training is a multidimensional phenomenon, influenced by many physiological and non-physiological factors such as type of exercise, training background, muscle groups involved, and inter-individual variations.

2.5Aerobic training and basketball game

Aerobic exercise is a highly crucialconditional component in a variety of team sports and the physical fitness of players.In elite basketball players, high aerobic power is found tobe related to loading during a competition and isreported to help recovering during high-intensityintermittent exercises (Reilly, 1997). Furthermore,the increase in aerobic capacity also increases the capacity of oxygen carrying which then helpsrecovery of muscle pH and glycogen consumptionduring overloads through anaerobic energy(Balsom et al., 1994). Due tothese qualities of aerobic exercise, it is used as oneof the primary methods of exercise basketball game.

2.6Benefits 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). 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.

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 Kraemer, &Ratamess, (2004).

2.7Resistance 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.

2.8Physical attributes of basketball players

Modern style basketball involves intense physical contact throughout the entire match in defense, counterattack and positional attack. Only players with high physical capacities can effectively satisfy such requirements (Jadach&Cieplinski, 2008). Thus, physical attributes such as power and strength, running speed, agility, throwing velocity and shooting accuracy are important

factors for success in competitive basketball. Therefore, these capacities are discussed as follows.

Strength

Muscle strength is an important factor in basketball performance (Kvorning, 2006). Most researchers agree that higher maximal power and strength may be associated with an advantage in blocking, hitting, pushing and ball throwing velocity (Marques, & González-Badillo, 2006). Basketball requires many different qualities, such as shooting, passing, blocking, throwing in, jumping, running, sprinting, starting, stopping and changing direction (Lees & Nolan, 1998). A variety of training methods are used to increase strength and power in sports in order to enhance physical quality and there by specific team sport physical quality, such as sprinting and jumping (Santos &Janeira, 2008).

Power

In basketball, the achieved 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 basketball 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 (MichalLehnert, 2009).

The standing long jump is a test for lower body power. This is a non-resistant exercise used to measure jumping ability. 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. Power cleans and jerks are exercises that can be used to measure total body power. These indicators of power are a different measure than the standing long jump. The snatch and the clean and jerk have been widely accepted as a viable means for increasing lower body power (Hedrick, 1996).

Running Speed and Acceleration

Speed is a part of basketball, but not that big compared to strength and endurance. Player needs speed especially when going to fast-break out. Most other times game speed is required in order to break past the opponent. Running speed is an important prerequisite factor in competitive basketball (Hoff &Almasbakk, 1995). Basketball consists of many high intensive situations that consist of repeated high-intensity sprints, jumps, body contact, duels and changes of direction (Karcher&Buchheit 2014). To perform these movements efficiently and for the players‟ ability to perform well for the team, they have to improve their ability to accelerate quickly to high speeds and effectively change directions in in-game situations (Murphy, Lockie& Coutts 2003).

Speed is the ability to cover a distance quickly. Harnessing the ability to move quickly in a straight line is an essential component of successful performance in a vast variety of sports (Little & Williams 2005). Acceleration is the capability to increase movement velocity in the least amount of time as possible (Little & Williams 2005). Acceleration determines the performance in sprinting abilities over short distances (e.g., 5-10 m) and it is commonly measured as velocity (Murphy, Lockie& Coutts 2003). In team sports, like basketball, the ability to accelerate can determine successful sport performance (Little & Williams 2005). In team sports sprints are often initiated while athletes are moving at slower speeds (Young et al. 2001) or when athletes want to make a breakaway or want to initiate a tackle (Murphy, Lockie& Coutts 2003). Therefore, an athletes‟ ability to accelerate quickly in the first few steps is crucial for an effective game play (Murphy, Lockie& Coutts 2003).

Speed is an essential component in almost every sport and although a major requirement in activities such as throwing it is more readily desired in running. The development of speed is influenced by both physical and technical qualities. In many circumstances athletes are asked to „run faster‟ and many coaches include running drills in their training programs. Too often these drills, and other fast running practices, are executed in a state of poor posture and with poor execution. It is highly recommended that coaches of the young athlete encourage the development of the physical qualities required for running before attempting to embark on high speed drills (Kelvin, et al., 2005).

Agility

The term “agility” encompasses a wide range of movements and abilities that athletes are required to perform throughout competition. Agility movements can be defined as rapid, whole body movements that require single or multiple changes in velocity (i.e., acceleration or deceleration) or direction (i.e., vertical, lateral, or horizontal) in response to an external stimulus (e.g., opponent movements, location of the ball, etc.) (Gabbett and Benton, 2007).

The ability to rapidly change direction and react to different stimuli is a particularly important requisite in team handball (Young, James and Montgomery, 2002). When examining a variety of anthropometric, physiological, psychological, and skill components in elite and sub-elite youth basketball players, it has been reported that agility is the most discriminating factor (Zapartidis, Toganidis, Vareltzis, and Christodoulidis,2009). The capacity of basketball players to produce varied agility and speed actions is known to impact basketball match performance (Hermassi, Gabbett, Spencer and Khalifa, 2014), and both does in fact constitute the more crucial moments of the game and contribute directly to winning possession of the ball and to conceding of throwing ball.

Aerobic capacity

Most of the actions during the game are characterized as anaerobic, e.g. jumping, changing direction and footwork (Abdelkrim et al., 2007; Gottlieb et al., 2014). A basketball game is considered anaerobic-dominated and requires repetitive short and intense sprints from the players. Such activities take a high toll on the players (Castanga et al., 2005, 2008). In a basketball game a player averages 105 intense movements lasting between 2 to 6 s, which occurs on average every 21 s on the game clock (not including time-outs). Intensity during these movements shows values of 60 to 75% of VO_{2max}, and 70-90% of the maximum heart rate (Meckel and Gottlieb, 2009; Meckel et al., 2009). The overall distance a player sprints during the game is less than 10% of the total distance a player moves throughout a full game. Overall, the intermittent activity pattern in basketball demands aerobic capabilities sufficient to sustain repeated short bouts of high-intensity exercise (Bishop, 2004).

2.9 The fitness component and energy system in basketball

Many coaches and players equate athleticism with physical fitness in this type of sport. Being physically fit is essential from a health standpoint, but the following fitness components are equally important for elite basketball players (Abdelkrim et al., 2007; Gottlieb et al., 2014; Shaher, 2011): cardiorespiratory fitness, muscular strength, muscular endurance, flexibility and body composition.

The first component, cardiorespiratory fitness, refers to the effective delivery of blood, oxygen and nutrients to the active body by the heart and lungs during physical work. Aerobic exercise improves cardiorespiratory function (Meckel et al., 2009) and also strengthens the heart muscle. Aerobic training can be done through any activity requiring continuous low-intensity effort for 20-60 min (Meckel and Gottlieb, 2009). In this sense basketball requires short and intense periods of activity, during which players expend a great deal of energy at a rapid rate. Anaerobic pathways are another aspect of cardiorespiratory fitness, and provide energy for high-intensity activities. Thus the anaerobic energy systems must also be well developed (Abdelkrim et al., 2007; Gottlieb et al., 2014; McInnes et al., 2008).

The physiology underlying the aerobic and anaerobic energy systems is complex, and especially so in basketball (Gottlieb et al., 2014; Meckel and Gottlieb, 2009). On the one hand, the aerobic system, which supplies long-term energy, depends on the presence of oxygen for the production of ATP. This is the preferred energy source for exercise lasting more than 3 min (Castagna et al., 2005; Meckel and Gottlieb, 2009; Meckel et al., 2009). When basketball players begin exercising, both the aerobic and anaerobic energy systems are involved. However, the relative contribution of each energy source varies according to the demands of the exercise, which in turn vary as functions of the intensity and duration of the activity. Basketball is about 20% aerobic and 80% anaerobic, and therefore many factors influence the exact energy expenditure ratio for individual players (Abdelkrim et al., 2007).

Assigning exact ratios to fit all styles of play would be impossible. It is widely accepted that basketball is a game requiring a high level of anaerobic fitness. This is certainly the case when a 2-hour game is broken down into shorter segments. For example, if we monitor one player for the first quarter (10 min), we can observe a work-rest ratio of 1:1 or less (Abdelkrim et al., 2007;

Meckel and Gottlieb, 2009; Meckel et al., 2009), but if we monitor the same player for the whole game, we see a work-rest ratio of 1:2-1:3, given that the game includes short breaks: time-outs, quarter breaks and halftime (Gottlieb et al., 2014). While the energy to perform high-intensity efforts is derived primarily from the anaerobic system during the basketball game, recovery for subsequent bouts of exercise is facilitated during the rest periods by the aerobic system (Meckel and Gottlieb, 2009).

It is important to develop a training program that specifically emphasizes the energy system required to play basketball. Within 20 s of rest, 50% of the muscle stores of ATP-CP is restored, and 87% is restored after 60 s. Heavy breathing after high intensity is the process through which the aerobic system metabolizes lactate in an effort to facilitate recovery. In addition, if basketball players have strong basic aerobic conditioning to tolerate high levels of accumulated blood lactate concentration, this will delay the onset of fatigue and enhance productivity on the court (Gottlieb et al., 2014; Meckel and Gottlieb, 2009; Meckel et al., 2009).

2.10 Trait of Physical Training in high school Basketball

To Strengthen Physical Quality

Among the traits to develop basketball physical training in college students, strengthening physical quality must be the first one. And among the technique points of basketball, the advantages of explosive effort and reaction speed is the vital support, no matter dribbling or defense, shooting or rebounding. During the physical training, students should develop their reaction speed with comprehensive field and transform actions to cope with the complex basketball field, speeding up and moving quickly. From present basketball activity, the rhythm of dribbling and defense are very quick, and in order to adapt these features, it is needed to emphasize the speed of players, (Alemdaroglu, 2012).

Physical Training Combined Traits

In every basketball match, if one wants to win, it should use flexible defense and attack to adapt the opposite's movements, and also needs constant moving to reach a nice position, and then grasp the chance of shooting. By that, we find basketball is not only asks sufficient energy of players, it also acquires tacit agreements with each other, (Zhang Ming, 2015). Physical training

could not only promote the players, it is also the important part to improve strategy and gets high score. Basing on it, strategic training is vital, we should combine both and thus promote the final effect.

Personal Features

According to Asadi, (2016), with the promoting of educational revolution, the targeted teaching method for students could be the important way of improving educational effects, same as physical training in basketball. Because every student has different physical quality, the position they stay during the matches is different, and therefore targeted training for improving comprehensive physical training has been the great feature of players. In the actual training, physical training plan to every player is different, and thus to consider every individual condition which lead to a whole advancing.

2.11 The Importance of Physical Training in high School Basketball

1. To Improve the Physical Quality and Technique

To improve physical quality of students and to balance every organ in the body, students should take physical training in high school basketball as aim, and thus students could face harder basketball activity. As for players, an important condition to keep going is a healthy physical quality. And for people who are not players, a fine body condition could help them go ahead. During matches, players with well physical quality could use every technique and never be afraid of any sudden issue. However, to strengthen physical training could increase the immune ability which could decrease illness, thus students could live healthier and happier (Chen Jinyi, 2015).

2. To Strengthen the Willpower of Students

As we all known, most high school students are born in one-child family, such family is used to grant whatever their kids request, thus with a long-term influence, those high school students usually are weak in willpower which hinder them to face difficulty, and in the long run, they will restrict the development of our country. However, physical training in basketball could reach the training aim by high-intense exercise, which means college students should repeat corresponding movements, and improve their speed and flexibility. Thus, during the specific exercise, mental quality is also a test for college students. A powerful mental quality has great influence for their future life and career (Zhong Si, 2016).

2.12Fundamental skills of basketball

2.12.1 Offensive Basic Skills

According to Vic Ambler, (1979), basketball has the following offensive skills:

A. Passing: initially it is important to learn how to pass from firm and balanced base with a good view of the target.

B. Dribbling: dribbling is essential to ball familiarity and is best done at the beginning coach should be encouraged to use split vision and feel the ball rather than slap. It keeping a loose wrist and pushing the ball to the ground.

C. Shooting: is the really essential skill and one which requires a great deal of practice. Good shooters, even young ones, are now expected to score on average in excess of forty per cent.

D. Rebounding offensively: physical qualities are important in rebounding and jumping practices such as continuous ball taping are effective.

2.12.2 Defensive Basic Skills

Vic Ambler (1979) also noted the following basic defensive skills:

A. Making and channeling: the ability of young players to stay with an opponent with or without the ball will require vision, technique agility and desire. In general, we stay between our man and the ball. He /She will be dangerous when he/she moves towards the basket and defender must beat him/ her to the spot.

B. Stopping an effective pass: the player defending the ball handler must make it as difficult as possible for a passer to get an open passing lane. Hand must be kept very active for this.

C. Stopping effective dribbling: this means preventing the dribbler from making a penetrating move towards the basket. In the correct defensive posture for this the player has a low center of gravity and has both feet solidly on the ground, facing his/her opponent.

D. Discouraging and checking shooters: when an offensive player stops dribbling he/she may shoot. The defender should immediately step closer to him/ her with his/her hand up.

E. Defensives rebounding: rebounders must have the feeling that when the shot goes up it is their ball. Rebounders should be aggressive, mobile and have good jumping ability.

CHAPTER THREE

RESEARCH METHODS

3.1 Geographical Location of the Study Area

The study was conducted in Adet town, in YilmanaDensa district of West Gojjam Zone, Amhara National Regional state (ANRS). The study is located 42km from the northern part of the capital city of Amhara regional state; Bahir Dar city and eastern part of the country at about 505 km road distance east of Ethiopia capital city Addis Ababa . The study area is borderd four districts parts. These are gonjikolela in the east, mecha in the west, kuarit in the south and north BahirDar. Moreover it is administratively sub divided in 36 kebeles.

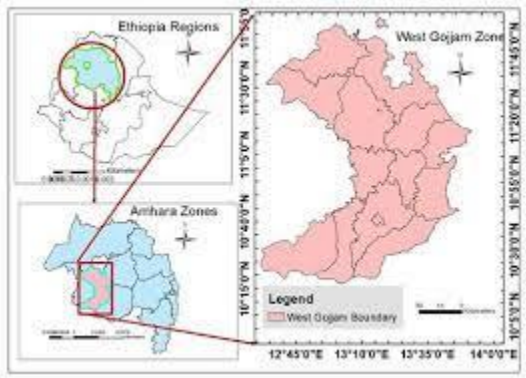

Figure 1. Map of the study area

3.2 Research Design

The focus of this study was to investigate the effect of combined aerobic and resistance training on some selected physical fitness variables among Adet secondary and preparatory school male basketball players.Depending on the nature and appropriateness of the pre and post test data the research approach designed in this study employed experimental design, since it helps to measure, assess, evaluate and analyze the effect of independent variable on the dependent variables. So, this design was selected because of the many types of research that might be used, the experimental design is the best way to establish cause-and-effect relationships among variables. Both groups was attended their regular basketball training sessions (three days per week), but in addition, Experimental groupunderwent a specific combined aerobic and resistance training program. The layout for this study is as follows:

Table1 the Study design lay out

Treatment	combined aerobic and resistance training
Frequency	3 days/week
Total duration	8 weeks
Duration/Session	40-60 minutes
Intensity	Moderate to high
Exercise days	Monday, Wednesday, Friday

3.3 Population, Sampling and Sampling Technique

All the 22 male basketball players of Adetwere selected to serve as subjects for this study. The subjects were randomly assigned into two groups, an experimental group, EG (n = 11) and a control group, CG (n =11). In this study, the researcher hasused comprehensive sampling techniques, this is because Adet male basketball team holds 22 players, and then the researcher has usedthese players as a whole for experimental study purpose. Therefore, the sample population of this study included all of the basketball players at Adet male basketball team. The subjects were homogenized and randomly assigned into two groups of eleven players: the experimental group and the control group. The group was equivalent in terms of variables of the study. Before applying experimental interventions, a pre-test was administered and post-test also conducted at the end of the intervention. It should be noted that the control group underwent only regular basketball training sessions given by the coach and experimental group was performed additional combined aerobic and resistance training for 8 weeks, with 3 sessions per week, each lasting 40-60 minutes.

3.4 Source of Data

The data for the study were collected from the results of test given from pre to post test of both Experimental and control group. To do this study the researcher has usedprimary data sources to get adequate amount of information regarding the effect of combined aerobic and resistance training on some selected physical fitness variables among Adet secondary and preparatory school male basketball players. So the primary data were taken from Adet secondary and preparatory school male basketball player‟s of pre and post-test measurements in the field.

3.5 Data collection instruments

In order to achieve the objective of the study regarding to the effect of combined aerobic and resistance training on some selected physical fitness variables among Adet secondary and preparatory school male basketball players, the researcher has collected Quantitative data through the appropriate Physical fitness test such as, 30m sprint for speed, standing vertical jump for explosive power, Illinois agility test for agility and three minute step testfor aerobic fitness. Before the experimental group goes to combine aerobic and resistance training, the pre-testwastaken from both control and experimental groups. Post-test was also taken from both groups after eight week training programs completed for experimental groups.

3.6 Training protocol

The studied players weredivided into two groups: experimental and control group. Experimental group was subjected to additional combined aerobic and resistance training and control group followed standard basketball training. Experimental group had performed three additional units of combined aerobic and resistance training lasting about 40-60 minutes each for eight weeks. The training protocol focused on aerobic and resistance was based on such exercises as the jogging, rope jumping running on truck barbell squat, the dumbbell and other body weight exercises. The training load hasincreased progressively throughout the experiment, changing the intensity as well as the number of sets and repetitions in accordance with standard training procedures. The training program was based on recommendations of intensity and volume. Therefore, the researcher had prepared training session plan for experimental players. The following physical fitness variables namely: agility, speed, explosive power and aerobic fitness were measured. The data were collected on two days of a week during pre-test and after two month of combined aerobic and resistance training again had taken two days and collected the post-test result. On the first day: 30-meter run, vertical jump, and Illinois agility was measured whereas three minute step test wasmeasured on the second day.

3.7 Procedures for administration of tests

The investigator has followed standard procedures for testing the selected variables and registered the score in fitness record sheet under the direct supervision of subjects. In order to evaluate the effect of combined aerobic and resistance training on selected variables, all pre- test measurements were done within the first week prior to the commencement of the 8-week training program, while post testing was performed within first week following the completion of the program. The participants had performed enough warming up and stretching exercise to all tests at the beginning. The testing session has consisted of warm-up and test interspersed with rest. All tests were explained and demonstrated. Before testing, subjects were given practice trials to become familiar with the testing procedures. Subjects wereperformed each test as per test procedure and the scores of best trials had taken for this study. Moreover, each test procedures are discussed below.

3.7.1 Evaluating Aerobic Fitness

Step test is designed to measure aerobic fitness by using a 12-inch high bench (or a similar-sized stair or sturdy box), watch for timing minutes. The step test works on the rationale that individuals with a high level of aerobic fitness will have a lower heart rate during recovery from three minutes of standardized exercise (bench stepping) than less conditioned individuals. The lower heart rate after the test will be an indicator for being the more fitter. (Goldinget al., 1986).

Purpose:-To determine the state of player's aerobic fitness and the recovery heart rate after exercise.

Equipment:-a bench with 30-40cm high from the ground level, a stopwatch, and an assistant.

Procedure:-The playerswere warm up for 10 minutes, step up and down on a 30-40cm bench for 3 minutes at a rate of 24 steps per minute, one step consists of 4 beats i.e. "up with the left foot, up with the right foot, down with the left foot, down with the right foot." Stop at exactly 3 minutes and immediately sit in a chair. The active part of the test here was completed. Counting begins the pulse 5 seconds after the exercise ends.

Scoring: -The assistant was recorded the player's heart rate for 30 seconds and multiplied the result by two.

Figure2. Three minute step test
Adopted from Mackenzie, 2005 101 performance evaluation test

3.7.2 Evaluating Speed

30-meter sprint test

Objective: The objective of this test is to monitor the development of the player's maximum speed.

Equipment: 400m track – 60m marked section on the straight, cone to mark 30m point, stop watch and Assistant.

Procedure: The athlete warmed up for 10 minutes. The assistant marked out a 30 meters straight section with cones. On a signal of "Marks – Set – GO" sprint to the other cone as quickly as possible. The test comprised of 3 x 30m runs from a standing start and with a full recovery between each run. The athlete used the first 30m to build up to maximum speed and then maintains the speed through to 60m. The assistant recorded the time for the athlete to complete the: first 30m and the whole 60m. To determine the athletes flying 30m time subtract the time for the first 30m from the time for the whole 60m.

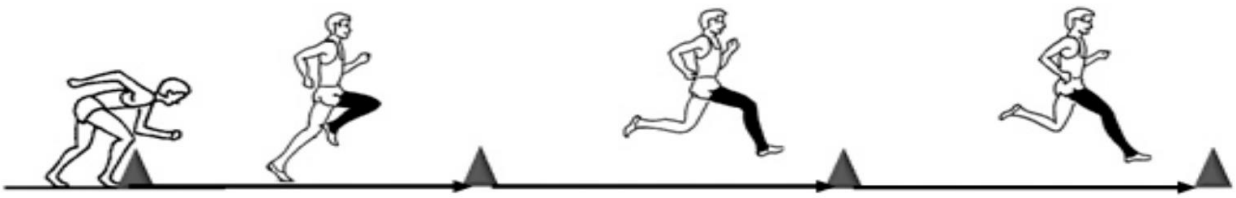

Figure3. 30-Meter Sprint Test

3.7.3 Evaluating Agility

Illinois agility run test

Objective: The objective of the Illinois agility run test is to monitor the development of the player's agility.

Equipment: Flat non-slip surface, measuring tape, 8 cones, stopwatch and assistant.

Procedure: The length of the course was 10 meters and the width (distance between the start and finish points) was 5 meters. On the track 5 lanes are used. 4 cones can be used to mark the start, finish and the two turning points. Each cone in the center was spaced 3.3 meters apart. This test requires the player to run the lines route in the diagram below as fast as possible. The player warmed up for 10 minutes. The assistance had set up the course as detailed in the diagram. The player lied face down on the floor at the "Start" cone. The assistant gave the command "GO" and starts the stopwatch. The player jumped to his feet and negotiates the course around the cones following the line route shown in the diagram to the finish. The assistant stoppedthestopwatch and records the time when the player passes the "Finish" cone. Finally, the assistant used the fastest recorded time.

Scoring: Two or more trails were allowed, and the quickest time was recorded. Results were record to the nearest tenth of a second.

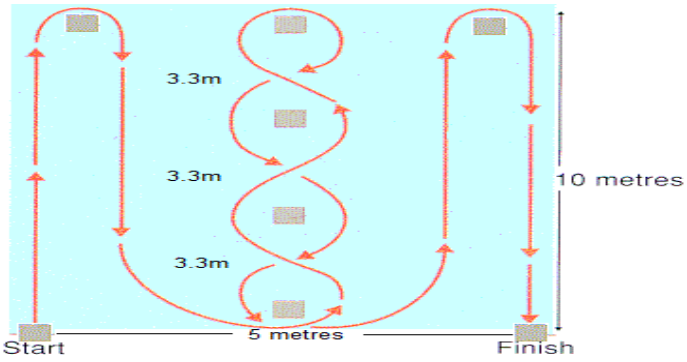

Figure4. Illinois Agility Test
Adopted from Mackenzie, (1997)

3.7.4 Evaluating Explosive Power

Vertical jump test

Objective: To measure the explosive power of the leg in vertical jump height jumped.

Equipment: Measuring tape or marked wall, chalk for marking wall, score sheet, pencil.

Procedure: The player was warmed up for 10 minutes. The player had chalk the end of her or his fingertips .The player wasstood side onto the wall, keeping both feet remaining on the ground, reaches up as high as possible with one hand and marked the wall with the tips of the fingers (M1). The player from a static position jumped as high as possible and marked the wall with the chalk on his fingers (M2). The assistant was measured and recorded the distance between M1 and M2. The player wasperformed three trials. The assistant was calculated and recorded the highest jump from the three trials.

Scoring: The jump height wasrecorded as a distance score in centimeter.

Figure5. Vertical Jump Test

Source: Sergeant Jump Test (Sergeant, 1921)

3.8 Methods of Data Analysis

The data which were collected through fitness tests was analyzed and interpreted in to a meaningful idea using computer in order to compare selected physical fitness variable changes observed among groups. The paired t-test was used to examine whether there is a significant difference between the pre and post test results of experimental & control group. All data analyses were performed with in computer system using statistical package for social science (SPSS), version 26. The significance level for all of the hypotheses waschosen to be at 0.05. In addition based on the data results and discussion, brief conclusions and recommendation were written.

3.9 Ethical considerations

This study was dealt with the ethical issues and code of conduct related to the investigation. Ethical standards require that researchers should not put participants in a situation where they might be at risk of harm as a result of their participation. The harm may be physical or psychological. This research was approved by an ethics review committee of Sport Academy, Bahir Dar University post graduate studies to make sure it is not resulting to any risk or harm to the participants of this study. Before beginning the research, the researcher obtained permissionfrom the coach, woreda sport office and all the players had clear information about the purpose of the study, the procedures to be used, the potential benefits and the possible risks of participation in this study was explained and written consent was given to the players. Participants were fully aware of all data gathering techniques and Research data were confidential.

CHAPTER FOUR
RESULTS AND DISCUSSION

4.1 Introduction

This chapter deals with the analysis of pre and post test data collected from experimental (n=11) andcontrol(n=11)groupsunderthestudy.The purposeofthisstudywasto investigate the effectof combined aerobic and resistance training on some selected physical fitness variables among Adet secondary and preparatory school male basketball players. The physical fitness components selected for this study wereaerobic fitness, explosive power, agility and speed. Pre-test and post-tests were taken from both experimental and control groups before and after eight weeks of strength 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.

4.1. Resultsofthe Study

Table2Demographiccharacteristicsofparticipants

Group	N	Sex	Age	Height	Weight	Playingexperience
			Mean± S.D	Mean± S.D	Mean± S.D	Mean± S.D
EG	11	Male	19.18± 2.316	1.7073± 0.049	57.91± 4.230	2.00± 0.632
CG	11	Male	18.73±0.1.679	1.7009± 0.058	57.55± 5.837	1.91± 0.701

Key:-EG=Experimentalgroup,CG=Controlgroup,PT=prettest,POT=post-test, SD= standard deviation

As shown from the above table, descriptive characteristics of 22 study participants from Adet secondary and preparatory school male basketball team of age (EG=19.18±2.316, CG=18.73±0.1.679) height (EG=1.7073±0.049, CG=1.7009±0.058) weight (EG=57.91±4.230, CG= 57.55±5.837) and playing experience (EG=2.00± 0.632, CG=1.91± 0.701). Subjects were relativelyhad the same age, height weight and playingexperience.

Table 3 Descriptive Statistics of Three minute step test and 30m sprint test

	EG(n= 11)		CG(n= 11)	
	Mean±SD		Mean± SD	
Test	PT	POT	PT	POT
Three minute step test(bpm)	104.09±11.282	93.64±10.443	105.73±9.530	102.82± 6.809
30m sprint test (sec)	5.336± 0.3695	5.091±0.2914	5.555±0.3804	5.318± 0.3401

Key: - EG=Experimental group, CG= Control group, PT= pre- test, POT= post-test, SD= standard deviation, sec=second, bpm=beat per minute

The above table shows the analyzed data of the three-minute step test. The pretest mean of EG was found to be 104.09±11.282whereas the CG pretest means found 105.73± 9.530. The Post Test means of the EG were 93.64±10.443whereas CG was found to be 102.82± 6.809. The result indicated that the mean value of the control group's heart beat in the pre and posttest was very close. The result also indicated that the mean value of EG heart beat after giving combined aerobic and resistance training was less than that of before giving aerobic and resistancetraining. This showed the increasing of cardiorespiratory fitness after giving the training was higher than before giving training.

The above table also shows the pre and post test results of 30m sprint testfor both experimental and control groups. As shown in the table, the pre-test score of EG were found to be 5.336± 0.3695and the CG pre-test found to be 5.555±0.3804. But after eight week combined aerobic and resistance training given to EG, the mean score of 30m sprint test 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 testcore of EG found 5.091±0.2914where-as CG found 5.318± 0.3401after combined aerobic and resistance training.

Table 4 Descriptive Statistics of Vertical Jump and Chin uIllinois Agility Run Test

	EG(n= 11)		CG(n= 11)	
	Mean±SD		Mean ± SD	
Test	PT	POT	PT	POT
Vertical Jump(M)	41.627±1.5925	45.045±2.1888	44.209±2.0661	42.964±1.4644
Illinois Agility Run(sec)	19.918±1.3106	19.327±1.5710	20.227±1.3915	19.727±1.5206

Key: - EG=Experimental group, CG= Control group, PT= pre- test, POT= post-test, SD= standard deviation,sec=second, M=meter

The above table shows the pre and post test results of vertical jump for both experimental and ontrol groups. As shown in the table, the pre-test score of EG were found to be 41.627±1.5925 and the CG pre- test score found to be 44.209±2.0661. But after eight week combined aerobic and resistance training given to EG, the mean score of vertical jump 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, vertical jump score of EG found 45.045±2.1888 whereas CG found 42.964±1.4644 after combined aerobic and resistance training.

The above table also shows analyzed data of Illinois agility run test. The pre-test score of EG were found to be 19.918±1.3106 whereas the CG pre-test score found to be 20.227±1.3915. The post test score of the EG were 19.327±1.5710 whereas CG were found to be 19.727±1.5206. The result indicated that the mean value of EG Illinois agility running time before giving the training was higher than that of after the intervention.

Table 6 Paired sample t-test results of fitness variables for the two groups of pre and post test

Variables	Subjects		paired differences				df	sig. (2-tailed)
			MD	Std. Deviation	95% Confidence Interval of the Difference			
					Lower	Upper		
3minute step test	EG	PT-POT	10.455	6.669	5.974	14.935	10	0.000
	CG	PT-POT	2.909	5.839	-1.013	6.832	10	0.129
30m sprint test	EG	PT-POT	0.2455	0.1809	0.1239	0.3670	10	0.001
	CG	PT-POT	0.2364	0.4523	-0.0675	0.5402	10	0.114
Vertical Jump	EG	PT-POT	-3.4182	2.0449	-4.7920	-2.0444	10	0.000
	CG	PT-POT	1.2455	2.2029	-0.2345	2.7254	10	0.090
Illinois Agility Run	EG	PT-POT	0.5909	0.5683	0.2092	0.9727	10	0.006
	CG	PT-POT	0.5000	0.9910	-0.1657	1.1657	10	0.125

Key: - EG=Experimental group, CG= Control group, PT= pre- test, POT= post-test, SD= standard deviation, df =degree of freedom

The above table shows the test of significant differences between the two groups (EG and CG) of pre and post-test results of three-minute step test. According to the data presented in the table, the pre and post-test results of cardiorespiratory fitness performance levels in step test of the EG showed a statistically significant difference (MD = 10.455, SD = 6.669, p = 0.000). Hence, ($P<0.05$) posttest heart rate was significantly lowered than pretest for the EG. But, no significant difference was observed in heart rates of CG between pre- and posttest (MD = 2.909, SD = 5.839, p = 0.129), no significant at ($p>0.05$). Between each pre and posttest, the mean value difference was 10.455for EG and 2.909for CG. These values showed that the heartbeat of EG was significantly lowered from pre-posttests than CG. From this, we can understand that combined aerobic and resistance trainingaffects cardiorespiratory fitness positively. Furthermore, it results in a lowered heart rate.

The table also shows that EG significantly improved 30-meter Sprint performance (MD=0.2455, SD=0.1809, p=0.001) after eight weeks combined aerobic and resistance training. But no significant difference was observed in CG (MD=0.2364, SD=0.4523, p=0.114).

The above table also reveals the test of significance differences of the two groups (EG and CG) of pre and post test results. According to the data presented in the table, the pre and post test result of vertical jump showed a statistically significant difference in EG. The result suggests that EG significantly improved vertical jumping performance (MD=3.4182, SD=2.0449, p=0.000) when exposed to eight weeks combined aerobic and resistance interventionthan CG (MD=1.2455, SD=2.2029, p=0.090). The results indicate that the applied training protocol caused a significant improvement in total and relative explosive power performance in EG.

Table 6 above also displays the test of significance differences of the two groups (EG and CG) pre and post-test Illinois agility run results. According to the data presented in the table, the pre and post test result of Illinois agility run showed a statistically significant difference in EG (MD =0.5909, SD=0.5683, p=0.006) when exposed to eight weeks combined aerobic and resistance interventionthan CG (MD = 0.5000, SD =0.9910, p=0.125).

4.3 Discussions

The purpose of this study was to investigate the effect of combined aerobic and resistance training on some selected physical fitness variables among Adet secondary and preparatory school male basketball players. The subjects participated throughout the testing period and cooperated for the success of collection of necessary data. The experimental group participated in combined aerobic and resistance training for eight-weeks While, the control group did not participate in this selected training program. Experimental group were instructed not to start any additional programs during the eight-week period and only perform activities of normal daily living. Prior to the study, procedures and guidelines had presented orally and Subjects were agreed to participate. In this study combined aerobic and resistance training showed improvements in selected physical fitness variables. The finding of this study in each variable are discussed as follows.

The findings of the study revealed that there were significance differences before the training and

after eight weeks of combined aerobic and resistance trainingon players aerobic fitnessThe result suggests that EG significantly lowered heart rate (MD =10.455, SD=6.669, p=0.000). Hence, (P <0.05) Post-training heart ratewassignificantlylowered than pre-test values for the EG. But in CG no significant difference were found (MD=2.909, SD=5.839, p=0.129), not significant at 0.05 level of confidence. As the data (table 6) showed the mean values of three minute step testwere104.09 in before the intervention, which was lowered to 93.64 after eight week combined aerobic and resistance training, this means the heart rate of EG reduced by 10.455 after eight weeks of combined aerobic and resistance training. But the pre and post test score of CG stay very close, 105.73 and 102.82 pre and post-test respectively. The reduction t of the heart rate in EG was one indicator of theimprovement of aerobic fitness of players. The reason behind this change was combined aerobic and resistance trainingthat they were engaged in. Hence the researcher rejectedH0.1 at 0.05 level of confidence.

The main results of the investigation showed that the implementation of combined aerobic and resistance training improved the aerobic performance of basketball players.This result was in agreement with the findings of Matthew, &Delextrat, (2009) that conductedHeart rate and blood lactate concentration of female basketball players after exposed to aerobic and resistance training. Their result revealed that heart rate wassignificantly ($p < 0.05$) lowered among experimental group of female basketball players. This finding is also in accordance with Conte D, Favero TG, Niederhausen, et al. (2015) whose finding on the effects of aerobic and high intensity resistance training program on physiological variables of young basketball players showed significantly improved aerobic fitness.

The finding of the study showed that combined aerobic and resistance training has an effect on the 30-meter sprint run andreduceitstime. Theresultsuggeststhatasignificantimprovementinsprint performance was shownbyEG(MD=0.2455, SD=0.1809, p=0.001) thanCG(MD=0.2364, SD=0.4523, p=0.114).The lower time spent in covering 30m distance were indicating improvement of sprinting performanceinEG. ItwasobservedthataftereightandresistancetrainingbasketballplayersreducedSprint time by 0.2455second 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

undergo any statistically significantreduction of running time($p>0.05$). Hence theresearcherrejected H0.2at 0.05levelof confidence.

This result is supported byGorostiaga et al. (2006), who noted a significant enhancement (p , 0.001) of running speed after heavy lower limb resistance combined with aerobic training; Certainly, data indicate that a combination of aerobic, resistance, basketball 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.

Thisresult isalsoinaccordancewiththefindingsof Martinaetal.,(2018)who studiedoneffectsof different aerobic and resistance training on sprinting abilityof basketball players. The result indicated that, aerobic and resistance training showed significant effect on sprint performance of basketball players.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 basket ballers that by applying regular resistance training could improve players running speed and maximal upper body strength.

The findings of the study revealed that combined aerobic and resistance training had an effect on the explosive power of basketball players and had increased the players' vertical jump. The result suggests that a significant increase in a vertical jump performance was reflected by EG ($MD=3.4182$, $SD=2.0449$, $p=0.000$) than CG ($MD=1.2455$, $SD=2.2029$, $p=0.090$). In the designed trainings performed three days a week in addition to players' basketball technical trainings, vertical jump was in the pre-training and post-training, it was observed that after the training players jumped 3.4182m higher than the post test score. This finding was found to be significant ($p<0.05$).Hence theresearcher rejected H0.3at 0.05levelof confidence. Thus, combination of aerobic and resistance training seems to be an essential tool in developing explosive power performances (Luebbers et al., 2003).

This finding 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 and aerobic training (Lehnert and Lamrova, 2009, Markovic, 2007). Studies indicate that the primary effect of resistance training is an increased rate of force production and velocity of movement, whereas traditional heavy-weight combined with aerobic 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.

This result is also in lined with Kalapotharakos et al., (2007) who evaluated the effects of 10 weeks of moderate resistance with aerobic training on muscle strength and jump performance. Explosive power performance improved after short-term moderate resistance and aerobic 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 resistance, aerobic and explosive power(Hoff andHelgerud,2004).Combination of aerobic and resistance exercise training affects power inplayers. This suggests that the continuation of a training program is essential for the maintenance of muscle power, functional performance. (Tsimahidis et al 2010) and throwing (Hoff, Almåsbakk B. (1995).

The finding of the current research showed that Combination of aerobic and resistance training has had a significant effect on the agility performance of male basketball players. The result suggests that a significant improvement in agility performance was shown by EG (MD=0.5909, SD=0.5683, p=0.006) than CG (MD=0.500, SD=0.9910, p=0.125). With the Combination of aerobic and resistance trainings performed three days a week in addition to players' basketball technical trainings, agility performance was in the pre-training and post-training, it was observed that after the training basketball players reduced illinois agility running time by 0.5909 second lower than the pre-test time. This finding was found to be significant ($p<0.05$). The lower time spent in covering distance, direction change and acceleration were indicating improvement of

agility. The above table 6 illustrates the improvement of agility, because there was decline in time resulting from eight weeks intervention. But in CG the pre and post test result did not undergo any statistically significant reduction ($p>0.05$). Hence theresearcherrejected H0.4at 0.05levelof confidence.

This finding of the study is in accordance with the findings of Frank et al., (2017) who studied on effects of a six-week combined resistance and aerobic training programme on change of direction performance in youth team sport athletes. The result showed that such training significantly improved agility performance of players. Another study conducted by Anil R. Waghmare, (2012) on study of flexibility, agility and reaction time in basketball Players also supports this finding. The result indicated that, resistance and aerobic training showed significant effect on agility performance of basketball ball players. Moreover, this result was also in accordance with the finding of Acsinte, Alexandru and Milon, (2012) who studied on effects of power, aerobic and resistance training on agility performance of basketball players. The result proved that combination of resistance and aerobic training is an effective method for improving agility performance of basketball players.

CHAPTERFIVE

SUMMARY,CONCLUSIONSANDRECOMMENDATIONS

5.1. Summary

The purpose of this study was to investigate the effect of combined aerobic and resistance training on some selected physical fitness variables among Adet secondary and preparatory school male basketball players.For this purpose, the researcher reviewed the available literatures in order to decide the focus of the study and methodologies. In order to attain the general objective of the study, the following specific research objectives were formulated.

1. To examine the effect of combined aerobic and resistance training on aerobic fitness of basketball players.
2. To determine the effect of combined aerobic and resistance training on speed of basketball players.
3. To measure the effect combined aerobic and resistance training on agility of basketball players.
4. To evaluate the effect combined aerobic and resistance training on explosive power of basketball players.

Based on the above specific objectives, the hypotheses were formulated. Subjects for the study were22males who areparticipatinginAdetsecondary and preparatory school male basketball team.Subjects weredividedinto two groups: an experimental and a control group. The experimental training group performed inatwo-month of additional combined aerobic and resistance training program. However, the control group did not perform the selected training program. Nevertheless, they did perform as equal asnormal training activities to the experimental players for the regular basketball training program. All subjects participated in all performance and physical qualities tests: aerobic fitness, explosive power, speed, and agility. Both had taken pre and post testing. Experimental method employed to collect a data used to analyze the change mean scores to experimental and control for (pre- post) values. Fitness profiling had achieved by means of a battery of tests. The data was gathered from the experimental and control groups results as in the form of pre-test and post-test method had been organized using appropriate and relevant statistical method of analysis. Paired t-test, which assists to come up with findings had used.

Through paired t-test the data was analyzed. Hence, the following major findings were investigated.

1. The finding of this study indicated that improvement in aerobic fitness was observed. Experimental groups had shown lowered heart rate as a result of the combined aerobic and resistance training,aerobic fitness was improved better in EG. In CG no significant change was found in pre to post test.

2. The finding of this study indicated that 30m sprint time was significantly reduced in EG after eight weeks of aerobic and resistance training. But no significant differences were found between pre to post test in CG.

3. The finding of this study indicated that there is a significant improvement of explosive power in EG than CG as a result of aerobic and resistance training. Experimental group show increased jumping height with the consequence of the intervention but no significant improvement was found in CG.

4. The finding of this study indicated that agility was significantly improved in EG as a result of eight weeks of aerobic and resistance training. In CG no significant change was observed.

5.2. Conclusion

Basedonthemajorfindingofthisstudy,thefollowingpointswerestatedasaconclusion.

- Eight weeks of combined aerobic and resistance training hadapositiveeffectonimprovementofaerobic fitness ofbasketballplayers.
- Eight weeks of combined aerobic and resistance training has a significanteffectsonreducingsprinttimeofbasketballplayers.
- Regular participation in aerobic and resistance training was found effective in significantly improving explosive power of basketball players.
- Implementing aerobic and resistance training during basketball training period results in a significant increase in agility performance of basketball players.

5.3. Recommendations

Basedonresults,discussions and findingsofthestudy,thefollowingwouldberecommended:

- Combination of aerobic and resistance training is vitally important in basketball since it leads to an improvement in the specific factors that influence game performance. Therefore, it would seem highly advisableto implement such type of trainingprograms in basketball training and in team sports in general, due to its influence on performance.
- Coaches should be concerned with developing explosive power, agility and speed fortheir main role in enhancing physical and skilled performance of basketball players.
- In addition to the technical training, physical training is important to improve overall performance related basketball game. So, for the better improvement l players should participate in programmed aerobic and resistance training.
- Further studies should be conducted in the same area on various age categories, sex and some more functional variables.

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EIGHT WEEK COMBINED AEROBIC AND RESISTANCE TRAINING PLAN

Training Program 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 – Jogging + coordination – Stretching	10 min			
	Main part - Jumping Jacks - rope jumping - Dumbbell curl - dips (bar) - PushUps - Crunches	20 min	2 x 10 2 x 10 2 x 10 2 x 10 2 x10 2 x10	Low to moderate	40:00 minute
	Cool down- stretching Exercise with breathing meditation	10 min			
Wednesday (10:00am-11:00am)	**Warming up** – Walking – Jogging + coordination – aerobic dance – stretching	10 min			
	Main part - basketball game - InclinePush-ups - pull up - Knee Highs - LateralMovement - Bounding	20 min(30 sec rest b/n eachex.)	5 min 2 x10 2 x 10 3 x 30sec. 3 x 30sec. 3 x 30sec.	Low to moderate	40:00 minute
	Cool down- stretching exercise with breathing meditation	10min			
Saturday (4:00pm-5:00pm)	**Warming up** - Walking - Jogging + coordination - Running - Stretching	10 min		Low to	

	Main part -running on truck - weight training Squat & Press -dumbbell row -Triceps Extension -Bent Row -Biceps Curl -Squats	20min	4 x 400m 2 x10 2 x10 2 x10 2 x10 2 x10 2 x10	moderate	40:00 minute
	Cool down- stretching and relaxation exercise	10 min			

Training Program for Second Month (April)

Day	Typesofexercise	Time/min /session	Set–Reps	Intensity	Total duration
Monday (10:00am-11:00am)	**Warmingup** - Walking - Jogging + coordination - Stretching	10min	10min 3 x45 sec 3 x15 3x15 3 x15	Moderate	60:00 minute
	Main part - aerobic dance -Shuttle Run - Dumbbell row - barbell squat - step up jumps	40min/60sec restb/n eachex.			
	Cool down- slow stretchingandrelaxation exercise with breathing meditation.	10 min			
Wednesday (10:00am-11:00am)	**Warmingup** - walking - Running - Stretching	10 min	10 min 3 x15 3x15 3 x15 3 x15	Moderate	60:00 minute
	Main part -basketball game - pull up - dips(bar) - BodyBuilders - Squat Jumps	30min/30secres t			
	Cooldown-slow stretching andrelaxationexercise	10 min			

Saturday (4:00pm-5:00pm)	**Warmingup** - Walking - Aerobic dance - Stretching	10 min	10 min 3 x15 3 x45 sec 3 x15 3 x15	Moderate	60:00 minute
	Main part - running on truck - Squat Jumps - Shuttle Run -BodyBuilders - chin up -	40min			
	Cooldown-slow stretching andrelaxationexercise	10 min			

APPENDICES

Appendix 1: Profile of participants

A. Experimental Group

No	Age	Height(m)	Weight(kg)	Playingexperience
1	18	1.75	59	2
2	17	1.65	53	2
3	18	1.68	51	2
4	17	1.70	55	1
5	19	1.65	56	2
6	18	1.77	58	1
7	22	1.78	60	2
8	24	1.70	64	3
9	20	1.68	65	2
10	17	1.66	57	3
11	21	1.76	59	2

B.ControlGroup

No	**Age**	**Height(m)**	**Weight(kg)**	**Playingexperience**
1	19	1.66	56	1
2	20	1.73	58	2
3	16	1.60	49	3
4	17	1.67	51	2
5	20	1.76	63	2
6	17	1.64	53	1
7	21	1.78	52	2
8	21	1.75	66	2
9	19	1.73	61	3
10	18	1.65	65	1
11	18	1.74	59	2

Appendix 2: Demographic characteristics of the study participants

Group	N	Sex	Age	Height	Weight	Playingexperience
			Mean± S.D	Mean± S.D	Mean± S.D	Mean± S.D
EG	11	Male	19.18± 2.316	1.7073± 0.049	57.91± 4.230	2.00± 0.632
CG	11	Male	18.73±0.1.679	1.7009± 0.058	57.55± 5.837	1.91± 0.701

Appendix

3:PreandPosttestresultofphysicalfitnessvariablesforexperimentalgrouppl ayers

No	Variables							
	Aerobi cFitnes s		AGILITY		Speed		Power	
	Three minute step test(bpm)		IllinoisAgility Run Test(sec)		30-metersprintTest(sec)		Vertical jump test(M)	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
1	112	99	18.7	16.5	5.3	5.1	38.2	46.5
2	108	101	21	20.8	4.4	4.5	41.9	46
3	114	99	19.2	18.5	5.3	5.1	43	47
4	114	97	21.3	20.8	5.6	5.4	42	46
5	111	95	18.2	18.1	5.2	5.1	40.8	41.3
6	119	113	21	20.4	5.4	4.9	42	44.5
7	87	78	21.6	21.2	5.9	5.6	41	43.5
8	102	93	19.7	19.5	5.3	5.2	42	46
9	97	76	17.8	17.2	5.6	5.2	44	48.2
10	93	89	19.9	19.3	5.4	5.1	40	41.5
11	88	90	20.7	20.3	5.3	4.8	43	45

Appendix 4: PreandPosttestresultofphysicalfitnessvariablesforControlgroupgrouppla yers

No	Variables							
	Aer obic Fitn ess		AGILITY		Speed		Power	
	Three minute step test(bmp)		IllinoisAgility Run Test(sec)		30-metersprintTest(sec)		Vertical jump test(M)	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
1	104	102	18.7	18.1	4.8	5.1	46	46.2
2	110	102	21	20.1	5.9	5.7	42	41.6
3	102	98	19.2	19.5	5.3	5.5	47	43
4	120	114	21.4	21.9	5.2	4.9	44	42.3
5	122	111	21.2	20.9	5.6	4.8	43.7	44.2
6	98	107	23	22.4	6.1	5.3	46.8	42.9
7	98	99	20.1	17.3	5.9	5.2	43	42.8
8	96	101	18.5	19.1	5.3	5.6	42	44.2
9	94	89	18.8	19.1	5.7	5.9	45	42.8
10	106	101	19.9	19.3	5.8	5.1	45.8	41.2
11	113	107	20.7	19.3	5.5	5.4	41	41.4

Appendix 4: Picture during test

A. Vertical jump test

B.Agility test