

**EFFECT OF AEROBIC EXERCISE ON SELECTED MOTOR FITNESS
VARIABLES IN CASE OF MALE SPORT SCIENCE STUDENTS OF
DEBRE BIRHAN UNIVERSITY; NORTHSHOWA ZONE, AMHARA
REGIONAL STATE**

MSc THESIS

HULUAGER ABEBE FENTAHUN

**OCTOBER, 2017
HARAMAYA UNIVERSITY, HARAMAYA**

**Effect of Aerobic Exercise on Selected Motor Fitness Variables in Case of
Male Sport Science Students of Debre Birhan University; North Showa
Zone, Amhara Regional State**

**A Thesis Submitted to Postgraduate Program Directorate
Department of Sport Science
Haramaya University**

**In Partial Fulfillment of the Requirements for the Degree of
MASTER OF SCIENCE IN SPORT MEDICINE**

Huluager Abebe Fentahun

**October, 2017
Haramaya University, Haramaya**

HARAMAYA UNIVERSITY
POSTGRADUATE PROGRAM DIRECTORATE

As a research Advisor, I hereby certify that I have read and evaluated this thesis entitled **“Effect of Aerobic Exercise on Selected Motor Fitness Variables in Case of Male Sport Science Students of Debre Birhan University; North Showa Zone, Amhara Regional State**, Prepared by Miss Huluager Abebe Fentahun. I recommend that it can be submitted as fulfilling the thesis requirements.

Desta Enyew (PhD)

Major Advisor

Signature

Date

Wegene Waltenegeus(PhD)

Co- Advisor

Signature

Date

As a member of the board of examiners of the MSc Thesis Open Defense Examination, I certify that I have read and evaluated the thesis prepared by Miss Huluager Abebe Fentahun and examined the candidate. I recommend that the thesis be accepted as fulfilling the Thesis requirements for the Degree of Master of Science in Sport Medicine.

Chairperson

Signature

Date

Internal Examiner

Signature

Date

External Examiner

Signature

Date

DEDICATION

This thesis manuscript is dedicated to my Grandmother, Zemenech Gebrie who had committed with strong prayer for the betterment and success of my life.

STATEMENT OF THE AUTHOR

By my signature below, I declare and affirm that this Thesis is my own work. I have followed all ethical and technical principles of scholarship in the preparation, data collection, data analysis and compilation of the Thesis. Any scholarly matter that is included in the Thesis has been recognition through citation.

This Thesis is submitted in partial fulfillment of the requirement for masters in sport medicine degree at Haramaya University. The Thesis is deposited in the Haramaya University library and is made available to borrowers under the rules of the library. I solemnly declare that this Thesis has not been submitted to any other institution anywhere for the award of any academic Degree, Diploma or Certificate.

Brief quotations from this Thesis may be made without special permission provided that accurate and complete acknowledgement of the source is made. Requests for permission for extended quotations from or reproduction of this Thesis in whole or in part may be granted by the Head of the School or Department when in his or her judgment the proposed use of the material is in the interest of scholarship. In all other instances, however, permission must be obtained from the Author of this Thesis.

Name: Huluager Abebe_Fentahun

Signature: _____

Date of submission: _____

School/Department: Sport Science

Program: Sport Medicine

BIOGRAPHICAL SKETCH

The Author was born in North Gonder, Tegede Wereda Kirakir Town in July 1993 from her Father Abebe Fentahun and her Mother Marie Wudu. She completed her primary and Secondary School education in Kirakir junior and secondary school and her preparatory education at Ketemanigus Preparatory School. After successfully passing the Ethiopian Higher Education Entrance Examination (EHEEE), she joined Debre Birhan University in 2012 and graduated in 2014 with BSc Degree Sport Science. After her graduation, she was employed in Debre Birhan University as Graduate Assistant for one year and in 2015-16 she joined Haramaya, University Sport Science Department to pursue her postgraduate studies in Sport Medicine.

ACKNOWLEDGEMENTS

No one is like you, the Almighty God. Thank you for giving me the chance, courage and strength to enjoy the fruits of my Endeavour and to overcome all the problems.

I am grateful to my Major Advisor Dr. Desta Enyew, (Assistant professor) and Co-Advisor Dr. Wegene Waltenege, (Assistant professor) for their willingness to advise and guiding me from the very beginning of the proposal development up to the successful accomplishment of the actual research.

My special thanks also go to all Debre Birhan University and Haramaya University Sport Science staffs for their moral encouragement and giving valuable suggestion by reading the research proposal, support in data collection and management.

Words fail to convey my deepest thanks to all Debre Birhan University Male Sport Science students those who have participated in my research as study subjects. Special thanks to my friends Elsabet Gebeyehu and Asferachew Dejenie for their unforgettable and consistence encouragement.

I would like to express my gratitude to my Grandmother Zemenech Gebrie, my Father Abebe Fentahun, Sisters Ertbie Abebe and Arsema Abebe and my Aunt Tbeyin Fentahun, without their support my research work could not be achievable.

ACRONYMS AND ABBREVIATIONS

ACSM	American Collage of Sport Medicine
DBU	Debre Birhan University
DTT	During Training Test
FAO	Food and Agricultural Organization
MD	Mean Difference
NSCA	National Strength & Conditioning Association
PoT	Post Test
PT	Pre Test
RT	Reaction Time
SBST	Stork Balance Stand Test
SPSS	Statistical Package for Social Sciences
SRT	Sit and Reach Test
Vo2 Max	Maximum Volume of Oxygen Uptake

TABLE OF CONTENTS

DEDICATION	iii
STATEMENT OF THE AUTHOR	iv
BIOGRAPHICAL SKETCH	v
ACKNOWLEDGEMENTS	vi
ACRONYMS AND ABBREVIATIONS	vii
LIST OF TABLES	xi
LIST OF FIGURES	xii
LIST OF TABLES IN THE APPENDIX	xiii
LIST OF FIGURE IN THE APPENDIX	xiv
ABSTRACT	xv
1. INTRODUCTION	1
1.1. Background of the Study	1
1.2. Statement of the Problem	3
1.3. Scope of the Study	4
1.4. Significance of the Study	4
1.5. Objective of the Study	4
1.5.1. General objective	4
1.5.2. Specific objective	4
2. REVIEW OF RELATED LITERATURE	5
2.1. Motor Fitness	5
2.2. Motor Fitness Components	6
2.2.1. Speed	6
2.2.2. Power	7
2.2.3. Muscular endurance	7
2.2.4. Flexibility	8
2.2.5. Agility	9
2.2.6. Reaction time	9

TABLE OF CONTENT *(Continued)*

2.2.7. Balance	10
2.2.8. Co-ordination	10
2.2.9. Cardio-respiratory Endurance	10
2.2.10. Strength	11
2.2.11. Body Composition	12
2.3. Motor Fitness Variable Tests	12
2.3.1. Flexibility test	12
2.3.2. Muscle strength and endurance tests	13
2.3.3. Cardiovascular endurance tests	13
2.3.4. Aerobic fitness test	14
2.3.5. Reaction time test-	14
2.3.6. Balance fitness test	15
2.4. Aerobic Exercise	15
2.5. History and Development of Aerobic Exercise	16
2.6. Types of Aerobic Exercise	17
2.7. The Effect of Aerobic Exercise on Reaction Time, Balance and Flexibility	17
2.8. General Principles and Dosage of Training	19
3. MATERIALS AND METHODS	22
3.1. Description of the Study Area	22
3.2. Definition of Terms	23
3.3. The Study Design	23
3.4. Sources of Data	24
3.5. Study Population	24
3.6. Sample Size and Sampling Technique	24
3.7. Inclusion and Exclusion Criteria	25
3.8. Method and Procedure of Data Collection	25
3.8.1. Method of data collection	25
3.8.2. Procedure of data collection	26
3.9. Fitness Test Procedure or Protocol	26

TABLE OF CONTENT *(Continued)*

3.10. Methods of Data Analysis	27
3.11. Data Quality Control	28
3.12. Ethical Issue	28
4. RESULTS AND DISCUSSIONS	29
4.1. Overview	29
4.2. Demographic Characteristics of the Study Subjects	29
4.3. Sit and Reach Test Result and Discussion	29
4.4. Ruler Drop Test Result and Discussion	32
4.5. Stork Balance Stand Test Result and Discussion	34
4.6. The Mean Difference And Values and Significance Level of all Parameters	3
5. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS	4
5.1. Summary	4
5.2. Conclusions	5
5.3. Recommendations	5
6. REFERENCES	6
7. APPENDICES	12

LIST OF TABLES

Table	page
Table 1: Mean and standard deviation values of Sit and Reach test result	29
Table 2: Mean and standard deviation values of Ruler Drop Test result	32
Table 3: Mean and standard deviation values of Stork Balance Stand Test result	34
Table 4: the mean difference and values and significance levels of pre and post test result of subject in all parameters.	3

LIST OF FIGURES

Figure	Page
Figure 1: Showing the mean comparison of Sit and Reach test results of the study subjects among pre, during and post tests.	31
Figure 2: Showing the mean comparison of Ruler Drop test results of the study subjects among pre, during and post tests.	33
Figure 3: Showing the mean comparison of Stork Balance Stand test results of the study subjects among pre, during and post tests.	35

LIST OF TABLES IN THE APPENDIX

Table	Page
1. Training Schedule for First Month (December, 2016)	20
2. Training Schedule for Second Month (January, 2017)	21
3. Training Schedule for Third Month (February, 2017)	22
4. Raw data's of the selected motor fitness variables for experimental group (30)	24
5. Raw data's of the selected motor fitness variables for control group (30)	25
6. Sit and reach test for experimental group (pre-during and pre post result)	26
7. Sit and reach test for control group (pre-during and pre-post result)	26
8. Ruler drop test for experimental group both pre-during and pre-post result	26
9. Ruler drop test for control groups both pre-during and pre-post result	27
10. Stand balance stork test (pre, during and post test result) for experimental group	27
11. Stand balance stork test (pre, during and post test result) for control group	27
12. Normative data of flexibility test (sit and reach test) in cm	28
13. Normative data of balance test (stand balance stork test) in second	28
14. Reaction time (ruler drop test) analysis	28

LIST OF FIGURE IN THE APPENDIX

Figure	page
1. Map of the Study Site	29

Effect of Aerobic Exercise on Selected Motor Fitness Variables in Case of Male Sport Science Students of Debre Birhan University; North Showa Zone, Amhara Regional State

ABSTRACT

Motor Fitness is a readiness or preparedness with special regard for big muscle activity without undue fatigue. The students of sport science need motor fitness as they are involved in various vigorous practical activities during their practical class. The purpose of this study was to investigate the effect of 12 week planned aerobic exercise on selected motor fitness variables (reaction time, flexibility and balance) of male sport science students of Debre Birhan University. Sixty (60) under graduate male sport science students free from any health problems, with age group between 19 – 25 years were selected by random sampling technique from Debre Birhan University sport science department in all batches, out of total population (111) only 60 subjects were able to complete the study and purposive sampling was used to select the sex and department of subjects in relation with the study site. The selected subjects were divided into 2 groups i.e. control and experimental groups randomly, each group consisting of 30 students. The experimental group underwent 12 weeks planned aerobic exercise program, three days per week and the duration was 1:00hour while, the control group continued with their regular activity. Pre-test, during training test and post tests were conducted on the selected motor fitness variables such as sit and reach test, stork balance stand test and ruler drop test, each subject was tested at the same time of day. The data collected from subjects were analyzed by SPSS version 20.0 and the comparison of mean value results was carried out by paired sample t-test. The level of significance was $p < 0.05$. The finding of the present study showed significance ($P < 0.05$) improvement in experimental group than control group of the study as sit and reach test (Mean difference 11.534), ruler drop test (Mean difference .0468) and stand balance stork test (Mean difference 12.234) for experimental group. However, in the control group there was not significance difference or improvement seen in all selected motor fitness variables. So this study concluded that 12week aerobic exercise have a positive effect on improving these selected motor fitness variables of sport science students of DBU.

Key words; Aerobic exercise, Motor fitness, Flexibility, Balance, Reaction time

1. INTRODUCTION

This chapter discussed on the background of the study, statement of the problem, scope, significance and objectives of the study as follow.

1.1. Background of the study

Sport should be considered as one of the more important aspects of daily life. Sport science is a multidisciplinary field (i.e., exercise physiology, biomechanics, motor control and motor development, sport psychology, sports nutrition, and so on) concerned with the understanding and enhancement of sports performance. Sport science can be thought of as using the scientific process to guide the practice of sport with the ultimate aim of improving sports performance (Bishop *et al.*, 2006). Sports science is a discipline that studies how the healthy human body works during exercise, and how sport and physical activity promote health from cellular to whole body perspectives. Sport science is the application of biophysical and social scientific methods to study sport behavior.

The word Aerobic literally means “with oxygen or in the presence of oxygen”. Aerobic exercises are any activity that uses large muscle groups can be maintained continuously for long period of time and is rhythmic in nature. Aerobic exercise is performed at low to high intensity workout that extends over a certain period of time and uses oxygen in this process, which is also, requires a little skill to perform and recommended for all adults to improve fitness. In the present times, carrying out aerobics has become the most happening workout trend among the youth. Not only is performing aerobic exercise interesting, but also is very beneficial for health. There are various types of aerobic exercise such as walking, biking, jogging, swimming, aerobic dance classes, cross-country skiing and cycling. In general, aerobic exercise is one performed at a low to moderate level of intensity over a long period of time, aerobic exercise is readily accessible, requires no specialist knowledge or equipment and which has also been linked to motor fitness components (Wolach and Harold, 2000).

Physical fitness is the state of body in which a person can do work for a longer duration effectively and efficiently, without undue fatigue. Physical Fitness is an essential quality for learning motor skills beside the influences of growth and maturation.

Motor fitness may be defined as a limited phase of motor ability, giving importance for the capacity to do vigorous work. Motor Fitness is “a readiness or preparedness with special regard for big muscle activity without undue fatigue”. Although it’s a single term, but to understand it and to work out, we need to concentrate on its components - Muscular Strength, Muscular Endurance, Muscular Power, Cardio-Vascular Endurance, Flexibility, Speed, Agility, Reaction Time and balance (Valsaraj, 2013).

Motor abilities contribute independently and interdependently for successful performance of skill. The role of motor abilities for successful sports performance cannot be disputed (Natraj and Kumar, 2006). Motor ability has been defined as the present acquired and innate ability to perform motor skills of a general and fundamental nature. The early researchers defined motor ability as general physical efficiency, “the level to which one has developed his innate capacity to learn more skill” the immediate capacity of an individual to perform various stunts or many athletics events. Motor ability variables have been considered as important prerequisite for sportsman to secure the top level performance in the sport. .

Motor abilities are the foundation of human locomotion and functioning. Maintenance of upright posture, movements of the trunk with countermovement of the extremities and postural balance of the body are necessary for walking, running and jumping, thus the abilities to move (Magill, 2004). The improvement and maintenance of motor fitness components are very important in sports training. No doubt the performance of athletes influenced by many factors but still motor fitness components is the primary factor among these entire factors (Lidior and Ziv, 2010). Basic motor abilities and skills are of crucial importance in the early phases of the motor learning process (Ackerman, 1998). The basis of motor learning is a specific motor program, which is created by the motor cortex based on external and internal information. Fundamental movement skills are common motor activities with specific observable patterns. Most skills used in sports and movement activities are their advanced versions. Motor fitness might be referred as an efficient performance in such basic requirements as running, jumping, jogging, climbing, swimming with sustained efforts in variety of situation and therefore, would involve such element as power, agility, speed, balance.

1.2. Statement of the problem

The students of sport science need motor fitness as they are involved in various vigorous practical activities during their practical class. Many researchers investigate that Aerobic exercise is the key to improve motor fitness variables of athletes who engage through different activities. However, according to research, students' Physical Activity levels decrease significantly during the transition from high school to university (Douglas KA *et al.*, 1997) and the creation of daily opportunities for participation in regular Practical classes is not always feasible especially in DBU i.e. unless they have practical class they do not involve in regular exercise mainly in aerobic exercise for the purpose of improving their motor fitness. According to scientists and Physical Exercise practitioners, low physical activity requirements may not contribute to a noticeable improvement in the students' motor abilities (Grabowski, 2003). So, it is clear that to develop this selected motor fitness variables participating in regular and planned aerobic training is important, but this hypothesis has not yet been tested. As a result, conducting research is mandatory to test the hypothesis and to see the effect practically as well as to minimize the gap. Also, in our country especially in DBU research was not conducted at this area. Hence, the investigator of this study planned to conduct a research on this area. As a result, this study was expected to investigate the effect of aerobic exercise on selected motor fitness variables such as, body balance, flexibility and reaction time of male sport science student of DBU.

Research hypothesis (H0= Null hypothesis, H1= Alternative hypothesis):

1. H0: Aerobic exercise has no effect on the improvement of body balance of male sport science students of DBU.
H1: Aerobic exercise has an effect on the improvement of body balance of male sport science students of DBU.
2. H0: Aerobic exercise has no significance effect on flexibility of male sport science students of DBU.
H1: Aerobic exercise has a significance effect on flexibility of male sport science students of DBU.
3. H0: Aerobic exercise has no effect on RT of male sport science students of DBU
H1: Aerobic exercise has an effect on RT of male sport science students of DBU.

1.3. Scope of the study

This study was conducted on male sport science students of Debre Birhan University with the aim of examining the effect of aerobic exercise on selected motor fitness variables. This study was only focused on aerobic exercise training, Thus from this training the study was used exercises which help to develop motor fitness variables (body balance, flexibility and reaction time) of male sport science students. Only male sport science students of DBU who are volunteer to participate in this study were included in this study.

1.4. Significance of the study

The finding of this study was helpful to fill the gap of research on this area in our country especially in DBU. Usually sport or exercise science professionals particularly those who engaged in improving motor fitness variables like flexibility, body balance and reaction time were benefited. The output of the study was also beneficial for Sport science department and teachers by providing information about the effect of aerobic exercise on motor fitness variables of their student. Concerned personnel like sport coaches were take appropriate corrections and interventions, if any, in their training programs on the outcome of this study. The improvement and maintenance of motor fitness components are very important for sport science students and scientific investigation or experimental research about flexibility, body balance and reaction time helps to maximize additional knowledge. So, mainly male sport science students of DBU know the effect of Aerobic Exercise on body balance, flexibility and reaction time. From this understanding the researcher was motivated to contribute her own finding on the effect of aerobic exercise on selected motor fitness variables. Moreover, this study was also expected to give basis or hint for future investigation to any interested researcher in this area.

1.5. Objective of the study

1.5.1. General objective

- The general objective of this study was to investigate the effect of aerobic exercise on selected Motor Fitness Variables of male sport science students of DBU.

1.5.2. Specific objectives

1. To assess effect of aerobic exercise on balance of male sport science students of DBU.
2. To explore the significant effect of aerobic exercise on flexibility of male sport science students of DBU.
3. To find out the effect of aerobic exercise on reaction time of male sport science students of DBU.

4. REVIEW OF RELATED LITERATURE

This section discussed on Motor fitness, components of Motor fitness, Motor fitness variable tests, aerobic exercise, the history and development of aerobic exercise, the type of aerobic exercise, the effect of aerobic exercise on reaction time, balance and flexibility and general principle and dosage of training.

2.1. Motor fitness

The term motor fitness is most often used synonymously with physical fitness by the coaches but it is very important for the physical education students to understand the basic difference between physical fitness and motor fitness. Physical fitness is used to denote only the five basic fitness components (muscular strength, muscular endurance, cardiovascular endurance, body composition and flexibility), whereas motor fitness is a more comprehensive term, which includes all the eleven fitness components including additional six motor performance components (power, speed, agility, balance, coordination and reaction time), important mainly for success in sports. In other word, motor fitness refers to the efficiency of basic movements in additional to the physical fitness (Kansal, 1996).

Motor fitness was also developed to describe a broad concept than physical fitness. This extensive term means the ability to perform basic motor skills efficiently and effectively. Motor fitness is an important component for an athlete in order to obtain optimal performance in sports. The level of motor abilities components is of prime importance for learning of various activities and perfection of different skills. Traditionally motor abilities have been viewed as a combination of factors that are basic to all moments. All the factors of motor ability are chiefly concerned with the ability of the athletes' and their capacity of action. The level of motor ability is the prime importance for learning various general activities and perfection of different skills in various sports and physical activities. Motor fitness might be referred as an efficient performance in such basic requirements as running, jumping, dodging, climbing, swimming with sustained efforts in variety of situation and therefore, would involve such element as power, agility, speed, balance. "Motor fitness is the final criterion through

which all other elements of physical fitness or total fitness are seen and measured in man. Importance of motor fitness can be described in these words that “motor fitness and competitive performance go hand in hand with athleticism” (Filipcic *et al.*, 2010). Motor Fitness is the ability to perform complex muscle and nerve acts that produce movement, fine motor skills are small movements like writing and tying shoes, gross motor skills are large movements like walking and kicking of ball (Raju *et al.*, 2016).

2.2. Motor Fitness Components

Motor fitness is a term that describes an athlete’s ability to perform effectively during sports or other physical activity. An athlete’s motor fitness is a combination of five different health related components and six components of motor skills related to fitness, each of which is essential for high levels of performance.

Student of sport science expected to perform numerous actions that require strength, power, speed, agility, balance, stability, flexibility and endurance (Bloomfield *et al.*, 2007; Gorostiaga *et al.*, 2004; Helgerud *et al.*, 2001).

2.2.1. Speed

According to Bhupinder (2013) speed is designed as capacity of individual to perform successive movements of the same pattern at a faster rate". It is also designed as the rate of change of position mean the ratio of distance travelled and the elapsed time. Speed directly influences the capacity of foot ball player to exert the maximum force in the shortest possible time. Speed is the ability to perform a movement within a short period of time. Speed training is an important component of physical fitness which enables athlete to move from one point to another, athlete needs to work on acceleration, starting ability, stride rate, speed endurance, and stride length (Neiman, 1995).

Running speed is not only an athletic event itself, but it is an important factor in almost all court and field games like football it can result the difference in whether a performer is able to gain an advantage over his/her opponent. It is determined by the length and frequency (speed) of strides and mostly dependent upon speed of muscular and neuromuscular coordination. (Nabhendra Singh, 2010)

2.2.2. Power

It is a capacity to release the maximum force in shortest time quickly. A power player is not only strong but generates the force quickly. The power is also known as strength ability of the athletes. The athletes also used to have full strength throughout their body muscles of both lower and upper extremities. Power is the individual capacity to exert maximal muscular force to perform a specific job. It is the ability to activate maximal muscle fibers for forceful contraction. Muscular power, often referred to as explosive power, is a combination of speed and strength an important in vigorous performance because it determines how hard a person can hit, jump and push etc. There are various means's and methods to increase power in football by increasing strength without sacrificing speed, by increasing speed of movement without sacrificing strength and by increasing both can be stressed by applying strong force through rapid motion. (Nabhendra Singh, 2010)

2.2.3. Muscular Endurance

This is ability to use localized muscle groups of wrist, forearm, shoulder and leg. Endurance is the result of physical capacity of an individual to sustain movement over a long group and muscles can exert against a resistance for a prolonged period. Muscular endurance is the ability of a muscle or muscle group to repeat a movement many times or to hold a particular position for an extended period of time. Muscular endurance is defined as the ability to maintain sub-maximal muscle actions (Willardson, 2008). Be careful not to confuse muscular endurance with muscular strength. While they can work together, they are definitely not the same. For many athletes, there may be a need to distinguish between muscular strength and muscular endurance. But for everyday people who want to easily perform their daily routines, are trying to stay healthy and fit, and just want to enjoy physical activities like hiking, biking, or snowboarding, muscular endurance plays a major role in fitness.

Common testing for muscular endurance can be dynamic (the ability to repeat contractions) or static (the ability to sustain a contraction). Dynamic tests would be to see how many sit-ups, for example, a person can complete in a designated amount of time (e.g. 30 seconds, a minute, or maybe longer). Or, without being timed, the person could do as many repetitions of the exercise as they could until they couldn't do anymore. An example of a static test would be the

plank exercise (core exercise like extending your back, arms, shoulders gluts and hamstring). Muscular endurance can be also improved by both aerobic and anaerobic exercises. Muscular endurance is specific in nature. For true assessment of muscular endurance it would be necessary to test each major muscle group of the body. Lab and field tests of muscular endurance are similar and are based on the number of repetitions that can be performed by the specific muscle group being tested (example: repetitions of push-ups or abdominal curls). Muscular endurance can be measured isometrically (static contractions) or isotonicly (dynamic contractions) (Willardson, 2008).

2.2.4. Flexibility

This is the ability to move the body through a wide range of position. Flexibility is defined as the degree one is able to move body thrust complete through range of motion. It is commonly described as the range of motion or movement (ROM) around a particular joint o set of joints. The range of motion is available in a joint. Flexibility is the degree to which an individual muscle will lengthen. It is affected by muscle length, joint structure, and other factors. A fit person can move the body joints through a full range of motion in work and in play (Charles R.Carbin, 1994). Flexibility is actually more important to physical fitness than people realize. Not only does flexibility play a big role in performing many daily tasks, but maintaining or even increasing your flexibility is critical to protecting your joints and keeping them healthy. In addition, being flexible contributes to improving your lower back health, reducing the appearance and effects of arthritis, and reducing muscle-tendon injuries.

Not everyone has the same flexibility or flexibility requirements. Your flexibility tells you how limber you are. And, when it comes to testing your flexibility fitness level, the sit-and-reach or shoulder flexibility test is most often used. Stretching is the best way to improve flexibility. And, most fitness experts recommend a daily routine of static and dynamic stretches for each joint. Some experts specify that flexibility requires range of motion without discomfort or pain. Flexibility is specific to each joint of the body, thus there is no general measurement of flexibility as there is for cardiovascular fitness. Flexibility is typically measured in the lab using measurement devices such as a goniometer, flexometer and in the field with test exercises such as the sit and reach, and the zipper.

2.2.5. Agility

It is an ability to change direction accurately and quickly while moving rapidly. Flexibility and agility are considered one's ability to change direction of the body or body parts swiftly and accurately. It is functional capacity of joints to move through a full range of movement. The ability to perform a series of explosive power movements in rapid succession in opposing directions (e.g. Zigzag running or cutting movements) The ability to rapidly and accurately change the direction of the movement of the entire body in space (Charles R. Carbin, 1994).

Agility is the ability to change the direction of body or its parts rapidly' is dependent on strength, reaction time, speed of movement and muscular coordination. Quick start and stops and quick changes in direction are fundamental to good performance in athletes (Nabhendra Singh, 2010). Agility (quickness) is "the ability to read and react to a situation; it is a multi-directional skill that combines explosiveness, reactivity, and acceleration" (Brown, Woodman & Yap, 2000).

2.2.6. Reaction Time

Reaction time is the taken time between the initial perception of the stimulus and the athlete's first muscular movement in response. The time interval between the presentation of stimulus and the initiation of response running and the time elapsed between stimulation and the beginning of reaction to that stimulation (Charles R Carbin, (1994). Reaction time study is an important method used for central information processing speed and fast coordinated peripheral movement response. It is extremely important in all performances, requiring quick response. It has special significance in events in which an individual depends on each other and thereby respond to each other's movement (Nabhendra Singh, 2010). Reaction time, defined as being the time between the application of a stimulus and the beginning of an organism's response to it, has been shown to be a valid indicator of the central nervous system's ability to receive and synchronize movement expressed through the peripheral nervous system. Reaction time has been widely studied, as its practical implications may be of great consequence, many factors have been shown to affect reaction times, including age, gender, physical fitness, fatigue, distraction, alcohol, personality type, and whether the stimulus is auditory or visual (Garg *et al.*, 2013).

2.2.7. Balance

Balance is the ability to keep the body's center of gravity over the base of support while completing various motor skills (Humphriss R et al., 2011). The ability to control the body's position either, stationary or while moving e.g. gymnastics stunt and handstand. Balance is typically defined as the ability to sustain or return the body's center of gravity (COG) over its base of support. Balance is thought to be of great significance as it is an integral part of all movements. It can be defined as the ability to maintain or recover the body's centre of mass within the body's base of support to prevent falling and complete the required movements and it is usually divided into two basic components: the static and dynamic. Static balance is the ability to maintain a posture in a resting position, while dynamic balance is the ability to maintain postural control during the performance of functional tasks (Farid et al., 2014). For sport science student dynamic balance is very important. Balance is involved to some degree with all motor performances and some performances heavily depend upon balance. Dynamic and stable both are of great importance in all sports such as sports and games athletics, football, Soccer, baseball and hockey. (Nabhendra Singh, 2010)

2.2.8. Co-ordination

The ability to use the senses with the body parts to perform motor tasks smoothly and accurately, (Charles R.Carbin, 1994). Coordination refers to a person's ability to perform complex movements due to the working together of the nervous system and the muscles of the body. This is also referred to as a person's ability to do two things at the same time. Coordinative abilities are relatively stabilized and generalized patterns of motor control and regulation processes that enable athletes' to do a group of movements with better quality and effect (Brétigny et al., 2011).

2.2.9. Cardio-respiratory Endurance

Cardio respiratory endurance is the ability to exercise your entire body for a long time without stopping. It requires a strong heart, healthy lungs, and clear blood vessels to supply your large muscles with oxygen. Examples of activities that require good cardio respiratory endurance are distance running, swimming, and cross-country skiing. Cardio respiratory endurance is sometimes referred to by other names, including cardiovascular fitness, cardiovascular endurance, and cardio

respiratory fitness. The term aerobic capacity is also used to describe good cardio respiratory function, but it is not exactly the same as cardio respiratory endurance. Cardio-respiratory endurance is closely connected with lung, heart and muscle functions. A good level of aerobic capacity determines high economic and energetic processes (Gorner et al., 2009).

The first word in the term is cardio respiratory because two vital systems are involved. Your cardiovascular system is made up of your heart, blood vessels, and blood. Your respiratory system is made up of your lungs and the air passages that bring air, including oxygen, to your lungs from outside of your body. In your lungs, oxygen enters your blood, and carbon dioxide is eliminated. The cardiovascular and respiratory systems work together to bring your muscle cells and other body cells the materials they need and to rid the cells of waste. Together, the two systems help you function both effectively and efficiently (with the least effort). Doing regular physical activity can help you look better by controlling your weight, building your muscles, and helping you develop good posture. Regular physical activity also produces changes in your body's organs, such as making your heart muscle stronger and your blood vessels healthier. These changes improve your cardio respiratory endurance and wellness.

2.2.10. Strength

Muscular strength is the ability of the body to exert force. Strength is important to every event for both men and women. Muscle fibers within the muscles respond when subjected to weight or resistance training. This response makes the muscle more efficient and able to respond better to the central nervous system. It is the amount of force your muscle can exert against resistance for short duration activities. Maximal strength is one basic quality that influences power performance in athletes. 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). Strength is specific in nature. For true assessment it would be necessary to test each major muscle group of the body. Lab and field tests are similar and involve the assessment of one repetition maximum (the maximum amount of resistance you can overcome one time). 1RM tests are typically conducted on resistance machines. Strength can also be assessed using dynamometers. Strength can be measured isometrically (static contractions) or isotonicly (dynamic contractions).

2.2.11. Body Composition

Body composition means a person's lean body tissue and fat body tissue. It is calculated by, BMI equals to athletes weight divided by height square. Loss of body fat in middle-aged men was in the range of 1–3 kg following 3 months of training, corresponding to a reduction in fat percentage of 1–3%. Specifically, fat mass was lowered by 1.8 kg in young and middle-aged men playing street exercise for 45 min two to three times a week for 12 weeks (Bangsbo, et al., 2006). Body composition is a better indicator of your overall fitness condition than body weight. So understand that your total body weight or what you see on your bathroom scale does not tell you how much fat or lean body mass (muscle) you have. Body composition is useful in helping to determine health risks. Therefore, knowing your body composition and how it relates to your overall fitness level is essential. An optimal ratio of fat mass to lean mass is a clear indicator of good fitness. Your body composition is a consequence of the extent that you perform the other components of physical fitness. In other words, when you improve the other components, it will have a positive impact on body composition resulting in less body fat.

2.3. Motor fitness variable tests

2.3.1. Flexibility test

Sit-and-reach test- The sit and reach test is a common measure of flexibility, and specifically measures the flexibility of the lower back and hamstring muscles. This test is important as because tightness in this area is implicated in lumbar lordosis, forward pelvic tilt and lower back pain. This test was first described by Wells and Dillon in 1952 and is now widely used as a general test of flexibility. So, Flexibility is measured by the “sit-and-reach” test (Clark et al., 1989). To perform those test after a warm-up, the participants sat on the floor with their legs straight out in front of them, heels touching the side of a box. Their fingertips were positioned on the 0 cm edge of the box that was marked in centimeters towards the opposite edge. They were then asked to bend forward with arms outstretched towards their toes. The farthest test score of the three trials was recorded. The sit-and-reach test was conducted to measure flexibility of the hamstrings and lower back.

2.3.2. Muscle strength and endurance tests

1 min sit-up test- is muscle strength and endurance tests the subjects lied on their back, with their knees at right angles (90°) and feet flat on the floor. The subject was then attempted to perform one complete sit-up during 1 min. Number of performed sit ups was counted (Zorba, 2000).

Handgrip strength test – The handgrip strength of the right and left hands was evaluated using a Takei handgrip dynamometer (Takei, Tokyo, Japan). The test was performed in the standing position. The subject held the dynamometer in the hand to be tested with the arm at right angles and the elbow by the side of the body. Subject was then asked to squeeze the dynamometer with her maximum isometric effort for a 5 second period. Test was repeated 2 times with both hands. 30 second resting intervals were provided between measurements and the highest score was recorded (ACSM, 2000).

Push-up Test: Measures muscular endurance of the shoulder (deltoids, pectorals and triceps.) to perform this, test administrator places his fist on the floor below the subject's chest. Subject must keep back straight at all times. From the up position, lower her/him self to the floor until the chest touches the administrator's fist and then push back to the up position again. Subject repeats push-ups for one-minute non-stop, except in the up position. Total numbers of correct push-ups in one-minute are recorded as the score.

2.3.3. Cardiovascular Endurance tests

Aerobic Power Test: the term “aerobics” was adopted from the term “aerobic” which refers to the type of metabolism utilizing oxygen in the production of energy for the body.

The 1.5 mile run/walk test- is used to determine the efficiency of the cardio-respiratory system. To perform this test, an indoor (or outdoor) track is sued, or another suitable running area measured so that exact distances are indicated. Using a stopwatch to measure time, each participant will run/walk to the best of their ability covering enough laps of the track to measure 1.5 miles. Record each participant's time as they cross the line at 1.5 miles, each participant's time will be measured against the data tables using standard norms for the most recent Cooper Protocol and scored accordingly.

2.3.4. Aerobic fitness test

Aerobic fitness is related to a person's ability to perform dynamic, moderate-to-high intensity physical activity with large muscle groups for prolonged periods. Thus, it expresses the abilities of both cardio-respiratory and muscular systems to transport and utilize oxygen for energy. It is one of the most fundamental measures of human physiology with remarkable health, wellbeing, life quality, work ability, and performance related associations (Heyward, 2014).

Maximal oxygen uptake or consumption (VO₂max) means the maximal capacity of an individual to perform aerobic work. It is the product of cardiac output (CO) and arteriovenous oxygen (AV-O₂) difference at exhaustion, and the golden standard measure for a person's aerobic fitness (ACSM, 2010). It refers to the maximal amount of oxygen the individual can utilize typically over one minute during an intense, maximal effort.

20 m shuttle run test- VO₂max was calculated by 20 m shuttle run test was used to determine aerobic fitness level. This test involves continuous running between two lines 20m apart in time to recorded beeps. For this reason the test is also often called the 'beep' or 'bleep' test. The time between recorded beeps decrease each minute (level) (Tomkinson et al., 2003; Saygin et al., 2009).

2.3.5. Reaction time test- In 'simple reaction time' experiments, there is only one stimulus and one response. Catching a dropped stick, or hitting a button when a light changes are examples.

Reaction Time Ruler drop Test- to measure reaction time, hand-eye quickness and attentiveness is important. To perform this test the following procedures are used, The ruler is held by the assistant between the outstretched index finger and thumb of the athlete's dominant hand, so that the top of the athlete's thumb is level with the zero centimeter line on the ruler, The assistant instructs the athlete to catch the ruler as soon as possible after it has been released, The assistant will releases the ruler and the athlete catches the ruler between their index finger and thumb as quick as possible, Then the assistant is to record distance between the bottom of the ruler and the top of the athlete's thumb where the ruler has been caught. The

subjects have three attempts and the best result is recorded. To undertake this test the researcher will require Meter ruler and Assistant.

2.3.6. Balance fitness test

Stork Balance Stand Test – is used to measure the balance of the participants and to assess the ability to balance on the ball of the foot. The stork balance test requires the person to stand on one leg. The procedure for this test were put as follow, The stork balance stand test requires the subjects remove shoes, stand on one leg and place the hands on their hips, then put their other leg on the inside knee of the supporting leg. They will have 1 minute of exercising the balance, then raises on the heel and tries to keep their balance as long as they can. The stopwatch is started as the heel is raised from the floor and stopped if the subjects dose one of the following: the hands are taken from the hips, the foot that remains on the floor moves or hops in any direction, the other leg is not in contact with the knee, and the heel of the supporting leg touches the ground. The scoring board: the total time in seconds is recorded. The subjects have three attempts and the best result is recorded.

2.4. Aerobic exercise

The word aerobic literally means "with oxygen" or "in the presence of oxygen." Aerobic activity trains the heart, lungs and cardiovascular system to process and deliver oxygen more quickly and efficiently to every part of the body. As the heart muscle becomes stronger and more efficient, a larger amount of blood can be pumped with each heartbeat. As a result, a fit individual can work longer, more vigorously and achieve a quicker recovery at the end of the aerobic session. Aerobic exercise is any physical activity that makes you sweat, causes you to breathe harder, and gets your heart beating faster than at rest. It strengthens your heart and lungs and trains your cardiovascular system to manage and deliver oxygen more quickly and efficiently throughout your body. Aerobic exercise uses your large muscle groups, is rhythmic in nature, and can be maintained continuously for at least 10minutes.

(http://www.emedicinehealth.com/aerobic_exercise/article_em.ht, 2013).

Aerobic exercise includes any type of exercise, typically those performed at moderate levels of intensity for extended periods of time that maintains an increased heart rate. Aerobic exercise

refers to exercise of moderate intensity which is undertaken for a long duration and refers to the use of oxygen in a muscle's energy generating process that helps to develop football player's ability to perform training for long duration without fatigue. An effective aerobic exercise should involve 5-10 minutes of warming up at an intensity of 50-60% of maximum heart rate, followed by at least 20 minutes of exercise at an intensity of 70- 80% of maximum heart rate, ending with 5- 10 minutes of cooling down at an intensity of 50-60% of maximum heart rate. Our study findings indicate that using 30 minutes of regular aerobic exercises in gymnasium improved reaction time (Monika et al., 2013).

2.5. History and development of aerobic exercise

In 1968 American physician Kenneth Cooper coined the term aerobics in his exercise book "Aerobics". Cooper explains that aerobics are "the foundation exercises on which any exercise program should be built. These exercises demand oxygen without producing an intolerable oxygen debt, so that they can be continued for long periods. They activate the training effect and start producing all those wonderful changes in your body." Cooper openly admits that his were not the first assertions in this direction. In his book, he describes the Pack Test, developed in the early 1940s for testing military personnel. Similar tests followed, such as the Harvard Step Test and Master's Two-Step Test. All of these tests were applied in an attempt to obtain and compare recovery heart rate values after soldiers performed exertion. But he used the term to describe aerobic exercises that "use oxygen to keep large muscle groups moving continuously for at least 20 minutes". Based on this definition, the name aerobics came to refer to calisthenics taught to music. Americans Judi Sheppard Missett and Jacki Sorensen were two early aerobics pioneers. They created early forms of dance-based routines that became the basis of group fitness classes. Americans Jane Fonda and Richard Simmons helped popularize aerobics in the United States during the 1980s through instructional videotapes and television programs. The impact of aerobic dance has been enormous: this is an organized activity which did not exist before the early 1970s, and which is embraced by millions of people, especially women, many of whom had never exercised regularly before. It also provides people the opportunity to participate in a group physical activity outside of the narrow realm of high school and college sports (Microsoft Encarta Encyclopedia Deluxe 2003). Aerobic exercises include walking (at a speed less than 8 minutes per mile), which requires little in the way of equipment and can be performed by people of all ages,

jogging/running (speed between 8 to 12 minutes per mile), jumping rope, or some kinds of ball-games (such as football, basketball, handball and etc.). All these forms of aerobic exercise combine running with hand-eye or foot-eye coordination skills. Ball-games add a slight anaerobic benefit to the aerobic benefits of running, since there is some minor muscular resistance in each sport, such as shooting or kicking the ball (Microsoft Encarta Encyclopedia Deluxe, 2003).

2.6. Types of Aerobic Exercise

Any activity that uses large muscle groups, can be maintained continuously, and is rhythmical in nature can be regarded as an aerobic exercise. In general, aerobic exercises requiring little skill to perform are more commonly recommended for all adults to improve fitness. Aerobic exercises that require minimal skills and can be easily modified to accommodate individual physical fitness levels include brisk walking, leisure cycling, swimming, aqua-aerobics and slow dancing. Aerobic exercises that are typically performed at a higher intensity and, therefore, are recommended for persons who exercise regularly include jogging, running, aerobics, stepping exercise, fast dancing and elliptical exercise.

2.7. The effect of aerobic exercise on reaction time, balance and flexibility

Reaction time (RT) is a reliable indicator of the speed of processing of sensory stimulus by central nervous system and its execution in the form of motor response. RT is defined as the time lapse between the onset of a stimulus and the initiation of a movement response and aerobic exercise helps to develop reaction time (Aley et al, 2007). Several studies have shown that physical exercise like aerobic exercise improve and protect the cerebral function, suggesting that physically active individuals have better cognitive function and are at a lower risk to develop mental disorder compared to individuals with sedentary life style (Autunes HKM et al ., 2006).

Zakas. A (2003) proved that warming up exercises increases the flexibility markedly in lower extremity and trunk. To attain an excellent degree of trunk flexibility along with shoulder and knee joints we should put the athletes to an exercise schedule comprising of light warm up rounds followed by static and dynamic stretching exercises. This will help them attain the

desired flexibility and prevent the muscle and tendon injuries. Coordinative abilities (dexterity) rely on the movement control and regulation processes, and they are fundamental in sports, as they allow athletes to easily control their own motor actions. Moreover, they allow the learning of complex movements in a relatively rapid way. One of the main components of coordinative abilities is balance. Postural control (or balance) can be defined statically as the ability to maintain a base of support with minimal movement, and dynamically as the ability to perform a task while maintaining a stable position (Winter et al., 1990). Some literature evidence suggests that a superior balance among experienced athletes is the result of repetitive training experiences through aerobic exercise that influence motor responses (Balter et al., 2004); others argue that superior balance is the result of training experience influencing a person's ability to attend to relevant proprioceptive and visual cues (Ashton-Miller et al., 2001). Balance refers to maintaining one's equilibrium while the body is either moving or stationary (Hopson JL *et al.*, 2013). Furthermore, balance is dependent on neural input from auditory, visual, sensory, and motor processes and involves both motor skills and movement patterns (Stevens-Smith D, 2006). Moreover, flexibility allows joints to move through a full range of motion (Powers SK *et al.*, 2014). Measuring flexibility and balance in students at any grade level is beneficial.

Contradicted issues in previous study

The studies that have looked at the connection of cognitive and reaction time have tested the reaction times of subjects following different types of physical activities. Reaction time, defined as being the time between the application of a stimulus and the beginning of an organism's response to it, has been shown to be a valid indicator of the central nervous system's ability to receive and synchronize movement expressed through the peripheral nervous system (Garg *et al.*, 2013). Current studies that have explored this have contradicting results due to an array of inconsistent methods and strategies of measuring reaction time. Other study was also contradicted with a few studies which have reported that exercise i.e. aerobic exercise does not lead to significantly decrease in reaction time, mainly McMorris T *et al* (2000) and Pesce C *et al* (2007) found that aerobic exercise have no effect on reaction time of athletes.

Recently, a number of studies suggest that aerobic exercise like static stretching has no significant effect or cannot improve performance of flexibility or balance of athletes (Dalrymple et al., 2010).

2.8. General principle and Dosage of training

The dosage of aerobic exercise is a function of the frequency (F), intensity (I) and duration (time, T) of the exercise performed. In combination with the type (T) of exercise performed, these factors constitute the basic components of the core principle of exercise prescription (the FITT principle). Three exercise intensity domains have been identified through the kinetics of the pulmonary oxygen consumption and the response of the blood lactate concentration during exercises of constant load, namely: moderate, heavy and severe (Xu and Rodhes , 1999) . The moderate domain corresponds to all the exercise intensities which can be performed without alteration of blood lactate concerning the rest values; that is, below the lactate threshold. The heavy domain starts from the lowest intensity at which blood lactate increases and has as highest threshold the critical power (Xu and Rodhes , 1999). The severe domain is characterized for the reach of the maximal oxygen consumption, being limited between the critical power and the exercise intensity which allows minimal time to VO₂max acquisition (Caputo and Denadai, 2008). The determination of the exercise intensity domains has important implications in the prescription of aerobic training and design of experimental outlines, since it makes better acute individualization of the physiological responses possible and possibly better correlation between the stress level and expected adaptation (Greco *et al.*, 2008, Vanhatalo *et al.*, 2011).

Since the practical application often provides the greatest challenge to personal trainers, the NSCA was developed to bridge that gap, helping personal trainers efficiently and effectively design training programs based on scientific principles, specific to the individual needs of their clients. While there are general training principles that apply to everyone, there are a number of factors that affect program design and client motivation. Regardless, programs should adhere to the principles put forth by the NSCA. These principles according to Haff G. H (2012) are:

1. Specificity (individuality)

Designing training programs/workouts with a specific goal in mind based on each client's individual needs. Specificity in training can be accomplished by targeting muscle groups, energy systems, speed of movement, movement patterns, and/or muscle action types. For example, strength training has little effect on endurance. Conversely, endurance training activates aerobic pathways, with little effect on speed or strength. Even so, a well-rounded training programme should contain a variety of elements (aerobic, anaerobic, speed, strength, flexibility), and involve all of the major muscle groups in order to prevent imbalances and avoid injuries. Each athlete will respond differently to the same training stimulus. There are many factors that alter the training response: genetics, maturity, nutrition, prior training, environment, sleep, rest, stress, illness or injury, and motivation, to name a few.

2. Overload

The training stress (based on frequency, intensity, and type of exercise as well as recovery processes) placed on a client should exceed the training stress experienced during the previous workout. This is accomplished by increasing the load, sets, reps, or by decreasing the rest periods.

3. Progression

Similar to overload, progression (or progressive overload) refers to the systematic modification of a training program over time. In addition to exercise intensity, progression also refers to frequency and increasing the difficulty of exercise selection (advancement from low-skill to high-skill exercises). Exercises are progressed on an individual basis rather than a pre-determined schedule, based on a client's ability and speed of adaptation. Biological systems can adapt to loads that are higher than the demands of normal daily activity. Training loads must be increased gradually, however, to allow the body to adapt and to avoid injury (system failure due to overloading). Varying the type, volume, and intensity of the training load allows the body an opportunity to recover, and to over-compensate. Loading must continue to increase incrementally as adaptation occurs, otherwise the training effect will plateau and further improvement will not occur.

4. Variation and Recovery

Variation is considered planned variety in exercise selection and training variables. Keeping in line with these principles, the FFP provides a recommended (linear periodization) training sequence that consists of muscular endurance, hypertrophy, strength, and power phases for relatively untrained through advanced clients. While other periodization models exist, a linear model is suggested for beginners. Muscle groups adapt to a specific training stimulus in about three weeks and then plateau. Variations in training and periods of recovery are needed to continue progressive loading, without the risks of injury and/or overtraining. Training sessions should alternate between heavy, light, and moderate in order to permit recovery. The content of training programmes must also vary in order to prevent boredom and “staleness”.

5. Adaptation

Adaptations to the demands of training occur gradually, over long periods of time. Efforts to accelerate the process may lead to injury, illness, or “overtraining. Many adaptive changes reverse when training ceases. Conversely, an inadequate training load will not provide an adequate stimulus, and a compensatory response will not occur.

6. Reversibility

A regular training stimulus is required in order for adaptation to occur and to be maintained. Without suitable, repeated bouts of training, fitness levels remain low or regress or return to their pre-training levels or former state.

3. MATERIALS AND METHODS

In this chapter the description of the study area that shows where the study was conducted and where the study area was located and the general feature of the study area was explained. The study design which shows the number of participants, the experiment period, the parameters were studied and the exercises and tests were used also discussed. The definition of terms, source of study population, the sample and sampling techniques, the inclusion and exclusion criteria of the study participants are described. Although, the source of data, the method and procedures in which the researcher used to collect data, the motor fitness test analysis, the data quality control and the protocol and ethical considerations were also included.

3.1. Description 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 was an early capital of Ethiopia and afterwards, with Ankober and Angolalla, was one of the capitals of the kingdom of Shewa. Today, it is the administrative center of the Semien Shewa Zone of the Amhara Region. Debre Berhan city is one of the coolest city which is found at sub tropical zone of Ethiopia. The average annual temperature of the city during day and night hour is 17.8°C and 8.83°C respectively with precipitation 66.17mm.

(https://www.meteoblu.com/en/weather/forecast/modelclimate/debrebirhan_ethiopia_339734)

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. The majority of the inhabitants practiced Ethiopian Orthodox Christianity, with 94.12% reporting that as their religion, while 3.32% of the populations are Muslim and 2.15% are Protestants. Debre Berhan University (DBU) is one of thirteen new Universities which were established in 1999 E.C (2007GC) by the Ethiopian government. 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 128km and 622.3 km from Addis Ababa and Harer

respectively. The altitude in the campus is 2830 meter above sea level with a mean annual temperature of 14.84°C (FAO, 2006). Debre Birhan University (DBU) offers courses and programs leading to officially recognized higher education degrees such as bachelor degrees in several areas of studys. DBU also provides several academic and non-academic facilities and services to students including a library, as well as administrative services. (The map of study site placed on page 61. appendix VIII)

3.2. Definition of Terms

- ❖ **Aerobic** – means oxygen or in the presence of oxygen (Wolach and Harold, 2000).
- ❖ **Aerobic exercise**- Aerobic exercises are any activity that uses large muscle groups can be maintained continuously for long period of time (Wolach and Harold, 2000).
- ❖ **Dependent variables**- Flexibility, Balance and Reaction time
- ❖ **Exercise**- is an activity that are planned and structured, and has been known to improve mood, motor function, and cognitive processing (Mayo Clinic, 2014).
- ❖ **Independent variable** – Aerobic exercise
- ❖ **Motor fitness**- is the ability to perform complex muscle and nerve acts that produce movement (Raju *et al.*, 2016).
- ❖ **Sport**- physical activity that involves competition, scorekeeping, rules, and an outcome that cannot be predetermined.
- ❖ **Sport science**- is a discipline that studies how the healthy human body works during exercise, and how sport and physical activity promote health from cellular to whole body perspectives ([https://en.m.wikipedia.org>wiki>sport...](https://en.m.wikipedia.org/wiki/sport...))

3.3. The Study Design

The research was aimed to investigate the effect of aerobic exercise on selected motor fitness variables of male sport science students of Debre Birhan University. The study was followed pre-post test experimental study design with control group. For this study 60 male sport science students with age of 19-25 years were selected from Debre Birhan University sport science department after completed the health status questionnaire. The samples were selected by random sampling method and divided into 2 groups i.e. control and experimental groups, each group consisting of 30 subjects, whereas their sex and the study place in relation with their department were selected by purposive sampling.

The experimental group underwent twelve weeks aerobic exercise program, three days per week and the duration was 60 minutes while, the control group continued with their regular activities. This study was used pre, during and post test result, Pre-post test is the preferred method to compare participant groups and measure the degree of change occurring as a result of exercise or interventions and during test helps to know the progress of the training. The motor fitness variables selected as dependent variable for this study were balance, flexibility and reaction time. Aerobic exercise was selected as independent variable.

3.4. Sources of Data

The researcher used primary sources of data. The researcher obtained primary source of data by collecting a data through the administration of experimental process (recording pre, during and post test results) to the sample taken from Debre Birhan University male sport science students.

3.5. Study Population

Since the researcher was interested to conducted research on male students, the study population was under graduate male sport science student of Debre Birhan University from first to third year. The total population of sport science students from first year to third year in Debre Birhan University was 225. However, male sport science students from all batches were 111 in number and the age of the selected sample for this study were ranging from 19-25 years old.

3.6. Sample Size and Sampling Technique

Simple random sampling technique was used to select subjects as well as to assign subjects for control and experimental groups, while purposive sampling was used to select the samples sex and the study place in relation with their department. Eighty seven (87) male sport science students of DBU were filled the health status questionnaire while selecting by random sampling technique. The questionnaire was prepared with the aim of identifying subjects who are free from any known cardiovascular disease, smoking, taking regular medication or psychiatric disorder and any recent physical injury. Hence, the subjects' health statuses was

used as one of study subject's selection criteria, Twenty Seven (27) male sport science students were eliminated from the study because of the factors mentioned above. Finally, Sixty (60) subjects were participated on this study and assigned in to two groups equally by using random sampling technique. The sample size which was taken from total population for this study was calculated by slovins formula ($n = N / (1 + Ne^2)$) where, n = sample size, N = total population and e = significance difference or $P\text{-value} \leq 0.05$.

3.7. Inclusion and Exclusion Criteria

All of the selected male sport science students of Debre Birhan University with the age of 19-25 years were included as the study subjects after completing their health history and fitness status questionnaire that helped the researcher to obtain information about the health status and readiness for physical activity of the subjects participating in the study (ASCM, 1997). Subjects with any known cardiovascular disease, smokers, taking regular medication or psychiatric disorder and also any recent physical injury were excluded from experimental trial. Subjects with age above 25 and below 19 were also excluded from this study.

3.8. Methods and Procedure of Data Collection

3.8.1. Method of data collection

Quantitative data were collected through the appropriate Motor Fitness test measures like sit and reach test to measure flexibility, Stork Balance Stand Test to measure balance and Ruler drop test to measure reaction time after giving aerobic training for about 12 consecutive weeks to male sport science students of Debre Birhan University. The data were recorded by the investigator with the help of assistant data recorder. The appropriate aerobic training workouts were given by the researcher.

3.8.2. Procedure of data collection

First, the researcher obtained ethical clearance from Haramaya University and communicated the participants of the study, during the familiarization session participants were informed of all procedures and familiarized with all performance measures to reduce the possibility of a learning effect. Then, before the participants are going to aerobic exercise the pre motor fitness variables test was given to them, recorded by the researcher and the assistant data recorder at the same time of day for each subject and during training tests were recorded on the end of 6th week, lastly post tests were recorded after 12weeks.

3.9. Fitness Test Procedure (Protocol)

The following fitness tests as the parameter of motor fitness variables were recorded for pre-test, during and post-tests of the study.

Sit and reach test- This test is designed to test the flexibility of the lower back and hamstring muscles. In preparation for this test, warm up session was set for 5–10 minutes, using low-intensity aerobic activity, and then stretching hamstrings and lower back. To perform this test the researcher followed the following procedures;

To standardize the measurement scale of SRT, a standard meter rule was placed on the sit-and-reach box for each test, with the reading of 23 cm in line with the heel position of each test. Reaches short of the toes were recorded as negative forward reach scores, and reaches beyond the toes were recorded as positive forward reach scores. The forward reach scores were recorded in centimeters to the nearest 0.5 cm using the scale on the box. Subjects remove their shoes and sat with their feet approximately hip-wide against the testing box. They kept their knees extended and placed the right hand over the left, and slowly reached forward as far as they could by sliding their hands along the measuring board. They perform the test 3 times and the researcher record the best measurement (Pedro et al., 2009).

Stork Balance Stand Test – is used to measure the balance of the subjects. The procedure for this test put as follow, The stork balance stand test requires the subjects to remove shoes, stand on one leg and place the hands on their hips, then put their other leg on the inside knee of the supporting leg. They will have 1 minute of exercising the balance, then stand on the heel and tries to keep their balance as long as they can. The stopwatch is started as the heel is

raised from the floor and stopped if the subjects did one of the following: the hands are taken from the hips, the foot that remains on the floor moves or hops in any direction, the other leg is not in contact with the knee, and the heel of the supporting leg touches the ground. The scoring board: the total time in seconds is recorded. The subjects have three attempts and the best result is recorded. Flat and non-slip surface, stopwatch, paper and pencil are materials needed to perform this test.

Ruler Drop Test – The reaction time increases proportionally to the number of possible responses until a point at which the response time remains constant despite the increases in possible responses (Hick's Law).

Ruler drop test helps to monitor the athletes' reaction time. To perform this test the following procedures are used, The ruler is held by the assistant between the outstretched index finger and thumb of the athlete's dominant hand, so that the top of the athlete's thumb is level with the zero centimeter line on the ruler, The assistant instructs the athlete to catch the ruler as soon as possible after it has been released, The assistant will releases the ruler and the athlete catches the ruler between their index finger and thumb as quick as possible, Then the assistant is to record distance between the bottom of the ruler and the top of the athlete's thumb where the ruler has been caught. The subjects have three attempts and the best result is recorded. To undertake this test the researcher required measuring tape Metric ruler and Assistant.

The time (t) it took for the ruler to fall can be calculated from the distance it fell. Distance (d) fallen can be converted to time (t) passed with the following formula: $d \text{ (in cm)} = (1/2)(980 \text{ cm/sec}^2)t^2$, $t^2 = d/(490 \text{ cm/sec}^2)$, $t = \sqrt{d/(1/2g)}$ i.e. $t = \sqrt{d/(490 \text{ cm/sec}^2)}$ (980 cm/sec² is the acceleration of a falling mass on Earth. Since we know how fast an object falls, we can figure out how long it took to fall a measured distance)

3.10. Methods of Data Analysis

The data were collected through motor fitness assessment tests. After that the data were coded and organized for analysis. The coded data were analyzed by using Statistical Package for Social Science version 20.0 and paired sample T-test to summarize the change. Level of significance was < 0.05%.

3.11. Data Quality Control

To ensure quality of the data of balance, flexibility and reaction time, the selected standardized fitness test was used with appropriate tools. To reduce the mistakes which can be occurred during data collection and to collect the appropriate data the assistant fitness test recorder was trained among technical assistants of sport science department of DBU.

3.12. Ethical Issue

The study was conducted in such way that ethical issues were properly addressed. Privacy of the participants protected and confidentiality was strictly observed and maintained throughout the study. Generally this research was conducted based on the research ethics of Haramaya University and the protocol was approved by the university guidelines. The participants were informed earlier with a written consent/ agreement letter.

4. RESULTS AND DISCUSSION

4.1. Overview

In this chapter, the results of the study were presented and discussed in detail to address the objectives of the research. The research was aimed to examine the Effect of 12week Aerobic Exercise on Selected Motor Fitness Variables in Case of Male Sport Science Students of Debre Birhan University. To achieve the purpose of these study 60 male students from Debre Birhan University sport science department were selected as study subjects and their age was 19-25 years. The study subjects were selected in Debre Birhan University sport science department from first to third year. The participants were engaged in a designed aerobic exercise program for 12weeks and 3 days per week for 60 minutes. In this study, Motor fitness tests were taken three times at before the start of the experiment (Pre), at the 6th month (during) and at the end of 12 week (Post exercise test). Under this, three motor fitness variables such as balance, reaction time and flexibility had been evaluated by stork balance stand test, ruler drop test and sit and reach tests respectively. The collected data were analyzed by paired sample t-test using SPSS version 20. The results of those variables are discussed below in the tables and figures.

4.2. Demographic Characteristics of the Study Subjects

A total of 60 Male Sport Science Students of Debre Birhan University were selected as study subjects and divided in to two groups, 30 experimental and 30 control groups. From the total number of the study subjects; no one was lost. 100% of the experimental study subjects were followed up the training program properly from initial till end.

4.3. Sit and Reach test results and discussions

Table 1: Mean and standard deviation values of Sit and Reach test results of the study subjects (centimeter).

Group	N	Variables	Pre test	During test	Post test
EG	30	SRT	47.80±2.92	53.27±2.24	59.34±1.24
CG	30	SRT	46.034±2.06	46.167±2.12	46.07±2.48

Values (mean + SD), SRT: Sit and reach test, EG: Experimental group, CG: Control group

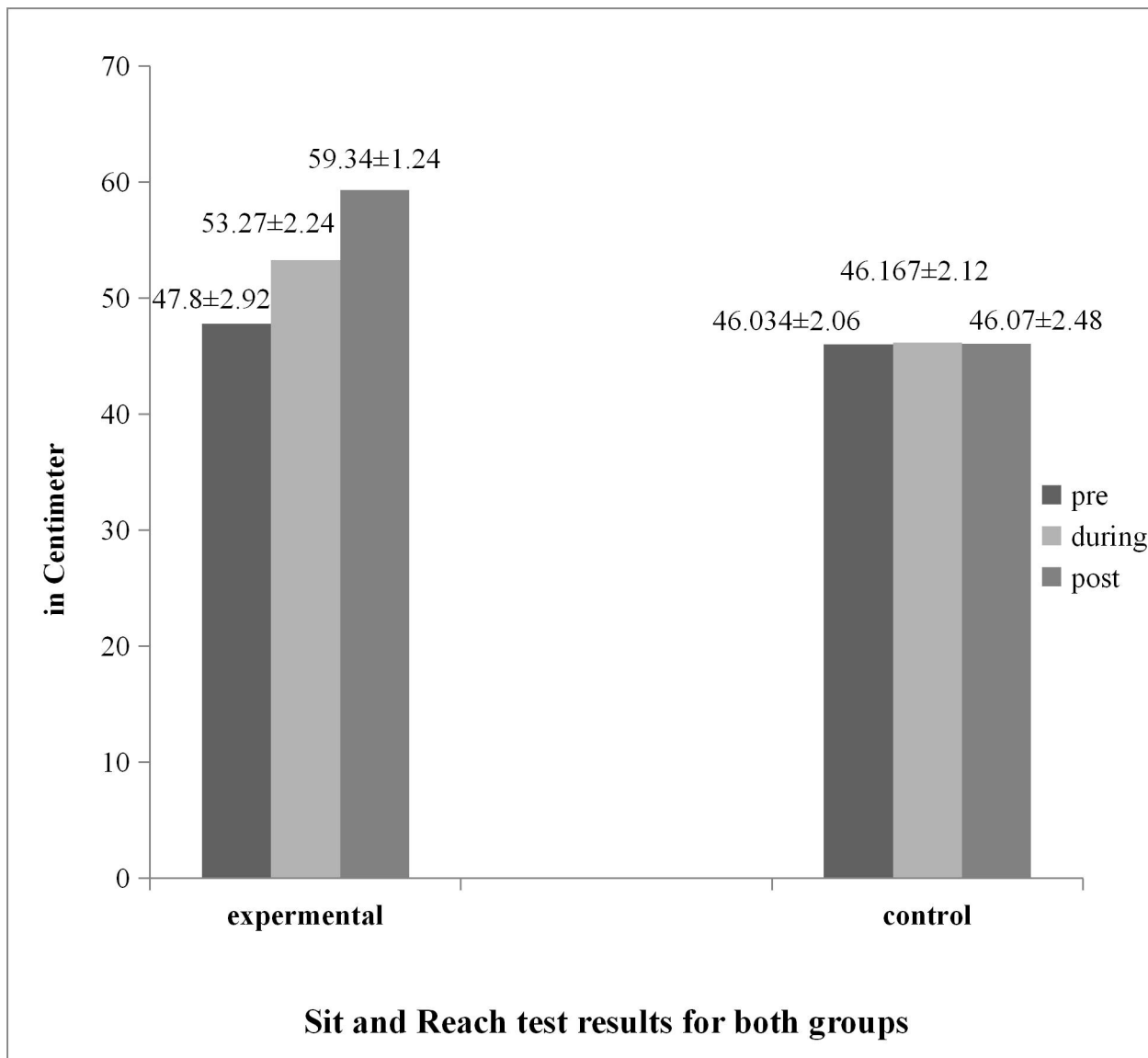
As the above table showed there was significant difference observed between pre test and post test results on the experimental group rather than control group in flexibility of the study subjects. Thus, as its indicated on the table the average value of flexibility was significantly increase for the experimental group after twelve week aerobic exercise training, The mean value of flexibility for experimental group was 47.80 ± 2.92 before they underwent to the aerobic exercise and 59.34 ± 1.24 after 12 week aerobic exercise training when compared to mean value of flexibility for control group 46.034 ± 2.06 and 46.07 ± 2.48 which was taken as pre and post test result respectively with the mean value difference were considered statically significant at $p < 0.05$. So from the above table we can say that there is significance change in flexibility of post test result on experimental group due to 12week aerobic exercise. However, in the control group there was not significant change as we can observe in the table. Hence, based on this result 12 week aerobic exercise have a positive effect on flexibility of male sport science student of DBU that means the null hypothesis was rejected while the alternative hypothesis accepted.

Zakas. A (2003) proved that aerobic exercise like warming up exercises increases the flexibility markedly in lower extremity and trunk. To attain an excellent degree of trunk flexibility along with shoulder and knee joints we should put the athletes to an exercise schedule comprising of light warm up rounds followed by static and dynamic aerobic stretching exercises. This will help them attain the desired flexibility and prevent the muscle and tendon injuries. Research also suggests that aerobic exercise like static stretching is viable options for increasing range of motion or flexibility (Mojock *et al.*, 2011). This finding also agreed with the finding of Odiango *et al.*, (2010) on effect of physical exercise program on health -related fitness components (cardio respiratory endurance, low back flexibility and body composition) of physically challenged pupils also reported similar results reported in this study.

The Sit and Reach test result was compared with an international Stork Sit and Reach test result among similar age groups that range from 19 to 29 years (ACSM, 2008).The international Sit and Reach test result is >50 for this age groups while the Sit and Reach test result Test mean value result of this study for experimental group was 59.34. Hence, the study result has fallen in excellent standard (norms found on Appendix VI).

As a result, improvement of the rate of this data was one indicator of the enhancement of the participant's range of motion in the joints (flexibility). The reason behind this change was aerobic exercise training that they were participating in well designed training program.

Figure 1: Showing the mean comparison of Sit and Reach test results of the study subjects among pre, during and post tests.



The above figure clearly showed that there was a significant difference observed between pre test and post test results on the experimental group rather than control group in flexibility of the study subjects.

4.4. Ruler Drop Test results and discussions

Table 2: Mean and standard deviation values of Ruler Drop Test results of the study subjects (second).

Group	N	Variables	Pre test	During test	Post test
EG	30	RDT	.158±.0126	.135±.0155	.110±.0201
CG	30		.158±.0149	.159±.0169	.157±.0165

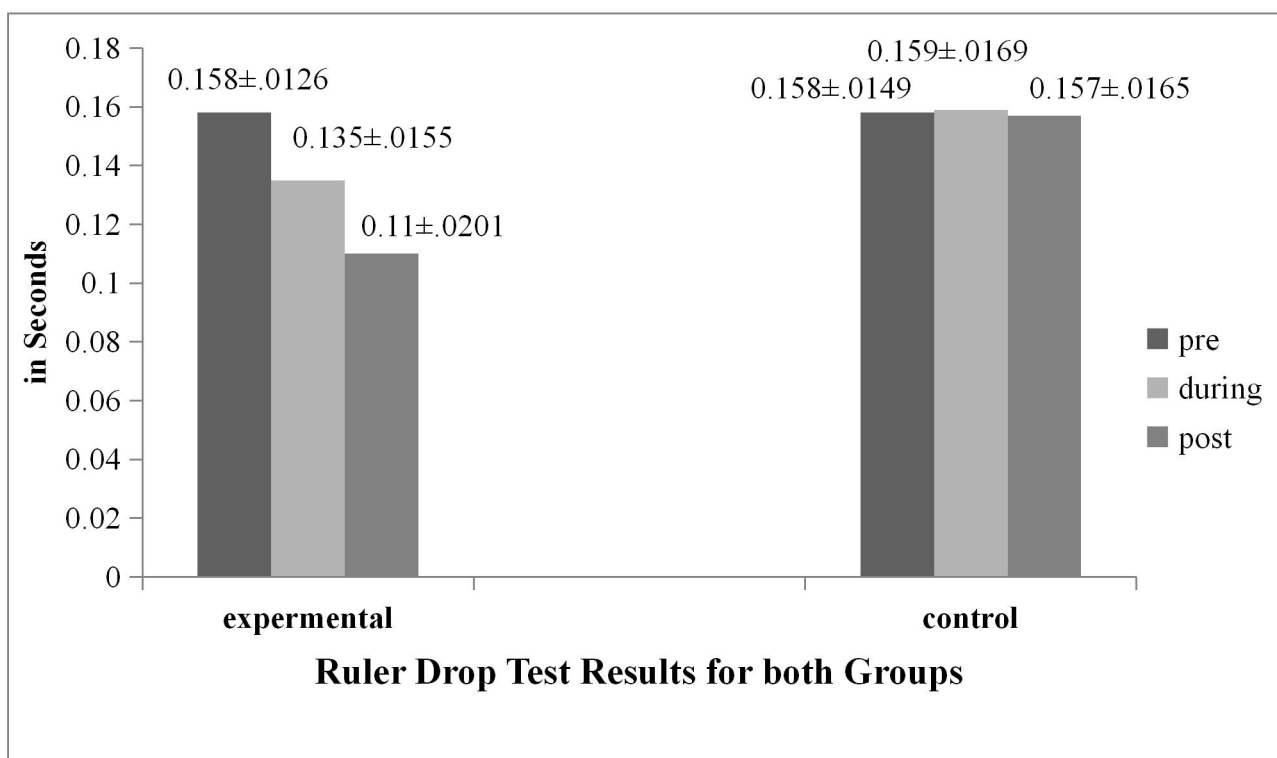
Values (mean + SD or standard deviation), EG: Experimental group, CG: Control group, RDT: Ruler Drop Test

As the above table showed there was significance difference on Ruler drop test before and after the experimental subjects underwent aerobic exercise. As its indicated on the table the average value of Ruler drop test was significantly lower (decreased) for the experimental group after twelve week aerobic exercise training that the Mean value of reaction time for experimental group was .158±.0126 before they underwent to the exercise and .110±.0201 after 12 week aerobic exercise when compared to mean value of reaction time for control group .158±.0149 and .157±.0165 which was taken as pre (before) and post test result after 12 week respectively. As a result, this finding showed that twelve (12) week aerobic exercise have extracted a significant improvement on reaction time of experimental subjects at difference between mean values were considered statically significant at $p < 0.05$ but, in the control subjects of the study there was no significant change or improvement seen. So, based on this result the null hypothesis was rejected while the alternative hypothesis accepted.

This finding was in agreement with the study of Masley on reaction time by the title Aerobic Exercise Enhances Cognitive Flexibility; according to Masley (2009) Physical activity is widely believed to improve overall health, physical appearance, and internal workings of our body. The brain is a key organ that physical activity can affect. It can enhance cognitive functions and in response to physical activity, can maintain and even improve those functions. Reaction time has offered interesting results in cognitive performance. In general Aerobic activity leads to enhance cognitive performance in particular cognitive flexibility, a measure of executive function. Thus, the study has shown a 9.1% decrease in reaction time in the aerobically exercising group, compared to the control.

Chittibabu B (2014) found that top class sportsmen and athletes normally had shorter reaction time than non-athletes and continuous participation in aerobic sports at higher level did reduce reaction time. Monika Garg *et al* (2013) also stated that regular aerobic exercise in gymnasium was significantly lower reaction time of the auditory and visual stimuli in aerobic exercise group when compared to non exerciser, irrespective of age and gender sub groups. The finding of this study was contradicted with a few studies which have reported that exercise i.e. aerobic exercise does not lead to significantly decrease in reaction time, mainly McMorris T *et al* (2000) and Pesce C *et al* (2007) found that aerobic exercise have no effect on reaction time of athletes.

Figure 2: Showing the mean comparison of Ruler Drop test results of the study subjects among pre, during and post tests.



The above figure showed that there was significance difference on Ruler drop test before and after the experimental subjects underwent in 12 week aerobic exercise. As its indicated on the table, the average value of Ruler drop test was significantly lower (decreased) for the experimental group after twelve week aerobic exercise training but, there is no significance difference observed in the control group.

4.5. Stork Balance Stand Test results and discussions

Table 3: Mean and standard deviation values of Stork Balance Stand Test results of the study subjects (second).

Group	N	Variables	Pre test	During test	Post test
EG	30	Stork Balance Stand	35.30±2.002	38.267±2.11	47.54±1.87
CG	30	Test (second)	34.367±2.697	34.167±2.8295	34.134±2.763

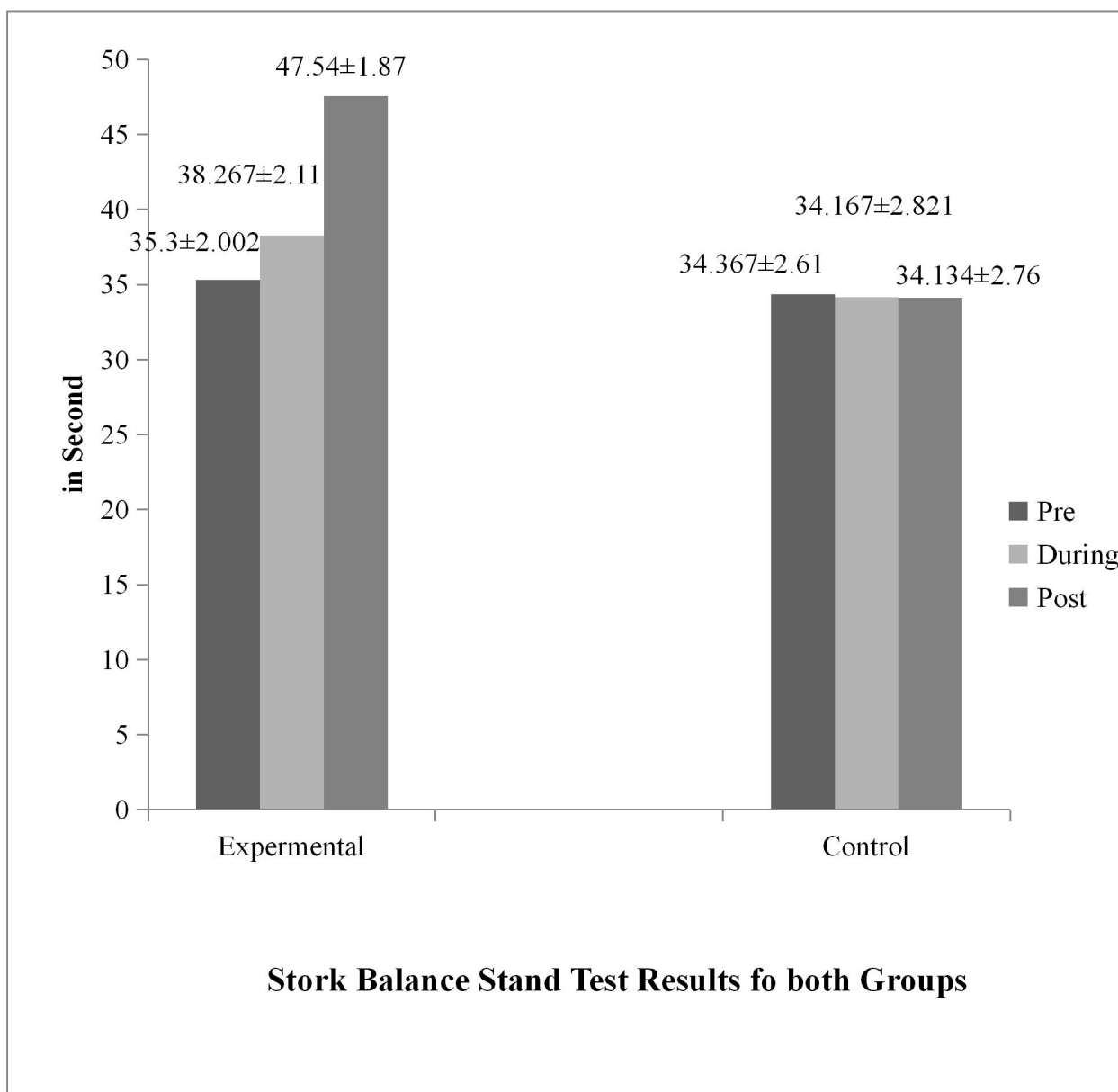
Values (mean + SD or standard deviation), EG: Experimental group, CG: Control group

As the above table showed there was significant difference on stork balance stand test of pre to post test result on the experimental group. As indicated on the table, the mean value of stork balance stand test for the experimental group was increase from pre test mean value (35.30±2.002) to post test mean value (47.54±1.87) due to the 12 week aerobic exercise when compared to the mean value of stork balance stand test for control group before the experiment started (34.367±2.697) and (34.134±2.763) after 12week. Thus, the finding shows that 12week aerobic exercise was significantly improve the balance of the experimental group at difference between mean values were considered statically significant at $p < 0.05$. On the contrary, there was not significant improvement in the control groups as showed in the above table. So, based on this result 12 week aerobic exercise have a positive effect on balance of male sport science student of DBU that means the null hypothesis was rejected while the alternative hypothesis accepted.

Some literature evidence suggests that a superior balance among sport science students is the result of repetitive training experiences through aerobic exercise that influence motor responses (Balter et al., 2004); others argue that superior balance is the result of training experience influencing a person's ability to attend to relevant proprioceptive and visual cues (Ashton-Miller et al., 2001).

The Stork Balance Stand Test result was compared with an international Stork Balance Stand Test norm among similar age groups that range above 19years (Schell, J and Leelarthap 1994).The Stork Balance Stand Test norms is 37-50 for these age groups while the Stork Balance Stand Test mean value result of this study for experimental group was 47.54. Hence, the study result has fallen in above average standard (norms found on Appendix VII).

Figure 3: Showing the mean comparison of Stork Balance Stand test results of the study subjects among pre, during and post tests.



The above table showed that there was significant difference on stork balance stand test of pre to post test result on the experimental group rather than control group due to 12 week aerobic exercise. So, aerobic exercises have a positive effect on balance of sport science students.

4.6. The mean difference values and significance level of each variables

Table 4: The mean difference values and significance levels of pre and post test result of subject in all variables i.e., Flexibility, Reaction time and Body Balance.

Variables	Groups	Parameter(A)	Parameter(B)	MD (A-B)	SIG
Flexibility	EG	PoT (59.34)	PT (47.80)	11.534	.000
			DTT (53.27)	6.07	.000
	CG	PoT (46.07)	PT (46.034)	.036	.887
			DTT (46.167)	-.097	.514
Reaction time	EG	PoT (.110)	PT (.158)	-.0468	.000
			DTT (.135)	-.025	.000
	CG	PoT (.157)	PT (.158)	-.0012	.344
			DTT (.159)	-.002	.334
Body Balance	EG	PoT (47.54)	PT (35.30)	12.234	.000
			DTT (38.267)	9.273	.000
	CG	PoT (34.134)	PT (34.367)	.24	.452
			DTT (34.167)	-.04	.246

MD: Mean difference, SIG: Significance level, PoT: Post Test, PT: Pre Test, DTT: During Training Test, EG: Experimental Group, CG: Control Group

As the above table indicated that both variables (flexibility, reaction time and balance) showed positive improvement on the experimental subjects of the study because of 12 week aerobic exercise, however there was not significant change or improvement showed on the control group of the study in all parameters. As a result 12week aerobic exercise was significant in order to improve these selected motor fitness variables of the study.

5. SUMMARY, CONCLUSIONS AND RECOMMENDATION

5.1. Summary

This study assessed and tried to investigate the Effect of Aerobic Exercise on Selected Motor Fitness Variables in Case of Male Sport Science Students of Debre Birhan University. To achieve the purpose of this study, 60 male sport science students with age of 19-25 years were selected by random sampling method (lottery method) and divided into 2 groups i.e. control and experimental group, each group consisting of 30 students that the experimental group underwent twelve weeks aerobic exercise program, three days per week and the duration was 60 minutes. Purposive sampling was used to select the samples sex and the study place in relation with their department. The sample size which was taken from total population for this study were calculated by slovins formula ($n=N/ (1+Ne^2)$). Thus, eighty seven (87) male sport science students of DBU were filled the health status questionnaire while selecting randomly and twenty seven (27) male sport science students were eliminated from the study because of health related factors. So, finally Sixty (60) subjects were participated on this study. In this study, the influence of Aerobic Exercise on flexibility, balance and reaction time have been seen. The dependent variables selected for this study were flexibility, balance and reaction time. Motor fitness tests used were; Sit and Reach test, Ruler Drop Test and Stork Balance Stand Test within three intervals (pre-test, during training test and post-test) each.

The data were collected by using the appropriate motor fitness tests before the starting of 12 week aerobic exercise, during the end of 6th week and after 12week aerobic exercise training. Paired T-test was used for comparisons of means and data were analyzed by SPSS version 20 with significance level of 0.05%. Final result of the study summarized and demonstrated that the result of post test to pretest showed significant improvement in the experimental group in both parameters (flexibility, balance and reaction time) 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 aerobic exercises have a positive effect on DBU male sport science students motor fitness performance.

5.2. Conclusions

Based on the major finding the following points are stated as conclusions.

- ❖ The result of the study indicated that 12 week aerobic exercise showed significance improvement on the selected motor fitness performance of the study subjects.
- ❖ It is conclude that 12 week aerobic exercise showed significant improvement on reaction time of Debre Birhan University male sport science students.
- ❖ Aerobic exercise significantly improved the balance of Debre Birhan University male sport science students.
- ❖ The range of motion or flexibility of the experimental study subjects also increased after 12 week aerobic exercise training.

5.3. Recommendations

The result of this study indicated that 12 weeks aerobic exercise improves the balance, flexibility and reaction time of the subjects. By considering the results, discussions, conclusions and the major finding of the research, it is important to state the following points as a recommendation to investigate more on effect of aerobic exercise in improvement of motor fitness variables for male sport science students.

- Considering the importance of aerobic exercises on improving motor fitness variables; sport science teachers of DBU should make the exercise as part of their practical class for their students regularly.
- Male Sport science students of DBU need to participate in regular aerobic exercise to promote their body balance, reaction time and flexibility.
- It is expected from DBU sport professionals, sport science teachers and related fields to guide and evaluate the importance of aerobic exercise in improving motor fitness variables for their students and athletes.
- Since aerobic exercise has a significant effect in improving motor fitness variables sport professionals, coaches as well as students 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 motor fitness variables in relation with different exercises that could improve the performance of sport science students of DBU.

6. REFERENCES

- Ackerman, L., Tzetzis, G., Mantis. 1998. Determinants of individual differences during skill acquisition, cognitive abilities and information processing. *Journal of Experimental Psychology*, 117 (3): 288-318.
- ACSM (American College of Sports Medicine). 1990. Position Statement: The Recommended Quantity and Quality of Exercise for Developing and Maintaining Fitness in Healthy Adults. *Medicine and Science in Sports and Exercise*, pp 500-501.
- ACSM (American College of Sports Medicine). 1997. Champaign, IL: Human Kinetics. ACSM's health/fitness facility standards and guidelines(2nd edition), 22(4): 12-19.
- ACSM (American College of Sports Medicine). 2000. Strength training by children and adolescents. *Pediatrics*, 107: 1470-1472.
- ACSM (American College of Sports Medicine). 2008. Quantity and quality of exercise. *Medicine and science in sports and exercise*, 14(1):3-5.
- ACSM (American College of Sports Medicine). 2010. ACSM's Guidelines for Exercise Testing and Prescription 8th edition. Lippincott Williams and Wilkins.
- Aley, L., Miller, E.W., Bode, S. 2007. Effects of age, task complexity and exercise on reaction time of women during ambulation tasks. *Journals of Geriatric Physical Therapy*, 30: 3-7.
- Ashton-miller, J.A., Wojtys, E.M., Huston, L.J., FRY-Welch, D. 2001. Can proprioception really be improved by exercises. *Knee Surgery, Sports Traumatology, Arthroscopy*, 9: 128-136.
- Autunes, H.K.M., Santos, R.F., Cassilhas, R., Santos, V.T., Bueno, F.A., Mello, T.D. 2006. Reviewing on physical exercise and the cognitive function. *Revision of Bras Medication in sport*, 12: 97-103.
- Balter, S.G.T., Stokroos, R.J., Akkermans, E. and Kingma, H. 2004. Habituation to galvanic vestibular stimulation for analysis of postural control abilities in gymnasts. *Neuroscience Letters*, 366: 71-75.
- Bangsbo, J., Mohr, M. and Krstrup, P. 2006. Physical and metabolic demands of training and match-play in the elite football player. *Journal of Sports Science*, 24(7): 665-74.

- Bhupinder, T. 2013. Prediction of playing ability of university level handball players in relation to their motor ability and kinthropometric variables. *International Journal of Social Science and Interdisciplinary Research*, 2 (1):4-5
- Bishop, D., Burnett, A., Farrow, D., Gabbett, T. and Newton, R.U. 2006. Sports-science roundtable: Does sports-science research influence practice. *International Journals of Sports Physiological Performance*, 1: 161–168.
- Bloomfield, J., Polman, R., O'Donoghue, P. and McNaughton, L. 2007. Effective speed and agility conditioning methodology for random intermittent dynamic type sports. *The Journal of Strength and Conditioning Research*, 21(4): 1093-1100.
- Brétigny, P., Leroy, D., Button, C., Chollet, D. and Seifert, L. 2011. Coordination Profiles of the Expert Field Hockey Drive According to Field Roles. *Sports Biomechanics*, 10(4): 146.
- Brown, L., Woodman, G. and Yap, C. 2000. 'Development of Speed, Agility, and Quickness for the Female Soccer Athlete'. *National Strength and Conditioning Association*, 22(1): 9-12.
- Caputo, F. and Denadai, B.S. 2008. The highest intensity and the shortest duration permitting attainment of maximal oxygen uptake during cycling: effects of different methods and aerobic fitness level. *European Journals Applied Physiology*, 103: 47-57.
- Charles, R. Carbin. 1994. Effect of proprioceptive training on selectmotor fitness and skill performance variables of hockey players. 5(1): 21
- Chittibabu, B. 2014. Analysis of visual and auditory reaction time among different levels of handball players. *International Journal of Recent Scientific Research*, 5: 697-698.
- Clark, B., Osness, W., Adrian, M., Hoeger, W.W.K., Raab, D. and Wiswell, R. 1989. Tests for fitness in older adults: AHPERD fitness task force. *Journals of Physical Education, Recreation and Dance*, 60(3): 66-71.
- Dalrymple K.J., Davis S.E., Dwyer G.B., Moir G.L. 2010. Effect of static and dynamic stretching on vertical jump performance in collegiate women volleyball players. *Journal of strength and conditioning research*, 24:149-155.
- Douglas, K.A., Collins, J.L., Warren, C., Kann, L., Gold, R., Clayton, S., Ross, J.G. and Kolbe, L.J. 1997. Results from the 1995 National College Health risk Behavior Survey. *Journals of American College of Health*, 46(2): 55-66.

- FAO. 2006. Food and Agricultural organization of the United Nations AgroMeterology group, Remot sensing center research and Technology Division, Rome, Italy.
- Farid, A.A., Yahya, S. and Raghad, M. 2014. The effect of the aerobic activities on dynamic and static balance in elementary boy students. *European Journal of Experimental Biology*, 4(1):440-447
- Filipic, A., Pisk, L. and Filipic, T. 2010. Relationship between the results of selected motor tests and competitive successfulness in tennis for different age categories. *kinesiology*, 42(2):175-183.
- Fisher, J. and Smith, D. 2012. Attempting to better define “intensity” for muscular performance: is it all wasted effort. *European Journals of Applied Physiology*, 1(15).
- Garg, Monica, Hem, L., Lily, W. and Omesh, G. 2013. Effect of Aerobic Exercise on Auditory and Visual Reaction Times: A Prospective Study. *Indian Journals of Physiology and Pharmacology*, 57.2: 138-45.
- Gorner, k., Boraczyński, T. and Stihec, J. 2009. Physical activity, body mass, body composition and the level of aerobic capacity among young, adult women and men. *Journal of Sport and physical activities*, 6(2): 8-10.
- Gorostiaga, E.M., Izquierdo, M., Ruesta, M., Iribarren, J., González- Badillo, J.J. and Ibáñez, J. 2004. Strength training effects on physical performance and serum hormones in young soccer players. *European Journal of Applied Physiology*, 91: 698-707.
- Grabowski, H. 2003. Leczyć czy amputować [To Treat or to Amputate]. *Forum Akademickie*, 11(12): 47-9.
- Greco, C.C., Caputo, F. and Denadai, B.S. 2008. Critical power and maximal oxygen uptake: Estimating the upperlimit of the severe domain, a new challenge. *Science Sports*, 23: 216-22.
- Haff, G. H. 2012. Resistance Training Program Design. In J. W. Coburn, M. H. Malek, J. W. Coburn, and M. H. Malek (Eds.), *National Strength and Conditioning Association's Essentials of Personal Training*, (2nd ed., pp. 347-388).
- Helgerud, J., Engen, L.C., Wisloff, U. and Hoff, J. 2001. Aerobic endurance training improves soccer performance. *Medicine and Science in Sports and Exercise*, 33(1): 1925-1931.
- Heyward, V.H. and Gibson, A.L. 2014. Advanced fitness assessment and exercise prescription. 7th edition, Human Kinetics, 11 (3): 202–221.

- Hoff, J. and Helgerud, J. 2004. Endurance and Strength Training for Soccer Players – Physiological Considerations. *Sports Medicine*, 34(3): 165-180.
- Hopson, J.L., Donatelle, R.J. and Littrell, T.R. 2013. *Get fit stay well!* Glenview, IL: Pearson, 34:174.
- http://www.emedicinehealth.com/aerobic_exercise/article_em.ht
- <https://en.m.wikipedia.org/wiki/sport.com>
- https://www.meteoblue.com/en/weather/forecast/modelclimate/debre_birhan_ethiopia_339734
- Humphriss, R., Hall, A., May, M. and Macleod, J. 2011. Balance ability of 7 and 10 year old children in the population: Results from a large UK birth cohort study. *International Journal of Pediatric Otorhinolaryngology*, 75:106-113.
- Jakl, P. 2008. Training Program Design and Evaluation Course. University of Maine at Presque Isle, the USA.
- Kansal, D. K. 1996. Test and Measurement. *Delhi: D. V. S. Publication*, 1(2): 21.
- Lidor, R. and Ziv, G. 2010. Physical and physiological attribute of female volleyball players. *A review Journal of Strength and Conditioning Research*, 24(7): 1963-1973.
- Magill, R.A. 2004. Motor learning and control. *Concepts and applications*. 7th edition, New York, McGraw-Hill.
- Masley, S. 2009. Aerobic Exercise Enhances Cognitive Flexibility. *Journal of Clinical Psychology in Medical Settings*, 16: 186-93.
- Mayo Clinic. 2014. Exercise: 7 Benefits of Regular Physical Activity. *Mayo Foundation for Medical Education and Research*, 1998-2014.
- McMorris, T., Sproule, J., Draper, S. and Child, R. 2000. Performance of a psychomotor skill following rest, exercise at the plasma epinephrine threshold and maximal intensity exercise. *Perception of motor skills*, 91: 553-562.
- Microsoft Encarta Encyclopedia Deluxe. 2003. <https://www.cnet.com/.../microsoft-encarta-encyclopedia-deluxe-2003-box-pack/>.
- Mojock, C. D., Kim, J.S., Eccles, D. W. and Panton, L. B. 2011. The effects of static stretching on running economy and endurance performance in female distance runners during treadmill running. *Journal of Strength and Conditioning Research*, 25(8): 2170-2176.

- Monika, G., Hem, L., Lily, W. and Omesh, G. 2013. Effect of aerobic exercise on auditory and visual reaction times. *Indian Journal in Physiologic Pharmacia*, 57(2): 138–145.
- Nabhendra Singh. 2010. A Comparative Study of Motor Performance Level among Categorized Skilled Hockey Players. *International Journal of Educational Administration*, 2 (2): 403-410.
- Natraj, H.V. and Kumar, C. 2006. Selected motor ability variables and kabaddi performance. *Journal of Sports and Sports Sciences*, 29(1): 6-11.
- Neiman, D. 1995. *Fitness and Sports Medicine: A health-related approach*. Mountain View, California, May field Publishing Company (3rd edition).
- Odiango, R., Wamukoya, K. and Simuyu, N. 2010. Effect of physical education programmes on health –related fitness components (cardio respiratory endurance, low back flexibility and body composition) of physically challenged pupils. *Journal Applied Bioscience*, 31:1916 – 1927.
- Pedro, A., López, M., Pilar, S.B.A., Pedro, L. and Rodríguez, G. 2009. A comparison of the sit-and-reach test and the back-saver sit-and-reach test in university students. *Journal of Sports Science and Medicine*, 8(1): 116
- Pesce, C., Tessitore, A., Casella, R., Pirritano, M. and Caprancia, L. 2007. Focusing on visual attention at rest and during physical exercise in soccer players. *Journal of Sports Science*, 25: 1259-1270.
- Powers, S.K., Dodd, S.L. and Jackson, E.M. 2014. *Improving flexibility. Total fitness and wellness*, Glenview, IL: Pearson;. Grade1-Grade8.
- Raju, Sathuluri., Subbar, K. and Paul Kumar, P.P.S. 2016. The relationship between selected motor fitness anthropometric parameters with playing ability of softball players sports science. *International Journal of Engineering Research and Sports Science*, 3: 84.
- Saygın, Ö. and Dükkancı, Y. 2009. Investigation of the Relation of Health Related Physical Fitness and Physical Activity Intensity in Girls. *International Journal of Human Science*, 6(1): 320-329.
- Schell, J. and Leelarthaep, B. 1994. *Physical fitness assessment in exercise and sport science* 2nd edition. *Leelar biomediscience services matraville*, 1: 327.
- Stevens, S.D. 2006. Balancing with the brain in mind. *Teaching Elementary Physical Education*, 15:28-33.

- Tomkinson, G.R., Léger, L.A., Olds, T.S. and Cazorla, G. 2003. Secular Trends in the Performance of Children and Adolescents (1980–2000): *An Analysis of 55 Studies of the 20m Shuttle Run Test in 11 Countries*. *Sports Medicine*, 33(4): 285-300.
- Valsaraj, K.M. 2013. Relationship between motor fitness components and body mass index of uttarakhand boys. *International journal of Sport Science*, 2(4): 33-36
- Vanhatalo, A., Jones, A.M. and Burnley, M. 2011. Application of critical power in sport. *International Journals of Sports Physiology Performance*, 6: 128-36.
- Willardson, J.M. 2008. A Brief Review: How Much Rest between Sets. *Strength and Conditioning Journal*, 30(3): 44-50.
- Winter, D.A., Patla, A.E. and Frank, J.S. 1990. Assessment of balance control in humans. *Medical Progress through Technology* 16: 31-51.
- Wolach, M.B. and Harold, M.M. 2000. Effect of aerobic and anaerobic exercise on the phagocytic in old trained female. *Journal of women and health*, 50 (77): 639-51.
- Xu, F. and Rodhes, E.C. 1999. Oxygen uptake kinetics during exercise. *Sports Medicine*, 27: 313-27.
- Zakas, A. 2003. Effect of stretching during warming up on the flexibility of junior handball players. *Journals Sports Medicine and Physical Fitness*, 43 (2); 145-914.
- Zorba, E. 2000. Physical Fitness, Gazi Kitabevi. *Ankara*, 5: 54.

7. APPENDICES

APPENDIX - II

Consent to Participate Voluntarily in This Research Study

Researcher Name: **Huluager Abebe Fentahun**

Supervisor Name: **Desta Enyew (PhD) and Wegene Waltenegus(PhD)**

Thesis title: - The Effect of Aerobic Exercise on Selected Motor Fitness Variables in Case of Sport Science Student's of Debre Birhan university; North Showa Zone, Amhara Regional State, Ethiopia

You are being asked to participate in this study as described below. All this like research study carried out are governed by the regulation for research on human beings. These regulations require that the researcher should obtain a signed agreement (consent) from you to participate in this research project. The researcher will explain to you in detail the purpose of the project, the procedure to be used, the potential benefits and the possible risk of participation in this study. You can ask the researcher any questions that you may have about the study. The basic explanation of the project is summarized below.

After discussion, if you agree to participate in the study, please sign this form in the presence of the researcher. You may discontinue at any time from the study if choose to do so.

1. Purpose and procedure

The purpose of this research project is to investigate the effect of aerobic exercise on selected Motor Fitness Variables of Sport Science Students of DBU with age of 19-25 years. The subjects to be involved in this study will be 30 in number and participation on this study will require you to perform a certain test to measure the physical fitness variables

2. Risk and the safeguards

The risks of this research study are small, while administering the tests and during test you may experience localized muscle fatigue in your thigh, you might feel some muscle soreness and fatigue during the tests. But we do not expect any unusual risks as a direct result of the

study, if any unexpected physical injury occurs, appropriate first aid will be provided, but no financial compensations will be given.

3. Confidentiality

The information obtained about you will be kept in confidence, although you are free to release it to your own trainer. The information will be used only for scientific purpose without identifying you as an individual.

4. Contact Address:

Huluager Abebe ----- 0923415810

Desta Enyew (PhD) ----- 0938310940

Wegene Waltenegeus(PhD)----- 0923670360

I certify I have read and fully understand the above project. I willingly consent to participate

Name of subject: _____

Signature of subject: _____

Address: _____

Date: _____

I certify that I have explained fully to the above subject the nature, the purpose, the potential benefits and the possible risks involved in this research study.

Date: _____

Signature of the investigator: _____

APPENDIX - III

Description of the Study Subjects and Training for the Three Months

The creation of daily opportunities for participation in regular Practical classes is not always feasible especially in DBU i.e. unless they have practical class they don't involve in regular exercise mainly in aerobic exercise for the purpose of improving their motor fitness and research was not conducted on this topic. The students of sport science need motor fitness as they are involved in various vigorous practical activities during their practical class. As a result, the research was done at Debre Birhan University sport science male student. The sample size which was taken from total population for this study were calculated by slovins formula ($n=N/(1+Ne^2)$). Thus, eighty seven (87) male sport science students of DBU were filled the health status questionnaire while selecting randomly and twenty seven (27) male sport science students were eliminated from the study because of health related factors. So, finally Sixty (60) subjects were participated on this study. Random sampling technique was used to minimize complain and error by giving equal chance for the total population.

Gender and age of the subject- the researcher selected male students only, due to the problem of the selected motor fitness variables (flexibility, balance and reaction time) is lay mainly in male student than females by nature. So, to see the effect of this study significantly male students are selected. Interest to develop the study on males than females is also the other reason. Selection of subjects age were based on the average age of the students i.e. the average age of Debre Birhan University male sport science students was above 19 so; the investigator was selected purposively students with age of 19-25.

Training protocol

Three Months of Training Schedule: According to Jakl (2008) 8 to 12 weeks of training program is essential to maximize individuals' motor fitness abilities. Based on this idea the investigator purposively prepared 12 weeks training program. Thus, the subjects underwent 3 months (12weeks) of training, which is December 2016, January and February 2017.

The Training Days per Week: according to ACSM (1990) 3-5 days per week and 20-60 minutes is needed for developing and maintaining fitness through aerobic exercise. So, the

investigator took a minimum of 3 days (60 minutes per session) that are Monday and Saturday morning 10:00am- 11:00am and Wednesday afternoon 4:00pm- 5:00pm, since they are student the schedule were prepared by considering their convenient time for them. The researcher was under taken pre, during and post test to know the change that occurred due to the 12 week aerobic exercise, during test also taken to know the progress of training and the dependent variables for this study were flexibility, reaction time and balance, independent variable is also aerobic exercise. The tests used for the study were sit and reach test, ruler drop test and stork balance stand tests respectively.

So, the following table includes different types of aerobic exercise which was performed by the subjects within 12 weeks in order to improve their motor fitness variables. The exercises involve in this study were warming up exercise, Running, Stationary bicycle, Treadmill running, jumping rope, aerobics, strength exercise like sit up and push up, brisk walking, stair climbing and finally cooling down exercise which helped to develop athletes' fitness level. Also FITT (Frequency, Intensity, Time and Type of Exercise) principle of training was applied in the schedule;

1. **Frequency of training:** the reptition of exercise in one set. The training schedule was completed 3 days per week that is Monday, Wendsday and Saturday.

2. **Intensity of training:** is how hard the body exerciscng or how much energy is expended when exerciscng. It can be defined on either an absolute or a relative scale. Absolute intensity refers to the amount of energy expended per min of activity, while relative intensity takes a person's level of exercise capacity or cardio respiratory fitness into account to assess the level of effort. Either scale can be used to monitor the intensity of aerobic exercises • In this study the researcher was used mainly moderate intensity to adapt the exercise to high intensity for increasing load in the consecutive three months. There were ways to measure intensity of training;

- ❖ Heart rate - Heart rate can be an indicator of the challenge to the cardiovascular system that the exercise represents.
- ❖ Vo2max- the amount of oxygen consumed by the body durin exercise

Exercise is categorized into three different intensity levels. These levels include **Low** (40-50% MHR), **Moderate** (50-65% MHR), and **Vigorous** (65-85% MHR) for aerobic exercise and are measured by the metabolic equivalent of task. The effects of exercise were different at each intensity level (i.e. training effect). Recommendations to lead a healthy lifestyle vary for individuals based on age, weight, and existing activity levels. “Published guidelines for healthy adults state is that 20-60 minutes of medium intensity continuous or intermittent aerobic activity 3-5 times per week is needed for developing and maintaining fitness” (ACSM, 1990).

3. **Duration of training:** the subjects perform the exercise for 1:00hr per day in this study. Duration is dependent on the intensity of the activity, thus, medium-intensity activity should be conducted over a longer period of time (30 min or more) and conversely individuals training at higher levels of intensity should train at least 20min or longer (ACSM, 1990).

4. **Type of activity:** any activity that uses large muscle groups, which can be maintained continuously, and is rhythmical and aerobic in nature, e.g., walking-hiking, running, jogging, bicycling, cross-country skiing, aerobic dance/group exercise, rope skipping, rowing, stair climbing, swimming, skating, and various endurance game activities or some combination thereof (ACSM, 1990).

5. **Load and Effort:** Within the area of aerobic exercise, intensity is generally considered to represent the effort required by the body at a given velocity, incline, and resistance (or other variable) at a given work rate and is typically expressed relative to quantities such as heart rate (HR), % of heart rate maximum (HRM), blood lactate or oxygen uptake (VO₂). With regard to muscular effort, however, the percentage of one repetition maximum is purely a representation of **load**. Whilst increasing or decreasing a given load might indeed require greater or lesser effort, it should never be considered a measure of the effort or intensity that the body is working at. It is surely not acceptable that terminology can be used with different meanings based on differing modalities of exercise being performed (Fisher and Smith, 2012).

Workload can have three components:

1. The amount of weight lifted during an exercise.
2. The number of repetitions completed for a particular exercise.
3. The length of time to complete all exercises in a set or total training session

The table of training schedule of this study for three months is listed in the next pages.

Table 1: Training Schedule for First Month (December, 2016)

Day	Types of exercise	Time /min during session	Frequency / rest	Intensity	Total Duration
Monday (10:00am-11:00am)	Warming up – jogging	5min	3rep/1min rest	Low to moderate	60:00 minute
	-static stretching which involves holding a position	5min			
	- dynamic stretching	5min			
	-slow walking	5min			
	Main part- Running	9min			
	Stationary bicycle	9min			
	Treadmill running	9min			
	jumping rope, stair climbing				
	Cool down- stretching and relaxation exercise	5min 5min			
Wednesday (4:00pm-5:00pm)	Warming up- walking	5min	3rep/1min rest	Low to moderate	60:00 minute
	jogging	5min			
	Static stretching	4min			
	dynamic stretching	4min			
	Main part Stationary Cycling	9min			
	Treadmill running	7min			
	stair climbing	6min			
	jumping rope	7min			
	Cool down- stretching exercise	10min			
Saturday (10:00am-11:00am)	Warming up- walking	5min	4rep/1min rest	Low to moderate	60:00 minute
	jogging	5min			
	static stretching	5min			
	dynamic stretching	4min			
	Main part- Tread mill running	9min			
	Stationary Cycling	9min			
	jumping rope, running	9min			
	Cool down- stretching and relaxation exercise	5min 5min			

The above training schedule was performed every week of the month of December, 2016

Table 2: Training Schedule for Second Month (January, 2017)

Day	Types of exercise	Time/min /session	Frequency /rest	Intensity	Total duration
Monday (10:00am-11:00am)	Warming up- walking	5min	5 rep/2min rest	Moderate to High	60:00 minute
	jogging	5min			
	dynamic and static stretching	5min			
	Main part- tread mill running	9min			
	stationary cycling	5min			
aerobics	6min				
jumping rope	5min				
strength exercise like sit up	5min				
Cool down- slow stretching and relaxation exercise	5min 5min				
Wednesday (4:00pm-5:00pm)	Warming up- slow walking	5min	5rep/2min rest	Moderate to High	60:00 minute
	jogging	5min			
	stretching exercise	5min			
	Main part- Tread mill running	8min			
	stationary bicycling	7min			
brisk walking	7min				
strength exercise like sit up	8min				
Cool down- slow stretching and relaxation exercise	5min 5min				
Saturday (10:00am-11:00am)	Warming up- slow walking	5min	5rep/2min rest	Moderate to High	60:00 minute
	jogging	5min			
	stretching exercise	5min			
	Main part- Tread mill running	7min			
	stationary bicycling	6min			
jumping rope	6min				
strength exercise sit up	6min				
brisk walking	5min				
Cool down- slow stretching and relaxation exercise	5min 5min				

The above training schedule was performed every week of the month of January, 2017

Table 3: Training Schedule for Third Month (February, 2017)

Day	Types of exercise	Time/min /session	Frequency / rest	Intensity	Total duration
Monday (10:00am-11:00am)	Warming up- slow walking	5min	5rep/2min rest	High	60:00 minute
	jogging	5min			
	stretching exercise				
	Main part- Tread mill running	8min			
Wednesday (4:00pm-5:00pm)	stationary bicycling	6min	5rep/2min rest	High	60:00 minute
	Aerobics	6min			
	jumping rope	4min			
	strength exercise like push up	6min			
Saturday (10:00am-11:00am)	Cool down- stretching and relaxation exercise	8min 7min	5rep/2min rest	High	60:00 minute
	Warming up- slow walking	5min			
	jogging	5min			
	stretching exercise				
Saturday (10:00am-11:00am)	Main part- Tread mill running	8min	5rep/2min rest	High	60:00 minute
	stationary bicycling	6min			
	running	5min			
	jumping rope	6min			
Saturday (10:00am-11:00am)	stair climbing	5min	5rep/2min rest	High	60:00 minute
	Cool down- stretching and relaxation exercise	5min 5min			
	Warming up- slow walking	5min			
	jogging	5min			
Saturday (10:00am-11:00am)	stretching exercise		5rep/2min rest	High	60:00 minute
	Main part- Tread mill running	8min			
	stationary bicycling	6min			
	running	5min			
Saturday (10:00am-11:00am)	jumping rope	6min	5rep/2min rest	High	60:00 minute
	stair climbing	5min			
	Cool down- stretching and relaxation exercise	5min 5min			
	Warming up- slow walking	5min			
Saturday (10:00am-11:00am)	jogging	5min	5rep/2min rest	High	60:00 minute
	stretching exercise				
	Main part- Tread mill running	8min			
	stationary bicycling	6min			
Saturday (10:00am-11:00am)	running	5min	5rep/2min rest	High	60:00 minute
	jumping rope	6min			
	stair climbing	5min			
	Cool down- stretching and relaxation exercise	5min 5min			

The above training schedule was performed every week of the month of February, 2017

APPENDIX - V

Motor Fitness 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	DTT	PoT	PT	DTT	PoT
1	Balance	Stork Balance Stand Test per one minute						
2	Flexibility	Sit and reach test, (cm/inches)						
3	Reaction time	Ruler drop test, (cm/inches)						

The raw data which was recorded for the selected motor fitness variables in 12 week (pre, during and post) on the target subjects was listed in the following tables;

Table 4: Raw data's for the selected motor fitness variables of experimental group (30)

Subjects code	age	Flexibility (SRT in cm)			Reaction time (in sec)			Balance (SBST, sec)			Class year
		PT	DT	PoT	PT	DT	PoT	PT	DT	PoT	
s1	19	48	52	59	0.15	0.13	0.11	34	40	50	1 st
s2	20	45	53	58	0.16	0.13	0.16	33	38	49	1 st
s3	21	50	53	60	0.15	0.14	0.11	32	37	47	1 st
s4	22	51	54	62	0.14	0.12	0.10	35	38	48	1 st
s5	19	53	55	60	0.14	0.11	0.08	33	34	47	1 st
s6	21	46	52	58	0.16	0.14	0.12	34	38	46	1 st
s7	23	50	56	60	0.14	0.11	0.10	35	37	48	1 st
s8	21	51	58	60	0.15	0.11	0.08	33	36	48	1 st
s9	21	49	55	61	0.14	0.11	0.08	35	39	47	1 st
s10	22	48	52	58	0.14	0.12	0.09	36	36	45	1 st
s11	22	44	51	59	0.15	0.13	0.09	38	39	46	1 st
s12	21	48	54	60	0.16	0.11	0.08	37	38	43	2 nd
s13	21	47	51	58	0.14	0.12	0.10	34	35	47	2 nd
s14	20	43	49	58	0.15	0.13	0.10	36	37	46	2 nd
s15	21	43	48	57	0.16	0.14	0.11	33	35	45	2 nd
s16	22	49	54	58	0.16	0.14	0.10	35	37	45	2 nd
s17	22	50	55	60	0.18	0.16	0.13	38	39	47	2 nd
s18	21	44	52	58	0.15	0.14	0.10	37	38	46	2 nd
s19	20	51	55	59	0.16	0.15	0.12	37	40	50	2 nd
s20	20	44	50	58	0.17	0.15	0.13	36	39	47	2 nd
s21	23	47	54	60	0.18	0.15	0.13	38	42	51	3 rd
s22	24	45	53	60	0.15	0.14	0.11	34	40	48	3 rd
s23	19	43	55	59	0.18	0.16	0.14	32	36	47	3 rd
s24	23	49	52	59	0.19	0.16	0.13	36	40	49	3 rd
s25	21	48	51	60	0.16	0.14	0.11	37	40	50	3 rd
s26	25	50	53	59	0.17	0.15	0.14	34	38	47	3 rd
s27	21	52	55	61	0.16	0.15	0.14	38	43	50	3 rd
s28	22	46	56	60	0.16	0.14	0.11	37	39	48	3 rd
s29	24	49	54	62	0.18	0.14	0.12	33	37	49	3 rd
s30	23	51	56	59	0.17	0.16	0.13	39	43	50	3 rd

Table 5: Raw data's for the selected motor fitness variables of control group (30)

Subjects code	age	Flexibility (SRT in cm)			Reaction time (in sec)			Balance (SBST, sec)			Class year
		PT	DT	PoT	PT	DT	PoT	PT	DT	PoT	
s1	21	50	48	49	0.13	0.15	0.14	35	36	38	1 st
s2	19	48	46	49	0.18	0.14	0.17	31	32	31	1 st
s3	20	47	47	48	0.15	0.14	0.14	34	34	33	1 st
s4	23	46	47	45	0.16	0.15	0.16	37	37	35	1 st
s5	22	48	48	47	0.14	0.14	0.14	29	30	33	1 st
s6	21	49	50	49	0.16	0.14	0.16	33	32	30	1 st
s7	24	45	44	44	0.14	0.14	0.15	36	36	35	1 st
s8	22	47	48	48	0.16	0.17	0.16	30	29	30	1 st
s9	22	45	46	47	0.16	0.18	0.14	35	36	35	1 st
s10	21	46	46	47	0.15	0.16	0.15	31	30	32	2 nd
s11	19	48	48	49	0.14	0.14	0.14	38	38	38	2 nd
s12	21	44	45	43	0.17	0.18	0.16	36	37	37	2 nd
s13	24	43	44	42	0.15	0.14	0.16	34	33	34	2 nd
s14	23	42	40	41	0.15	0.16	0.14	36	36	38	2 nd
s15	22	45	46	46	0.16	0.17	0.16	33	34	34	2 nd
s16	23	43	43	44	0.16	0.16	0.15	35	34	35	2 nd
s17	22	45	47	43	0.18	0.19	0.18	38	38	36	2 nd
s18	21	46	46	44	0.15	0.15	0.14	37	36	37	2 nd
s19	25	49	48	50	0.18	0.19	0.18	38	38	37	2 nd
s20	23	45	46	47	0.14	0.16	0.14	33	34	33	2 nd
s21	24	46	45	45	0.18	0.18	0.18	38	38	37	2 nd
s22	21	43	43	44	0.15	0.16	0.15	32	31	30	3 rd
s23	22	48	46	47	0.18	0.17	0.18	32	32	31	3 rd
s24	22	45	45	43	0.17	0.18	0.17	36	35	37	3 rd
s25	21	43	44	44	0.14	0.14	0.14	37	38	36	3 rd
s26	21	46	47	45	0.18	0.19	0.18	34	32	33	3 rd
s27	22	48	49	50	0.15	0.14	0.15	29	29	31	3 rd
s28	22	46	46	47	0.16	0.16	0.16	37	35	37	3 rd
s29	21	47	48	48	0.2	0.2	0.2	34	33	31	3 rd
s30	19	48	49	47	0.14	0.16	0.14	33	32	30	3 rd

APPENDIX - VI

Paired Sample T- Tests of Parameters

Table 6: Sit and reach test for experimental group (pre-during and pre post result)

Parameters	Mean value	Paired Differences					t	df	Sig. (2-tailed)
		Mean difference	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
PT - DTT	47.80-53.27	-5.4667	2.27025	.41449	-6.31439	-4.61894	-13.189	29	.000
PT - PoT	47.80-59.34	-11.5333	2.43159	.44395	-12.4413	-10.6255	-25.979	29	.000

Table 7: Sit and reach test for control group (pre-during and pre-post result)

Parameters	Mean value	Paired Differences					t	df	Sig. (2-tailed)
		Mean difference	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
PT - DTT	46.034-46.167	-.13333	1.10589	.20191	-.54628	.27961	-.660	29	.514
PT - PoT	46.034-46.07	-.03333	1.27261	.23235	-.50853	.44187	-.143	29	.887

Table 8: Ruler drop test for experimental group both pre-during and pre-post result

Parameters	Mean value	Paired Differences					t	df	Sig. (2-tailed)
		Mean difference	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
PT - DTT	.158-.135	.02334	.00763	.00139	.02050	.02619	16.766	29	.000
PT - PoT	.158-.110	.04681	.01505	.00275	.04119	.05243	17.034	29	.000

Table 9: Ruler drop test for control groups both pre-during and pre-post result

Parameters	Paired Differences						T	df	Sig. (2-tailed)
	Mean value	Mean difference	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
PT - DTT	.158-.159	-.00153	.00856	.00156	-.00473	.00166	-.981	29	.334
PT - PoT	.158-.157	.00127	.00722	.00132	-.00143	.00396	.962	29	.344

Table 10: Stand balance stork test (pre, during and post test result) for experimental group

Parameters	Paired Differences						T	df	Sig. (2-tailed)
	Mean value	Mean difference	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
PT - DTT	35.30-38.267	-2.9667	1.65015	.30127	-3.58284	-2.3505	-9.847	29	.000
Pre - Post	35.30-47.54	-12.24	2.48698	.45406	-13.1619	-11.305	-26.942	29	.000

Table 11: Stand balance stork test (pre, during and post test result) for control group

Parameters	Paired Differences						t	df	Sig. (2-tailed)
	Mean value	Mean difference	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
PT - DTT	34.367-34.167	.20000	.92476	.16884	-.14531	.54531	1.185	29	.246
PT - poT	34.3673-4.134-	.23333	1.67504	.30582	-.39214	.85880	.763	29	.452

APPENDIX - VII

Norms of Balance, Flexibility and Reaction Time Test Analysis

Table 12: Normative data of flexibility test (sit and reach test) in cm

Age	Excellent	Above average	Average	Below average
19-29				
Sex (Men)	=>23in (58cm)	20.5in (52cm)	17.5 in (44 cm)	12.25 in (31cm)

Source: *The American College of Sports Medicine (2008)*

Table 13: Normative data of balance test (stand balance stork test) in second

Sex	Excellent	Above average	Average	Below average	poor
Male	>50	37-50	15-36	5-14	<5

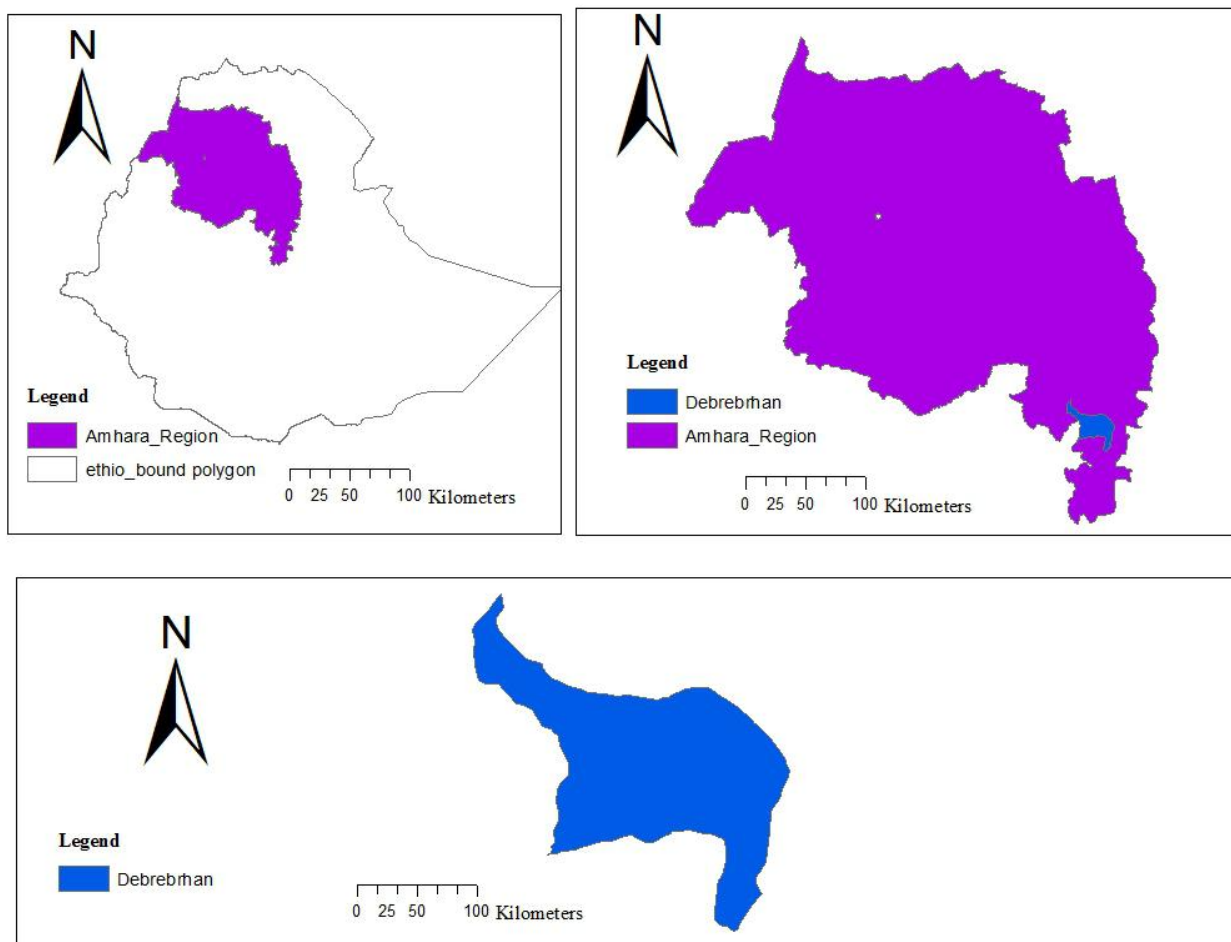
Source: *Schell, J and Leelarthaeap in 1994*

Table 14: Reaction time (ruler drop test) analysis

The table below was used to determine how long it took the ruler to being caught. Distance (d) fallen can be converted to time (t) passed with the following formula: $d \text{ (in cm)} = (1/2)(980 \text{ cm/sec}^2)t^2$, $t^2 = d/(490 \text{ cm/sec}^2)$, $t = \sqrt{d/(1/2g)}$ i.e. $t = \sqrt{d/(490 \text{ cm/sec}^2)}$, (980 cm/sec² is the acceleration of a falling mass on Earth. Since we know how fast an object falls, we can figure out how long it took to fall a measured distance)

Distance (cm)	Time (sec)	Distance (cm)	Time (sec)	Distance (cm)	Time (sec)	Distance (cm)	Time (sec)
1	0.045	8	0.128	15	0.175	22	0.212
2	0.064	9	0.136	16	0.181	23	0.217
3	0.078	10	0.143	17	0.186	24	0.221
4	0.090	11	0.149	18	0.192	25	0.226
5	0.101	12	0.156	19	0.197	26	0.230
6	0.111	13	0.163	20	0.202	27	0.234
7	0.120	14	0.169	21	0.207	28	0.239

Source: the experimental data

APPENDIX - VIII**Figure; 4: Map of the Study Site**

Source: Geographical Information System Software version 10.