

**EFFECT OF RESISTANCE TRAINING ON SELECTED HEALTH  
RELATED PHYSICAL FITNESS COMPONENTS OF DEBREWOK  
MILLENNIUM SECONDARY SCHOOL MALE STUDENTS IN CASE  
OF DEBUB BENCH WOREDA, MIZAN AMAN, SNNPR. ETHIOPIA**

**MSc THESIS**

**BINALF TESHOME ASSAYE**

**MARCH 2018**

**HARAMAYA UNIVERSITY, HARAMAYA**

**Effect of Resistance Training on selected Health Related Physical Fitness  
Components of Debrework Millennium Secondary School Male Students In  
Case of Debub Bench Woreda, Mizan Aman, SNNPR. Ethiopia**

**A Thesis Submitted to the Department of Sport Science**

**Postgraduate Program Directorate**

**HARAMAYA UNIVERSITY**

**In Partial Fulfillment of the Requirements for the Degree of**

**MASTER OF SCIENCE IN SPORT MEDICINE**

**Binalf Teshome Assaye**

**March 2018**

**Haramaya University, Haramaya**

# HARAMAYA UNIVERSITY

## POSTGRADUATE PROGRAM DIRECTORATE

As thesis Research Advisors, we hereby certify that we have read and evaluated this thesis entitled **“Effect of Selected Resistance Training on Health Related Physical Fitness Components of Debrework Millennium Secondary School Male Students in Case of Debub Bench Woreda, Mizan Aman, SNNPR. Ethiopia”** prepared by Binalf Teshome Assaye. We recommend that it can be submitted as fulfilling the thesis requirement.

Shemelis Mekonnen (PhD) \_\_\_\_\_

Major Advisor

Signature

Date

Desta Enyew (PhD) \_\_\_\_\_

Co-Advisor

Signature

Date

As members of the Board of Examiners of the MSc. thesis Open Defense Examination, we certify that we have read and evaluated the thesis work prepared by Binalf Teshome and examined the candidate. We recommended that the thesis can be accepted as fulfilling the thesis requirement for the Degree of Master of Science in Sport Medicine.

\_\_\_\_\_

Chair person

Signature

Date

\_\_\_\_\_

Internal Examiner

Signature

Date

\_\_\_\_\_

External Examiner

Signature

Date

## **DEDICATION**

I dedicated this thesis manuscript to my Mother W/ro Mulu Bahiru and my father Ato Teshome Assaye ,my Grand Father Dagne Tegege and my Grandmother Tiruye Limenih for their love ,affection and unrestricted encouragement they gave me not only to accomplish this research , but also for every success in my life.

## STATEMENT OF THE AUTHOR

First I declare this thesis is not submitted to any other institution anywhere for the award of any academic degree, diploma, or publication. This thesis has been submitted in partial fulfillment of the requirements for Master of Science degree in sport medicine at Haramaya University and deposited at the university library to be made available to borrowers under rules of the library. I declare that this thesis is my work and all sources of materials used in this thesis have been duly acknowledged. Brief quotations from this thesis are allowed without special permission provided that accurate acknowledgement of sources is made. Requests for permission for extended quotation from or reproduction of this manuscript in whole or in part may be granted by the head of the Deans of the School of Graduate Studies at Haramaya University when he/ she reaches judgment that the proposed uses of the material is in the interest of scholarship. Alternatively, permission may also be obtained from the author.

Name: Binalf Teshome Assaye      Signature: \_\_\_\_\_

Date: \_\_\_\_\_

Department: Sport Science

Place: Haramaya University, Haramya

## **BIOGRAPHICAL SKETCH**

The Author was born in West Gojam Zone, Finoteselam Town from his Mother Mulu Bahiru and his Father Teshome Assaye on November 11, 1993. He attended his primary school at Hodansh Gategon primary school and completed his primary education at Zeguay Primary school. He attended his high school education and preparatory at Damot secondary school. Then he joined Haramya University, College of Natural and Computational Science in Department of Sport Science in 2012 and received a Bachelor science degree in Sport Science in 2014.

Soon after graduation, he served in Southern Region Bench Maji Zone at Dehub Bench Woreda in Debrework Millennium Secondary School and then he Joined Haramaya University Postgraduate program in 2016 to pursue his Masters of Science Degree in Sport Medicine.

## **ACKNOWLEDGMENTS**

First and foremost, I thank the Almighty God who gave me the health, the stamina and strength to go through the rigor of graduate study and, helped me to finish the research work, thesis write up and led me to successful complete of the study.

I would like to express my deepest gratitude to my major Advisor Dr.shemelis mekonnen , and my Co-Advisor,Dr.Desta Enyew, for their constructive comments and encouragements throughout this study. It would have been impossible to complete this study without their unreserved support and guidance.

My heart-felt thank goes to Debrework Millennium Secondary School Staff Members, Students and Management for providing me with relevant information and support.

My thanks also go to my best friends, for their assistance data recorder, financial support, encouragement to start my post graduate program and thought the completion of thesis. My heart-felt thank also goes to my parents and family for their moral support, financial support, consistent advice and overall love they gave to me.

## ACRONYMS AND ABBREVIATIONS

<b>ACSM</b>	American College of Sport Medicine
<b>BMI</b>	Body Mass Index
<b>CG</b>	Control group
<b>CSA</b>	Cross Sectional Area
<b>CVD</b>	Cardio-vascular Diseases
<b>DTT</b>	During Training Test
<b>EG</b>	Experimental Group
<b>FG</b>	Fat Glycolytic
<b>MS</b>	Muscular Strength
<b>NHLBI</b>	National Heart Lung and Blood Institute
<b>NSCA</b>	National Strength and Conditioning Association
<b>PF</b>	Physical Fitness
<b>PoT</b>	Post-Test
<b>PT</b>	Pre- Test
<b>ROM</b>	Range of Motion
<b>RT</b>	Resistance Training
<b>SNNPR</b>	Southern Nation Nationalities and People Region
<b>SPSS</b>	Statistical Package for Social Science

# TABLE OF CONTENTS

<b>DEDICATION</b>	<b>iv</b>
<b>STATEMENT OF THE AUTHOR</b>	<b>v</b>
<b>BIOGRAPHICAL SKETCH</b>	<b>vi</b>
<b>ACKNOWLEDGMENTS</b>	<b>vii</b>
<b>ACRONYMS AND ABBREVIATIONS</b>	<b>viii</b>
<b>LIST OF TABLES</b>	<b>xii</b>
<b>LIST OF TABLES IN THE APPENDICES</b>	<b>xiii</b>
<b>LIST OF FIGURES IN THE APPENDIX</b>	<b>xiv</b>
<b>ABSTRACT</b>	<b>xv</b>
<b>1. INTRODUCTION</b>	<b>1</b>
1.1. Background of the Study	1
1.2. Statement of the Problem	2
1.3. Scope of the Study	3
1.4. Significance of the Study	4
1.5. Objective of the Study	4
1.5.1. General Objective	5
1.5.2. Specific Objectives	5
<b>2. REVIEW OF RELATED LITERATURE</b>	<b>6</b>
2.1. Physical Fitness and Its Components	6
2.2. Components of Health Related Physical Fitness	6
2.2.1. Cardio Respiratory Endurance	7
2.2.2. Muscular Strength	7
2.2.3. Muscular Endurance	7
2.2.4. Body Composition	8
2.2.5. Flexibility	8
2.3. Strength	9
2.3.1. Benefits of Strength Training	9
2.4. Progression of Volume and Intensity	10
2.5. Body Composition Adaptations to Resistance Training	10
2.6. Strength Adaptations to Resistance Training	11

Table of Contents (*Continued*)...

2.7.	Heart Rate Adaptations of Resistance Training	11
2.8.	Blood pressure Adaptations to Resistance Training	12
2.9.	Muscle Size and Structure	12
2.10.	Muscular Fatigue	12
2.11.	Effectiveness of Youth Resistance Training	13
2.12.	Strength Development in Children	13
2.13.	Male-Female Resistance Training Adaptation Comparisons	14
2.14.	Resistance Training Adaptations in Children and Adolescents	14
2.15.	Application of the Training Principles	15
2.16.	Resistance Training	19
2.17.	Various Types of Resistances	19
2.18.	Resistance Training Guidelines	20
<b>3.</b>	<b>MATERIALS AND METHODS</b>	<b>22</b>
3.1.	Description of the Study Area	22
3.2.	Duration of the Study	22
3.3.	Definition of Variables	22
3.4.	Experimental Design	23
3.5.	Source of Data	23
3.6.	Study Population	23
3.7.	Sampling Size and Sampling Technique	24
3.8.	Inclusion and Exclusion Criteria	24
3.9.	Data Collection Instrument	24
3.10.	Method and Procedures of Data Collection	24
3.11.	Physical Fitness Test Analysis	25
3.11.1.	Sit up Test	25
3.11.2.	Body Mass Index	25
3.11.3.	Push-up Test	26
3.12.	Resistance Training Protocol	26
3.13.	Methods of Data Analysis	27

Table of Contents (*Continued*)...

3.14.	Data Quality Control	27
3.15.	Ethical Consideration	27
<b>4.</b>	<b>RESULTS AND DISCUSSION</b>	<b>28</b>
4.1.	Overview	28
4.2.	Demographic Characteristics of the Study Participants	28
4.3.	Effect of Selected Resistance Training on Selected Physical Fitness Variables	30
<b>5.</b>	<b>SUMMARY, CONCLUSIONS AND RECOMMENDATIONS</b>	<b>33</b>
5.1.	Summary	33
5.2.	Conclusions	34
5.3.	Recommendations	35
<b>6.</b>	<b>REFERENCES</b>	<b>36</b>
<b>7.</b>	<b>APPENDICES</b>	<b>45</b>

## LIST OF TABLES

<b>Table</b>	<b>Page</b>
1. Physical characteristics of study participants	29
2. The means and mean difference values of Push up test (MR), BMI (Bwt(kg)/h <sup>2</sup> ), Sit up( in 1 minute) test result for muscular endurance of both control group(CG) and experimental group(EG).	30

## LIST OF TABLES IN THE APPENDICIES

Tables	Page
1.Paird t test result of push up	49
2. Paired t test result of sit up	49
3.Paired t test result of BMI	50
4. Selected Resistance Training Program of first Month for week 1, week 2, week 3, week 4, (October, 2017)	54
5. Resistance Training program of second month for week 1, week 2, week 3, week 4, (November, 2017)	55
6. Resistance Training program of third month for week 1, week 2, week 3, week 4 (December, 2017)	56
7. Parameters used to test muscular strength	57
8.Parameters used to test Muscular endurance	57
9.Classification of BMI	58
10.Row data recorded sheet for experimental group	59
11.Raw data recorded sheet for control group	60

## LIST OF FIGURES IN THE APPENDIX

<b>Figures</b>	<b>page</b>
1. Map of The Study Site	60

# **Effect of Selected Resistance Training on Health Related Physical Fitness Components of Debrework Millennium Secondary School Male Students In Case of Debu Bench Woreda, Mizan Aman, SNNPR. Ethiopia**

## **ABSTRACT**

*The purpose of the study was to find out the effect of resistance training on selected physical fitness components of Debrework millennium secondary school male students. To achieve the purpose of the present study, 40 male students were selected as study subjects. The subjects were selected purposively and were assigned into two equal experimental (20) and control (20) group through randomly. The experimental group participated in individualized and supervise moderate intensity resistance training program 3 days/week for 12 weeks. The control group did not participated in training program but the tests were conducted for both groups. The ages of subjects were ranged from 15-16 years. The collected data were analyzed by SPSS to determine the difference, if any among the adjusted post test means on selected dependent variables separately. In all the cases, 0.05 level of confidence was fixed to test the level of significance. The results showed that experimental groups were better performance on selected physical fitness components of Debrework millennium secondary school male students. The parameters selected for the study were: physical fitness (muscular strength, muscular endurance, and body composition) and Data were analyzed by using SPSS. The result of the study found that, muscular strength (9), muscular endurance (10.55), showed significant improvement of mean difference at ( $p < 0.05$ ). RM tests were analyzed by paired sample T-test and it was found that, push up test and sit up improved by mean difference of 53.25% and 36.37% respectively. Body composition did not show substantial alteration in statistically significant difference. However, an improvement of 7.1% was registered. There was no substantial significant improvement observed in control group. This study proved that resistance training program significantly improved selected variables.*

**Key words:** *muscular strength, muscular endurance, BMI, Resistance training.*

# 1. INTRODUCTION

## 1.1. Background of the Study

In recent years a growing body of evidence has accumulated to indicate that resistance training can be a safe, effective, and beneficial method of conditioning for youth. Research into the effects of resistance exercise on children and adolescents has increased over the past decade, and the qualified acceptance of youth strength training by medical and fitness organizations has become almost universal. (American Academy of Pediatrics 2001) Support participation in youth resistance training activities provided the program is appropriately designed and competently supervised. The term resistance training refers to a specialized method of conditioning that involves the progressive use of a wide range of resistive loads and a variety of training modalities (e.g., free weights [barbells and dumbbells], weight machines, elastic cords, medicine balls, and body weight) designed to enhance muscle function, increase muscle size, improve body composition, boost sports performance, and reduce athletic injuries. While the terms resistance training, strength training, and weight training are sometimes used synonymously, the term resistance training encompasses a broader range of training modalities and a wider variety of training goals.

Although the health a benefit of youth resistance training has not been unequivocally established, a growing body of evidence suggests that appropriately prescribed and competently supervised resistance training programs may have observable health value for boys and girls. Along with other types of physical activity, regular participation in resistance training activities has been shown to positively influence bone mineral density. (Morris et al., 1997).Resistance training, also known as weight training or strength training has gained great popularity in recent years, largely due to its appeal and positive impact on many diverse populations, such as athletic, recreational and clinical communities. Thus, resistance training programs are used to achieve many different goals, such as performance improvement, injury rehabilitation, muscle tone improvement and strength improvement (ACSM, 2011)

Resistance training is a systematic program of exercises involving the exertion of force against a load with the goal of developing strength, endurance, and/or hypertrophy of the muscular system (Davies and Barnes, 1972). It is commonly called strength or weight training. Resistance training is used for a wide variety of reasons, including to improve overall health,

improve athletic performance, rehabilitate an injury, change one's physical appearance, or compete in power lifting or bodybuilding contests. Resistance training is a recommended component of a well-rounded fitness program for healthy children, adolescents, adults, and older adults. A resistance training program should be individualized, be progressive, and involve all the major muscle groups (ACSM, 1998).

The scientific and medical community accepts that muscular strength is a necessary trait for health, functional ability, athletic performance, and an enhanced quality of life. Resistance training is acknowledged as an effective way to develop musculoskeletal health and is now routinely recommended by health and fitness professionals. Especially when incorporated as part of a comprehensive fitness program, resistance training helps reduce the risk factors associated with coronary artery disease, type 2 diabetes, and colon cancer; promotes weight loss and maintenance; and improves dynamic stability and preserves functional capacity (ACSM, 2002; Bird et al., 2005).

Resistance exercise leads to increased muscular strength, endurance, and power. Increased strength is the most obvious result of a resistance training program and the reason many individuals participate in resistance training. Strength gains following a resistance training program vary widely, owing largely to differences in initial strength and the training program. Resistance training at least twice a week improves muscle strength and endurance by approximately 25–100% (Haskell et al., 2007).

RT increases muscle size and strength. The increase in the cross-sectional area (CSA) of the whole muscle reflects an increase in the individual muscle fiber cross-sectional area. The increased cross-sectional area of the muscle results from hypertrophy of all three muscle fiber types, although the fast-glycolytic (FG) fibers appear to have the greatest increase (Bird et al., 2005). The hypertrophy that occurs is due to an increase in the total contractile protein (actins and myosin), in the size and number of the myofibrils per fiber, and in the amount of connective tissue surrounding the muscle fibers (Rogers and Evans, 1993).

## **1.2. Statement of the Problem**

Resistance training is a systematic program of exercises involving the exertion of force against a load with the goal of developing strength, endurance, and/or hypertrophy of the muscular system (Davies and Barnes, 1972). Resistance training is important to improve sport performance and prevent injuries and enhance long-term health. Similar to other physical activity, resistance training is a recommended component of a well-rounded fitness program for healthy children, adolescents, adults, and older adults and has a beneficial effect on several measurable health indices, such as cardiovascular fitness, body composition, bone mineral density, and blood lipid profile, mental health. (Fainguenbaum, 2000 and ACSM 1998). Current recommendations suggest that school-aged youth should participate daily in 60 minutes or more of moderate to vigorous physical activity that is developmentally appropriate, enjoyable, and involves a variety of activities (Strong et al., 2005). While children and adolescents have traditionally been encouraged to participate in aerobic activities such as swimming and bicycling, a compelling body of evidence indicates that resistance training can be a safe and effective method of exercise for youth. (Blimkie, C. 1993). Similarly, in Debu Bench Woreda, especially in Debrework millennium secondary school, most students are not participating in a resistance program and have not been studied further yet. So this research emphasizes the effect of resistance training on health-related physical fitness components of body composition, muscular strength, and muscular endurance of Debrework millennium secondary school among grade 10<sup>th</sup> male students. In the case of Debu Bench Woreda.

Therefore, the following questions were answered.

1. What is the effect of resistance training on body composition on male students?
2. What is the effect of resistance training on muscular strength and muscular endurance on male students?
3. What changes does the resistance training program have on the selected physical fitness components of male students?

### **1.3. Scope of the Study**

The scope of this study is located at southern Ethiopia which is far 589 km from the capital city Addis Ababa. This research was covered Debrework millennium secondary school grade 10<sup>th</sup> male student's age between 15-16 years old. According to time and money only muscular strength, muscular endurance and body composition were selected for this study.

#### **1.4. Significance of the Study**

The main significance of this study was help to find out the effect of resistance training program on selected health related physical fitness components of body composition, muscular strength and muscular endurance of male students. The outcome of this study was help to know the effect of resistance training on health related physical fitness components of students. The finding of the research may help as reference for researchers who will conduct advanced researches of exercise physiology particularly in resistance training program effect. More ever have the following advantages:-

- It would help to increase awareness of resistance training on male students.
- It would help to guide coach and physical educators on procedures of training.
- It would help to encourage and motivate participation of students on resistance training.

#### **1.5. Objective of the Study**

### **1.5.1. General Objective**

The general objective of this study was to investigate the effect of selected resistance training on selected health related physical fitness components of debrework millennium secondary school grade 10<sup>th</sup> male students in Debrework city.

### **1.5.2. Specific Objectives**

- To investigate the effect of resistance training on body composition of Debrework millennium secondary school male students.
- To evaluate the effect of resistance training on muscular endurance and strength of Debrework millennium secondary school of male students.
- To compare and examine the performance improvement of experimental group when compared with the control group after the intervention of resistance training.

## **2. REVIEW OF RELATED LITERATURE**

This chapters includes physical fitness and its components, components (cardiovascular endurance, muscular strength, muscular endurance, body composition, flexibility),strength, benefits of strength training, progression of volume and intensity, body composition adaptation to resistance training, strength adaptation to resistance training, heart rate adaptation to resistance training, blood pressure adaptation to resistance training, muscle size and structure and muscular fatigue, effectiveness of youth resistance training, strength development in children, male female resistance training adaptation comparisons, resistance training adaptations in children and adolescent ,application of the training principle.

### **2.1. Physical Fitness and Its Components**

Physical fitness is an integrated measure of most, if not all, the body functions (skeletonmuscular,cardio-respiratory,hemato-circulatory,psycho-neurologicaland) involved in the performance of daily physical activity and/or physical exercise (Ortega et al., 2008). When Physical fitness is tested; the functional status of all these systems is actually being checked. This is the reason why physical fitness is nowadays considered one of the most important health markers, and predictor of morbidity and mortality for cardiovascular disease (CVD) and for all causes. Physical fitness is in part genetically determined, but it can also be greatly influenced by environmental factors. Physical exercise is one of the main determinants (Andersen, 2003).

### **2.2. Components of Health Related Physical Fitness**

Health-related physical fitness is a physiological state of well-being that reduces the risk of hypo-kinetic disease; a basis for participation in sports; and vigor for the tasks of daily living. It includes components like cardio respiratory endurance, muscle strength, muscle endurance, flexibility, and body composition which are directly related to improved health (Anschel et al., 1991).

### **2.2.1. Cardio Respiratory Endurance**

Cardio-respiratory endurance is the ability of the blood vessels, heart and lungs to take in, transport, and utilize oxygen. Cardio-respiratory fitness is one of the most important components of health-related fitness. Cardio-respiratory fitness reflects the overall capacity of the cardiovascular and respiratory systems and the ability to carry out prolonged strenuous exercise. Hence, cardio-respiratory fitness has been considered a direct measure of the physiological status of the person. Cardio-respiratory fitness, cardiovascular fitness, cardio respiratory endurance, aerobic fitness, aerobic capacity, aerobic power, maximal aerobic power, aerobic work capacity, physical work capacity and maximal oxygen consumption (VO<sub>2</sub> max) all refer to the same concept and are used interchangeably in the literature (Jonatan et al., 2006).

### **2.2.2. Muscular Strength**

Maximum strength represents the maximal amount of force that can be generated by a muscle or group of muscles, regardless of the amount of time it takes (Tan, 1999). Training for maximum strength improves the ability to recruit fast-twitch muscle fibers, which typically are not recruited when training with lighter loads, especially among novice clients (Weir and Brown, 2012). From a physiological standpoint, the heavy loads and longer rest periods can result in a greater increase in circulating testosterone, while the use of moderate loads and intensity combined with short rest periods employed during hypertrophy training can lead to greater increases in growth hormones comparatively. (Willardson, 2008).

### **2.2.3. Muscular Endurance**

Muscular endurance is defined as the ability to maintain sub maximal muscle actions (Willardson, 2008). Training for muscular endurance combines high repetition ranges with short rest periods, bringing about high levels of metabolic stress thereby requiring lighter loads to complete the prescribed number of repetitions. These lighter loads are not as effective in stimulating muscle hypertrophy as moderate loads with slightly longer rest periods (as recommended in the hypertrophy phase) (Schoenfeld, 2010). Muscular endurance training is most commonly performed with either standard exercise order (completing all sets of an

exercise before moving on to another exercise) or through circuit training. Resistance exercise performed through circuit training has been shown to improve VO<sub>2</sub> max, lactate threshold, body composition, and strength endurance in untrained populations (Waller, et al., 2011).

#### **2.2.4. Body Composition**

Body composition has been known to be one of the major health related components of physical fitness (PF) that is affected by body weight and interconnected with muscles, fat, bone, and other important body tissues. Sometimes though, this element of a larger whole is reduced to fat and fat-free mass, and assessed as a body fat percentage and total body weight (in kilograms) (Lindsay et al., 2013).

#### **2.2.5. Flexibility**

Flexibility is the range of motion (ROM) in a joint or series of joints that reflects the ability of the musculoskeletal structures to elongate within the physical limitations of the joint (Hubley-Kozey, 1991). The two basic types of flexibility are static and dynamic. Static flexibility is the ROM about a joint without considering how easily or quickly the ROM is achieved. Dynamic flexibility is the resistance to motion in a joint that affects how easily and quickly a joint can move through its ROM. More recently, dynamic flexibility is also defined as the rate of increase in tension in a contracted or relaxed muscle as it is stretched. Thus, dynamic flexibility accounts for the resistance to stretch (Knudson et al., 2001).

Flexibility exercises should be held to the point of tension for 15 seconds or longer, and be performed 3 to 7 days per week (Tony and Susana, 2006). Even though children will often gravitate naturally toward ballistic stretching, the focus should be on slow, controlled static stretching. Some good examples of flexibility/stretching exercises for kids are shoulder stretch, triceps stretch, sit and reach, quadriceps stretch, hamstring stretch, calves stretch etc. (EETC Inc., 2002).

The importance of flexibility to health, good posture and physical performance is even appreciated by animals like the cat and the dog that stretch after sleeping to maintain good joint mobility. Every person needs some flexibility to perform efficiently and effectively in daily life. Body builders, who have developed bulged muscles through improper weight

training, usually sacrifice flexibility in order to develop muscle strength. In strength training, it is important to ensure that all movements are carried through their full range of motion to satisfy the good thumb rule; stretch what you strengthen and strengthen what you stretch (Scott, 2002).

## **2.3. Strength**

Strength is the ability of a muscle or muscle group to exert force against a resistance. It is usually measured as one maximal effort. For dynamic resistance exercise, this is often called a one-repetition maximum (1-RM). Strength is related to body size and muscle mass, so that sex differences might relate to a size advantage in boys. During childhood and adolescence boys tend to have greater strength per unit body size, especially in the upper body and trunk than girls, but corresponding sex differences in lower extremity strength are negligible. In fact, isometric strength in boys and girls increases during childhood and adolescence more than predicted from height alone (Asmussen and Heeboll-Nielsen 1955).

### **2.3.1. Benefits of Strength Training**

In addition to the obvious goal of getting stronger, strength-training programs may be undertaken to try to improve sports performance and prevent injuries, rehabilitate injuries, and/or enhance long-term health. Similar to other physical activity, strength training has been shown to have a beneficial effect on several measurable health indices, such as cardiovascular fitness, body composition, bone mineral density, blood lipid profiles, and mental health.(Faigenbaum AD, 2000).Resistance training is being incorporated into weight-control programs for overweight children as an activity to increase the metabolic rate without high impact. Similar to the geriatric population, strength training in youth may stimulate bone mineralization and have a positive effect on bone density. (Morris FL, et al., 1997).

As we age we tend to lose lean muscle mass. Resistance training helps maintain and combat the loss of muscle mass by increasing muscular fitness. This form of training can also prevent osteoporosis by augmenting bone mineral density. What's more? Regular resistance training can decrease the risk of heart disease by lowering body fat, decreasing blood pressure, improving cholesterol, and lowering the stress placed on the heart while lifting a particular

load. Improving muscular fitness is very important for enhancing quality of life. (ACSM, 2013).

## **2.4. Progression of Volume and Intensity**

When untrained or sedentary youth with a low-training age and poor technical competency first begin to participate in formalized resistance training programs, the use of 1RM measurements (actual or predicted) to determine training intensities will typically be unnecessary. Consequently, an appropriate repetition range should be prescribed to develop technical competency and acquire a base level of adaptation, and over time the external load can be increased provided exercise technique has sufficiently improved. For individuals without prior experience of resistance training, initial prescription should use low volume (1–2 sets) and low-moderate training intensities ( $\leq 60\%$  1 RM) for a range of exercises and movement patterns. (Ratamess et al, 2009).

## **2.5. Body Composition Adaptations to Resistance Training**

RT programs can increase fat-free mass and decrease the percentage of body fat. One of the outstanding benefits of resistance exercise, as it relates to weight loss, is the positive impact of increasing energy expenditure during the exercise session and somewhat during recovery, and on maintaining or increasing fat-free body mass while encouraging the loss of fat body weight (Young and Steinhard, 1995) . It is more likely that body composition is affected and controlled by resistance training programs using the larger muscle groups and greater total volume (Stone, et al., 1991). Moderate-intensity resistance training also significantly increased lean mass (3.4% for women and 1.9% for men), peak force, and strength for the men as well as the women (Maddalozzo and Snow, 2000). Volume in resistance training is equal to the total workload, which is directly proportional to the energy expenditure of the workout. Total volume is determined by the total number of repetitions (repetitions x sets) performed times the weight of the load (total repetitions x weight). Often you will see total volume calculated multiplying the number of sets x repetitions x load. For example, three sets of 12 repetitions with 50 lbs would be expressed,  $3 \times 12 \times 50 = 1,800$  lbs of volume. An impressive finding to highlight with resistance training is that the energy expenditure following the higher total

volume workouts appears to be elevated, compared to other forms of exercise, and thus, further contributes to weight loss objectives.

## **2.6. Strength Adaptations to Resistance Training**

The increases in muscular strength during the initial periods of a resistance training program are not associated with changes in cross-sectional area of the muscle (Sale, 1988) . Changes in strength evidenced in the first few weeks of resistance training are more associated with neural adaptations (Moritani and deVries, 1979). Which encompass the development of more efficient neural pathways along the route to the muscle. The motor unit (motor nerve fiber and the muscle fibers it innervates) recruitment is central to the early (2 to 8 weeks) gains in strength. Collectively, the learned recruitment of additional motor units, which may respond in a synchronous (the coincident timing of impulses from 2 or more motor units) fashion (Wilmore and Costill, 1994). The increased activation of synergistic muscles, and the inhibition of neural protective mechanisms (Kraemer, 1994). all contribute to enhance the muscle's ability to generate more force. It is possible that two adjacent muscle fibers, with different motor nerves, could result in one fiber being activated to generate force while the other moves passively.

## **2.7. Heart Rate Adaptations of Resistance Training**

Heart rate is acutely elevated immediately following a workout and affected by the amount of resistance, the number of repetitions and the muscle mass involved in the contraction (small vs. large mass exercises) (Fleck, 1988) . Interestingly, in terms of chronic adaptations, there appears to be a reduction in heart rate from resistance training, which is considered beneficial (Stone et al., 1991). Long term adaptations observed in the research, from no change up to a 11% decrease in heart rate, may be explained by the differences in intensity, volume, rest between sets, use of small vs. large muscle mass, duration of study and fitness level of the subjects.

## **2.8. Blood pressure Adaptations to Resistance Training**

Conservative estimates postulate that 50 million Americans, approximately 1 in 4 adults, have high blood pressure. More than 90% of these cases are identified as primary hypertension, which increases the risk of heart failure, kidney disease, stroke, and myocardial infarction (Tipton, 1984). During a resistance exercise bout, systolic and diastolic blood pressures may show dramatic increases, which suggest that caution should be observed in persons with cardiovascular disease (Stone et al., 1991), or known risk factors. The extent of the increase in blood pressure is dependent on the time the contraction is held, the intensity of the contraction, and the amount of muscle mass involved in the contraction (Fleck, 1988). More dynamic forms of resistance training, such as circuit training, that involve moderate resistance and high repetitions with short rests are associated with reductions in blood pressure. Studies have shown decreases in diastolic blood pressure (Harris and Holly, 1987).

## **2.9. Muscle Size and Structure**

Resistance training increases muscle size and strength. The increase in the CSA of the whole muscle reflects an increase in the individual muscle fiber cross-sectional area. The increased cross-sectional area of the muscle results from hypertrophy of all three muscle fiber types, although the FG fibers appear to have the greatest increase (Bird et al., 2005). The hypertrophy that occurs is due to an increase in the total contractile protein (actins and myosin), in the size and number of the myofibrils per fiber, and in the amount of connective tissue surrounding the muscle fibers (Rogers et al., 1993).

## **2.10. Muscular Fatigue**

Anyone who has participated in vigorous activity is familiar with muscular fatigue. Although exercise physiologists have studied fatigue for a long time, many questions remain about the basic cellular causes of fatigue. The NHLBI defines fatigue as “a condition in which there is a loss in the capacity for developing force and/or velocity of a muscle, resulting from muscle activity under load which is reversible by rest” This means that fatigue results in a transient loss in the ability of the muscle to develop force and/or velocity, often leading to a cessation of

muscular work or an inability to maintain a given intensity of work. The muscle is not damaged, and restoration and recovery are possible (NHLBI, 1990).

## **2.11. Effectiveness of Youth Resistance Training**

During childhood and adolescence, physiologic factors related to growth and development are in a constant state of evolution. Due to the progression of growth, it can be expected that healthy children will show noticeable gains in height, weight, maximal oxygen uptake, anaerobic capacity, and muscle strength during the developmental years (Rowland, T. , 2005.).

Although different children do not follow the same rates of change, performance variables such as grip strength normally increase from childhood through the early teenage years (Malina et al., 2004). Consequently, strength changes from low-volume (sets 3 repetitions 3 load), short-duration resistance training programs may not be distinguishable from gains due to normal growth and development (Docherty et al 1987). A compelling body of scientific evidence indicates that children and adolescents can significantly increase their strength—above and beyond growth and maturation providing that the resistance training program is of sufficient intensity, volume, and duration (Blimkie, et al 1996).

## **2.12. Strength Development in Children**

Exercises in this article can be implemented for both young girls and boys. Essentially, there is no difference in strength among boys and girls during early childhood prior to puberty. As both genders advance through puberty, the difference intensifies (Malina & Bouchard, 1991). By age 11-12 years, the average strength of girls is about 90% that of boys. The percentage drops to about 80% by age 13-14 and 75% by age 15-16. Such changes occur primarily due to pubertal, hormonal changes. Developing an appropriate resistance training program for younger children requires an understanding of the adaptations that occur in their bodies after <sup>regular</sup> participation in a resistance training program. Preadolescent boys and girls have the ability to improve their relative strength similar to gains observed in adults (Pfeiffer & Francis, 1986). However, due to low levels of muscle building hormones, strength gains in preadolescent children are more a result of neuromuscular adaptations and improved technique (Blimkie, 1993). In adolescence, strength improvements become attributable to neuromuscular

adaptations, improved technique, and muscle hypertrophy (Pfeiffer & Francis, 1986). So, when resistance training programs are well organized and students are taught proper technique and safety precautions, training can be safe and beneficial for both preadolescents and adolescents (Faigenbaum et al, 1998)

### **2.13. Male-Female Resistance Training Adaptation Comparisons**

Although men are typically stronger than women, both sexes respond to resistance training in a similar manner (Bird et al., 2005). Typically, sedentary males and females can attain strength gains of 25–100% in a training program, although the actual increase in strength varies among muscle groups and is affected by the individual's initial strength (Haskell et al., 2007)

### **2.14. Resistance Training Adaptations in Children and Adolescents**

Resistance training produces strength gains in prepubescent and adolescents and is recognized as an important component of youth fitness programs. Research suggests that strength gains of approximately 30% (range 13–40%) are typical of following short-term resistance training programs (up to 20 weeks) in children. Increases in strength seem fairly consistent between prepubescents and adolescents. There is no apparent difference in the relative strength (percentage) increases between boys and girls or between children / adolescents and adults (Falk and Tenenbaum, 1996; Rowland, 2005). A common misperception related to youth resistance training is that it will stunt the structural growth of youth or damage the epiphyseal or growth plates. This myth seems to have come from an earlier report that suggested that children who performed heavy labor experienced damage to their epiphyseal plates which results in significant decreases in stature (Kato & Ishiko, 1964). Current observations indicate no evidence of a decrease in structure in youth who participate in resistance training programs in controlled environments (Sadres, et al., & Falk, 2001).

## 2.15. Application of the Training Principles

The training principles for a safe and effective resistance training program are the same as for other types of exercise programs.

**Exercise Intensity.** Exercise intensity can be expressed as a percentage of either maximal heart rate (%HRmax) or heart rate reserve (%HRR). Both techniques, explained below, require HRmax to be known or estimated. The methods are most accurate if the HRmax is actually measured during an incremental exercise test to maximum. If such a test cannot be performed, HRmax can be estimated. Classification of intensity by %HRmax as ,Very Light = (<35), Light = (35-54), Moderate = (55-69), Hard = (70-89), Vey Hard = (90), Maximal = (100). Note that these percentages and classifications are intended to be used when the exercise duration is 20–60 minutes and the frequency is 3–5 d·wk<sup>-1</sup>. (ACSM, 1998).

Exercise for CR development must be strenuous enough to elevate the heart rate to between 60 and 90 percent of the heart rate reserve (HRR). Those with low fitness levels should start exercising at a lower training heart rate (THR) of about 60 percent of HRR. For muscular strength and endurance, intensity refers to the percentage of the maximum resistance that is used for a given exercise. When determining intensity in a strength-training program, it is easier to refer to a “repetition maximum” or “RM.

Volume and intensity are key resistance training variables that are routinely manipulated within a training session, or overall phase of training, depending on the primary training goal of the individual. Volume refers to the total number of times an exercise is performed within a training session, and is comprised of the number of sets, and number of repetitions within each set. Volume can also relate to the overall loading within short- and long-term training blocks, but for the purposes of the current manuscript the former definition will be used. Intensity most commonly refers to the magnitude of resistance that is required to be overcome during a repetition. The relationship between volume and intensity is inverse in nature; the greater the load (intensity), the lower the number of repetitions that can be completed (volume) by the individual. Both variables must be considered synergistically when prescribing resistance training for youth, however, training intensity is arguably more important owing to the injury risk associated with exposing a child or adolescent to excessive external loading at the expense

of correct technique. In order to prescribe appropriate training intensity, coaches typically stipulate a percentage of an athlete's one repetition-maximum (1RM). (Baechle, et al., 2008).

**Specificity** As in any training program, a plan for muscular fitness must be specific to the individual's goals. Individuals may pursue resistance training as part of a comprehensive fitness program to improve overall health, to enhance functional capacity, or to improve athletic performance. For muscular fitness, the goals of a resistance training program may include the development of muscular strength, hypertrophy, power, muscular endurance, or any combination of the above. Of course, these goals overlap. A person who gains muscle mass (hypertrophy), for example, is certainly stronger. However, the resistance training program should emphasize the goal that is most important to the individual. Many individuals focus on different components of muscular fitness at different times as part of a well-designed periodization plan. The specificity training principle applies to the muscle groups being trained, the type of contraction performed, the selection of single- or multiple-joint exercises, and the velocity of contraction.

## **Overload**

Successfully applying the overload principle in resistance training requires the manipulation of intensity (load), volume, frequency, and rest intervals. The intensity of the workout can be expressed as a relative load (a percentage of an individual's 1-RM) or an absolute load (a specific amount of weight). Volume is a measure of the total amount of work done in an exercise session and can be expressed in several ways, for example, total number of repetitions, number of repetitions  $\times$  number of sets, or number of repetitions  $\times$  number of sets  $\times$  intensity (Wernbom et al., 2007).

Load is commonly expressed as a percentage of 1RM (one repetition maximum), which is the heaviest load that can be lifted once while maintaining correct form/technique during a given exercise. Load and the number of reps performed have been shown to be highly associated to specific training goals. For example, heavier loads ( $> 80\%$  of 1RM) with lower reps are associated with gains in strength, while lighter loads ( $< 70\%$  of 1RM) with higher reps are associated with gains in muscular endurance (Haff G. H., 2012). Before assigning load, the personal trainer must determine the 1RM of the desired lift. This can be attained by

performing a true 1RM test or by using a multiple repetition maximum (RM) test to estimate the 1RM.

## **Progression**

Once the body has adapted to the current training level, exercise stress should be increased following the overload principle if further adaptations are desired. This principle is the basis of progressive resistance exercise. Progression should be done gradually. Progression can be accomplished by increasing the load, the repetitions, the number of sets, or the frequency of the workout or by decreasing the rest period between sets. Load and the number of repetitions are the variables most often manipulated. Again, the choice depends largely on the individual's goals. If strength is the primary goal, then a heavier weight should be used. If endurance is the goal, then the same weight should be lifted more times. Often a combination of these two variables is used. For instance, many people begin with a weight they can lift for six repetitions. As they adapt to this stress, they progress to seven repetitions, then eight repetitions, and so on. Once they can perform 8–10 repetitions, they increase the weight to something they can again only lift for 6 repetitions. As recommended earlier, a novice lifter should begin by doing more repetitions with a lighter load. Once the body has adapted, the individual can lift heavier weights. Although it has been recommended that acute increases in training volume should be small (2.5–5%), advanced athletes often exceed this recommendation (Kraemer and Ratamess, 2004).

## **Rest/Recovery/Adaptation**

Muscles adapt to the stress placed on them. The most obvious changes that result from a resistance training program are increased muscle strength and size. However, the extent to which muscles adapt to training by becoming stronger and bigger depends on the training program that is followed. For example, at some point during a resistance training program, individuals will realize that their initial 10-RM can now be lifted more than 10 times. This indicates that adaptation has occurred. The rate of adaptation depends on several factors, including rest periods and adequate diet, and the rate may not be the same for all muscle groups trained. The importance of rest (recovery) between exercise sessions to allow for the positive adaptations of exercise training cannot be overemphasized. At least 1 day of rest

should follow a day of training for a particular muscle group. Adequate rest periods and alternating heavy and light days are important to allow training adaptations to occur and to prevent injury and soreness.

### **Retrogression/Plateau/Reversibility**

Despite the best plans of coaches, training improvements do not occur in a linear fashion. Even with progressively increasing workloads, at times, performance will stay at the same level (plateau) or show a decrease (retrogression). The causes may be overtraining or individual differences. If overtraining is suspected, it is wise to include more rest days or include light days in the training regimen.

### **Warm-Up and Cool down**

A proper warm-up raises body temperature and is often recommended to prevent injury and muscle soreness. Although a warm-up has not been conclusively proven to decrease the incidence of injury, some evidence is consistent with this theory. A higher temperature decreases the viscosity of the joint capsule and increases the speed of muscle contraction and relaxation and enzymatic reactions (Enoka, 1988). General and specific warm-ups for resistance training are recommended for weight lifting and isokinetic exercises (Perrin, 1993). A general warm-up involves the major muscles of the body; it is similar to the warm-up used for aerobic exercise and includes activities such as jumping rope or jogging. Specific warm-up activities for weight training involve performing the same lifts that are part of the normal program but at a weight well below the training level. The duration and the intensity of the warm-up should be suited to the individual and the task to be performed. A proper warm-up should cause a rise in core body temperature of 0.5-1.0°C but should not be so strenuous that it causes fatigue. Generally, a warm-up is considered adequate when the individual begins to sweat.

A cool down period, followed by stretching, is recommended after a training session. Cooling down may prevent muscle soreness and lead to an increase in flexibility, an aspect of muscular fitness often overlooked in resistance training programs. Importantly, cooling down helps prevent venous pooling of blood in the lower extremities. A warm-up and cool down are just

as important for children as for adults. The same pattern of activities should be followed to increase body temperature and to stretch the muscles.

Source: plowman, Sharon A. Exercise physiology for health , fitness, and performance- 3<sup>rd</sup>.

## **2.16. Resistance Training**

The term “resistance training” refers to a specialized method of conditioning that involves the progressive use of a wide range of resistive loads, including body mass, and a variety of training modalities designed to enhance health, fitness, and sports performance. Although the terms “resistance training”, “strength training”, and “weight training” are sometimes used synonymously, resistance training encompasses a broader range of training modalities and a wider variety of training goals. The term “weightlifting” refers to a competitive sport that involves the snatch and clean and jerk lifts. RT programs do not seem to influence growth in height and weights of pre- and early adolescent youth, whereas changes in body composition, considering both fat and muscle mass, are minimal. (Malina 2006; et al). The terms resistance exercise and resistance training are often used interchangeably; however, there is an important distinction between the two terms. Resistance exercise refers to a single exercise session, whereas resistance training refers to the combination of many consecutive resistance exercise sessions over time. Thus, a resistance exercise protocol is an exercise prescription for a single session (also called a “workout”) and a resistance training program is an overall program guiding the specific exercise parameters chosen for each exercise protocol (ACSM, 1998). RT define as a specialized method of conditioning that involves the progressive use of a wide range of resistive loads, including body mass, and a variety of training modalities (e.g., machine-based training, free weight training, plyometric training, complex training, functional training) designed to enhance muscular fitness and athletic performance (Behm et al.2008).

## **2.17. Various Types of Resistances**

Resistance training can be accomplished with traditional free weights and dumbbells, weight machines, body weight, elastic tubing, medicine balls, or even common household products like milk jugs filled with sand or soup cans. The choice to incorporate a certain type of resistance depends on level of physical fitness, how familiar a person is with specific exercise

movements, and individual goals. For example, low fit individuals can focus primarily on machine-based exercises as they have been regarded as safer to use compared to more complex free weight exercises. The incorporation of free weight movements can be performed as a person increases his or her muscular fitness. For example, advanced individuals can perform multiple sets and heavier resistances using multiple-joint exercises, such as squats and dead lifts. Whichever form of resistance is chosen, multiple-joint, large muscle group exercises should be performed before single-joint, smaller group exercises. (ACSM 2013)

## **2.18. Resistance Training Guidelines**

A prerequisite for the development and administration of safe, effective and enjoyable youth resistance training programs is an understanding of established training principles and an appreciation for the physical and psychosocial uniqueness of children and adolescents. Although there is no minimum age requirement at which children can begin resistance training, all participants must be mentally and physically ready to comply with coaching instructions and undergo the stress of a training program. In general, if a child is ready for participation in sport activities (generally age seven or eight), then he or she is ready for some type of resistance training. Although a medical examination prior to participation in a youth resistance training program is not mandatory for apparently healthy children, a medical examination is recommended for youth with signs or symptoms suggestive of disease and for youth with known disease. Instruction and supervision should be provided by qualified adults who have an understanding of youth resistance training guidelines and who are knowledgeable of the physical and psychosocial uniqueness of children and adolescents. Moreover, teachers, personal fitness trainers, and youth coaches should develop an appropriate philosophy about training youth that is consistent with the needs, goals and interests of children and adolescents. ( Jones, et al 2000). Activities should be carried out at a pace that is comfortable for the user. Users should discontinue participation in any exercise activity that causes pain or discomfort. In such event, medical consultation should be immediately obtained. Muscular strength is the ability of a muscle or muscle group to exert a maximal external force. W Load: 60-70% 1RM for novice to intermediate; 80-100% for advanced • Volume: 1-3 sets of 8-12 repetitions for novice to intermediate; 2-6 sets of 1-8 repetitions for advanced • Rest period: 2-3 min for higher intense exercises that use heavier loads; 1-2 minutes between the lower intense

exercises with light loads and Local muscular endurance is the ability of a muscle or a muscle group to repeatedly exert a sub maximal resistance. • Load: lower than 70% of 1RM • Volume: 2-4 sets of 10-25 repetitions • Rest period: 30 seconds to 1-minute between each set (ACSM 2013).

### 3. MATERIALS AND METHODS

This chapters includes Experimental area ,Experimental Materials, Experimental Design, Source of data, Study population, Sampling size, and Sampling Technique, Inclusion and exclusion criteria, Data collection instrument, Method and procedures of data collection, Resistance Protocol, Methods of data Analysis and Ethical consideration.

#### 3.1. Description of the Study Area

The research study was take place at debrework millennium secondary school grade 10<sup>th</sup> male students in Debrework, Debub Bench woreda, Bench Maji zone, SNNPR. Mizan tefere is the largest town and the administrative center of Bench Maji zone of SNNPR in southern Ethiopia and located between a 7<sup>0</sup>’N latitude and 35<sup>0</sup> 35’E and elevation of 1451meters the study area was located about 160 km from southern jima and 565km of Addis Ababa and the specific area of the study far 24 km from Mizan Tefere town. South bench is one of zone of bench maji zone nation nationality people live in Debub bench woreda. The map of study sit is indicated on page 60. ([https://en.wikipedia.org/wiki/Mizan\\_Teferi](https://en.wikipedia.org/wiki/Mizan_Teferi)).

#### 3.2. Duration of the Study

The research was carried out for three consecutive months from October 06, 2017, to January 06, 2018 (for 12 weeks) and 3 non consecutive days (Tuesday. Thursday, Saturday) for 60 minutes each day.

#### 3.3. Definition of Variables

**Body composition-** is refers to the proportion of fat and fat-free mass (muscle, bone and water) in the body. (Health and wellness for life, 2010)

**Muscular endurance:** The ability of a muscle or muscle group to perform repeated contractions against a resistance over a period of time. (Coulson & Archer, 2009)

**Muscular strength-** Muscular strength is the maximum amount of force a muscle or muscle group can generate (Coulson & Archer, 2009).

**Resistance training** is refers to a specialized method of conditioning whereby an individual is

working against a wide range of resistive loads to enhance health, fitness and performance. (Faigenbaum .,et al.2009)

**Body mass index (BMI):** A measure of a person's stockiness (body mass in kilograms divided by height in meters squared,  $BMI = \text{Weight} / \text{Height}^2$ ) used to assess if a person is underweight, of healthy weight, overweight, or obese (Swain, 2014).

### **3.4. Experimental Design**

Pretest during test and posttest completely randomized experimental study design was used for this study. All students who is voluntary to participate was invited to participate through a notice for study and 55 volunteers male students were filled medical history and physical activities readiness questionnaire . 15 of 55 volunteers were rejected based on the designed requirements.40 volunteers students were selected as the study subject. Then participants were randomly assigned in to two groups 20 subjects as experimental group and 20 control groups by randomized method. Control group (CG) was not implemented regular physical exercise or resistance training but they participated on their daily routines. While specially designed resistance training program was implemented on the experimental group (EG) for 60 minutes of 3 non constitutive days per a week for 12 weeks.

### **3.5. Source of Data**

Both primary and secondary source of data was used in this research study. Primary source of data was designed by collecting a data through the supervision of experimental process (recorded pre test, during training test and post test result) and secondary data was obtained from different documents, journals, books, internet source.

### **3.6. Study Population**

Study population of this study was grade 10<sup>th</sup> Debrework millennium secondary school 403 male students with the age range between 15-16 years old.

### **3.7. Sampling Size and Sampling Technique**

The researcher employed simple random sampling technique to select the groups and for treatment allotment. The samples of this study were consisted of 40 male students of debrework millennium secondary school and their age is 15-16 years old. First the study population were informed to come and registered for participation in the study, through a notice. Then 55 male volunteers were registered to the researcher to become the subject of the study. To know their physical activity status and health status and injury status participants were filled the medical questioner. 15 of 55 volunteers were rejected due to questionnaire. Finally 40 subjects were participated on the study and they were assigned in to two groups equally (experimental and control group) by using random sampling techniques. Physical activity readiness, health status, injury status and age restriction questionnaire of the subject was the criteria to identify select and reject study subjects.

### **3.8. Inclusion and Exclusion Criteria**

All male students who registered, have not health problem, free of physical injury, their age was 15-16 and depending on questioner students who does not engage regular physical activity or resistance training before a study, who have not health problem and free of physical injury was included. Subjects according to their health history questionnaire result athletes who have a medical condition restricted by the physician and recent physical injury Who engage regular physical activities, Addicted by drugs , their parents will not voluntary, and whose age under 15 and >16 was not be included as participants of this research study.

### **3.9. Data Collection Instrument**

In order to conduct this study the researcher used and sport field to conduct test and for training. During this research process instruments like stop watch, whistles, writing pad for record data, weight machine for body weighting, and mat for sit up were used.

### **3.10. Method and Procedures of Data Collection**

Quantitative data were collected through standardized and appropriate, physical fitness tests. Prior to data collection, researcher explained the information related to the study, which included the purpose, basic procedures, and their parental assent to the potential participants. Students were encouraged to raise any questions and concerns regarding the study. Properly designed and supervised resistance training program was given by the researcher. Before the trainers are going to resistance training program the pre-health related physical fitness variables test was given to both group and recorded by two assistant data recorders. Then after the intervention during test and post test was done and recorded at the end of three month.

### **3.11. Physical Fitness Test Analysis**

#### **3.11.1. Sit up Test**

**Sit-up Test-** The abdominal muscular strength and endurance of the abdominals was assessed using sit-up test. To assure the starting position, the participant's was told to lie on their back with knees flexed, feet on floor with the hands on the opposite shoulders. A partner assisted by anchoring the feet to the ground. The student, by tightening his abdominal muscles, curls to the sitting position. Arm contact with the chest must be maintained. The chin should remain tucked on the chest. The sit-ups completed when the elbows touch the thighs. To complete the sit-up the participants returns to the down position until the mid-back makes contact with the testing surface. When the timer gives the signal "ready go", the sit-up performance started and the performance was stopped on the command "stop". The numbers of correctly executed sit ups performed in 60 seconds were the score (Kamyabnia *et al.*, 2011).

#### **Analysis**

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement

#### **3.11.2. Body Mass Index**

Body mass index- it is method of evaluating body composition which evaluates weight in relation to height. Body Mass Index (BMI) is a ratio of the total body weight to height. BMI used most frequently is body mass (in kilograms) divided by height (in meters) squared  $[WT \div HT^2(kg/m^2)]$ . Calculated BMI can then be compared against standard values to determine whether the individual has acceptable body weight, is overweight, or is obese. In order to calculate BMI subject body mass and height was measured and recorded. Depending on the measurement, BMI was calculated (Plowman and Smith, 2011).

$$\text{BMI} = \frac{\text{Body mass (kg)}}{\text{Height square (m}^2\text{)}}$$

### **3.11.3. Push-up Test**

The push-up test was used to measure muscular strength of the subjects. Before starting the test participants were given warming up time and stretching exercise. The subjects being tested in prone position; putting their palms at the shoulder level on the ground, face down on the mat. On the signal go they were asked to raise their body upward until the arms were fully extended, then lowered until their elbows bent at 90 degrees. The maximal number of push-ups performed consecutively without rest was counted as the score (ACSM, 2009).

### **3.12. Resistance Training Protocol**

The training session program was performed 3 nonconsecutive days of a week for 12 weeks. The training was consisted of warm up and cool down exercise before main training session. The training program consisted of 2-3 sets and 8-12 repetition of upper body, lower body and abdominal muscle exercises. At the end of training session 5 minute cooling down and stretching exercise was performed. Exercises like push-up, sit up, parallel dips, pull up, bench dips, dumbbells lungs, bench press, dumbbells press, arm curls, lateral raise, was performed during training program. To control training load intensity and volume was conducted progressively and the intensity is depend on the level of individual fitness and researcher was proper supervised through ought the training session.

### **3.13. Methods of Data Analysis**

The gathered data was analyzed by the statistical tool paired sample T- test and interpreted the data that was collected from muscular endurance, muscular strength and BMI test before and after intervention. Some of the parameters with standard norm used for muscular strength, muscular endurance BMI tests were compared pre-test and post test result to draw conclusion. Paired sample T test was used to compare the change after intervention. All statistical calculations were carried out using SPSS package version 20. The level of significance was (0.05).

### **3.14. Data Quality Control**

Data quality control procedure was through standardized measurement of ACSM strength test. In order to decrease common errors in physical fitness test measurements, care was taken and properly supervised during procedure of push, up test, set up test, and other and measurement of BMI were recorded. In addition to this the standard procedure for measurement of test was used to gather the data from the subject and to minimize common errors during fitness test.

### **3.15. Ethical Consideration**

The study was carried out with great ethical concerns. First the researcher was asked the school by application in order to get informed consent from the school director and staff members. It heeds for the privacy of research participant and makes guarantee and confidentiality in risk of harm as a result of their participant. Therefore the study was conducted after the informed consent of school director and staff members. Ethical standards require that researcher should not imposed participants in a situation where they might be risk at of physical harm as a result of their participation. All actions will be based on haramaya university rules, code of conduct and policies concerning to research ethics. This research study was approved by the school guidelines and written consent is given and informs the concerned bodies and participants.

## **4. RESULTS AND DISCUSSION**

### **4.1. Overview**

This chapter deals with the analysis of data collected from the samples under study. The purpose of this study was to find out effects of selected resistance training on selected health related physical fitness components. To achieve the objectives of the study 40 students were randomly selected as subjects. They were assigned into two groups, experimental group (20) and control group (20). The training was conducted for three consecutive months and 3 non constitutive days per a week. The variables selected for this study were: a, physical fitness variables, (push up test for muscular strength, sit up test for muscular endurance and BMI test for body composition). Pre, during and post tests were conducted for all 40 subjects on every selected variables and the data were recorded. The collected data were analyzed by paired sample T-test using Statistical Package for Social Sciences (SPSS) version twenty (V20). The results for each variable were presented in tables as discussed below.

### **4.2. Demographic Characteristics of the Study Participants**

A total of 40 individuals, who were positively responded to the advertisement made. All selected individuals are debrework millennium secondary school male students completed moderate intensity resistance training program. From the total number of the study subjects; no one was lost motivation to follow up training program properly and no one was dropped out. 100% of the study subjects; follow up training properly. Almost all participants were beginners for physical exercise.

**Table 1: Physical Characteristics of Study Participants**

Measure ment	Experimental group			Control group		
	Pt	Dtt	Pot	Pt	Dtt	Pot
Age	15.5±0.51	15.5±0.51	15.5±0.51	15.5±0.51	15.5±0.51	15.5±0.51
Ht	1.65±0.031	1.65±0.031	1.65±0.031	1.647±0.034	1.647±0.034	1.647±0.034
Wt	53.35±3.36	55±3.49	57.2±3.41	53.1 ±3.27	53.45 ±3.22	53.9±3.27

*Data are mean ±SD, PT= pre training, DT= during training, PoT= post training, Wt = weight, Ht = height*

Table 1 showed the physical characteristics of study participants. The mean value of participant's age was 15.5 for both experimental and control group. The mean value of weight pre-test was 53.35 and 57.2 post test for experimental group. The mean value of weight pre-test was 53.1 and 53.9 post test for control group. The mean value of height for both pre-test and post test was 1.65 and 1.64 for experimental group and control group respectively. Body weight of the subjects showed slight increment after 12 weeks of resistance training for the experimental group than the control group with mean difference of 3.85 and 0.8 respectively. The mean of body weight was increased by 7.2 and 1.5 for experimental and control group respectively. So resistance training showed better gained in body weight than the control group.

### 4.3. Effect of Selected Resistance Training on Selected Physical Fitness Variables

Table 2 The means and mean difference values of Push up test (MR), BMI (Bwt(kg)/h<sup>2</sup>), Sit up( in1minute) test result for muscular endurance of both control group(CG) and experimental group(EG).

Variables	Experimental group				Control group			MD
	Pt	DTT	Pot	MD	Pt	DTT	Pot	
Pp	16.9±3.37	20.55±3.186	25.9±2.88	9	14.8±2.93	15.55±2.95	16.55±2.74	1.75
Sp	29±4.645	33.6±4.946	39.55±5.44	10.55	23.75±3.22	25.05±3.456	26.05±3.51	2.3
BMI	19.6±1.589	20.2±1.64	21±1.539	1.24	19.5±1.397	19.7±1.37	19.8±1.379	0.3

*Values are in the form of mean ± SD = standard deviation, MD=mean difference (Pot-Pt), PT, = pre training test which was taken before training, DTT= during training test ,which was measured at the end of 6<sup>th</sup> week and beginning of the 7<sup>th</sup> week of training, POT= post training test measured at the end of 12 weeks training. BMI = body mass Index, Pp = push up, Sp = sit up,*

The mean value of push up pre test was 16.9 and 25.9 post test for experimental group. The mean value of push up pre test was 14.8 and 16.55 post test for control group. The mean difference was 9 and 1.75 for experimental and control group respectively was recorded. The mean of push up test was increased by 53.25% and 11.82% for experimental and control group respectively throughout the study period. This showed that due to the 12 resistance training program the resistance training group (experimental group) showed better improvement. Therefore, participation in resistance training significantly improved the muscular strength of participants. The result of this study is consistent with the finding of (Azeem and Amer 2013) who studied effect of weight training program on body composition, muscular endurance and muscular strength of males. They reported significantly improved muscular strength of weight

squat and bench press from 47.50 to 77.17 and from 30.96 to 54.00 at ( $p=0.05$ ) respectively. The result also corroborated with the research conducted by (Liang *et al.* 2012) in which they found that 10 weeks of resistance training produced significant improvement in muscular strength performance in number of push-ups (111%), chest press (23.5%) and pull downs (15.6%) at ( $p<0.05$ ).

As indicated in Table 2, there was significant difference among groups at post test. The mean value of sit up pre test was 29 and 39.55 post test for experimental and 23.75 pre test 26.05 post test for control group. The mean difference was 10.55 and 2.3 for experimental and control group respectively. The mean of sit up test was increased by 36.37% and 9.7% for experimental and control group respectively. Experimental group showed more significant improvement due to the resistance training program in which they were engaged in. The finding of the study is in agreement with the finding of project entitled physiological and functional responses to low moderate (LI) versus high-intensity (HI) progressive resistance conducted by (Seynnes *et al.* 2004) in which they reported significant increment of muscular endurance in LI (33.1%) and HI (73.5%) groups and did not improve in the placebo-control group. (Shahidi *et al.* 2012) who studied effect of two resistance training types on muscle fitness and anaerobic capacity in 16-18 years old male soccer players also reported that progressive resistance training had significant effect on the subjects lower body muscle endurance and abdominal muscle endurance.

Table 2 showed that the mean value of pre test BMI was 19.6 and post test was 21 and pre test 19.5 and post test 19.8 for experimental and control group respectively. The mean difference of BMI was 1.4 and 0.3 for experimental and control group respectively. Therefore this showed that there was no substantial alteration of significant difference between the experimental group and control group in pre and post-test of BMI. But if we observe the mean difference value there was slight difference in between the groups. The percentage improvement of BMI was better in experimental group than the control group due to the increment of body weight. The improvement was recorded as 7.1% and 1.5% for experiment and control group respectively. Therefore, participation in resistance training slightly increases the body composition of the participants' even if it was statistically in significant. Similar result has been reported by Poehlman and his colleagues. They reported that body mass index increased

in resistance training individuals by 1.3 mean differences and fat-free mass increased by 2.00 mean differences in the resistance training group (Poehlman *et al.*, 2000).

According to research conducted by (Weiss *et al.* 2010) entitled effect of functional resistance training on muscular fitness outcomes in young adults. They also reported that BMI of traditional resistance training group showed 1.78 mean difference improvement at ( $p < 0.05$ ). (Young and Steinhard 1995) also concluded that resistance training programs can increase fat-free mass and decrease the percentage of body fat. One of the outstanding benefits of resistance exercise, as it relates to weight loss, is the positive impact of increasing energy expenditure during the exercise session and somewhat during recovery, and on maintaining or increasing fat-free body mass while encouraging the loss of fat body weight.

## **5. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS**

### **5.1. Summary**

The purpose of this study was to find out effects of resistance training on selected physical fitness components of Debrework millennium secondary school male students. To achieve the purpose of the study 40 male students were selected from Debrework millennium secondary school students. The selected subjects were 15-16 years old. They were grouped into two groups and each group consisted of 20 participants. First group assigned as Experimental and control group. The resistance training programs was given 3 times none consecutive days per week for 12 consecutive weeks with 60 minute duration and moderate intensity for the experimental groups but control group was not trained. The health related physical fitness variables for the study were muscular strength, muscular endurance, and body composition. The pre during and post tests were given to all participants. The collected data were analyzed by SPSS version 20 with significance level of 0.05%. The paired sample t-test was used for this study. Final result of the study summarized and demonstrated that the result of post test to pre test showed improvement in all muscular strength, muscular endurance, of the athletes. Generally the results obtained from this study showed that there was improvement in health related physical fitness variables due to the effect of resistance training. The result of this study proved that there was significant improvement in most of selected variables such as muscular strength, muscular endurance, and slight change on body composition due to participation in moderate intensity resistance training.

## 5.2. Conclusions

Depending on the major findings of this study, the following points are stated as a conclusion:

- The result of the study showed that the 12 consecutive weeks resistance training brings significant improvement on selected health related physical fitness variables.
- Resistance training was found effective in significantly improved muscular strength of subjects.
- Resistance training significantly improved muscular strength of experimental group of the subject.
- Resistance training had slight effects on the body composition.
- There was no substantial significant improvement observed on control group when compared to experimental group.

### 5.3. Recommendations

The findings of this research proved that twelve weeks of resistance training significantly improved most of selected variables of the participants. Based on these results, discussions and findings of the research, it is important to state the following points as a recommendation:

- ❖ Resistance training can be used by fitness programmers, coaches, athletic trainer and instructors to improve their trainees of muscular endurance and muscular strength.
- ❖ Interested individuals who want to improve their physical fitness variables can engage in resistance training program to get maximum benefits from the program.
- ❖ Un individual who want improve his level of strength should be train Properly designed and supervised resistance training program.
- ❖ In order to increase strength and safe for children; physical education teacher, should be properly designed and supervised resistance training program.

## 6. REFERENCES

- ACSM, 1998 b Position stand on the quantity and quality of exercise for developing and maintaining cardio respiratory and muscular fitness and flexibility in healthy adults. *Medicine and Science in Sports and Exercise*. 30(6):975–991).
- ACSM, 2001. ACSM'S Resource Manual for guidelines for Exercise testing and prescription, 4th ed pg 7
- ACSM, 2002 Position stand on progression models in resistance training for healthy adults. *Medicine and Science in Sports and Exercise*. 34(2):364–380
- ACSM, 2009. Progression models in resistance training for healthy adults. *Medicine and Science in Sports & Exercise*, 34: 687-708.
- ACSM, 2011. Position Stand on Quantity and quality of exercise for developing and maintaining cardio respiratory, musculoskeletal, and neuromotor fitness in apparently healthy adults: guidance for prescribing exercise. *Med Sic Sports Exerc*.43:1334-1359.
- ACSM.2013. [www.acsm.org](http://www.acsm.org)
- American Academy of Pediatrics.2001. Strength training by children and adolescents. *Pediatrics*. 107(6), 1470-1472.
- Andersen, L. B., 2003. Cardiovascular risk factors cluster in children and adolescents with low physical fitness. *The European Youth Heart Study (EYHS)*, 15:419-427
- Anschel, M. H., P. Freedson, J. Hamill, K. Haywood, M. Horvat, and S. A. Plowman, 1991. *Dictionary of the Sport and Exercise Sciences*. 264p.
- Asmussen, E. & Heeboll-Nielsen, K., 1955 A dimensional analysis of performance and growth in boys. *Journal of Applied Physiology* 7, 593–603.
- Azeem, K. and A. A. Ameer, 2013. Effect of weight training programme on body composition, muscular endurance, and muscular strength of males. *Annals of Biological Research*, 4 (2):154- 156

- Baechle, T.R., Earle, R.W., and Wathen, D. 2008. Resistance training. In *Essentials of Strength Training and Conditioning*. T.R Baechle and R.W Earle Eds. Champaign, IL: Human Kinetics, pp. 381-412.
- Behm, D. G., Faigenbaum, A. D., Falk, B., and Klentrou, P. 2008. Canadian society for exercise physiology position paper: resistance training in children and adolescents. *Appl. Physiol. Nutr. Metab.* 33, 547–561. doi: 10.1139/H08-020
- Benson AC, Torode ME, Fiatarone Singh MA. 2008a .The effect of high-intensity progressive resistance training on adiposity in children: a randomized controlled trial. *Int J Obes*;32:1016–27.
- Bird, S. P., K. M. Tarpenning, and F. E. Marino.2005 Designing resistance training programmes to enhance muscular fitness: A review of the acute program variable. *Sports Medicine.* 35(10):841–851.
- Blimkie, C, Rice, S, Webber, C, Martin, J, and Gordon, C. 1996.Effects of resistance training on bone mineral content and density in adolescent females. *Can J Physiol Pharmacol* 74: 1025–1033,
- Blimkie, C. 1993.Resistance training during preadolescence. *Issues and Controversies. Sports Med.*15: 389-407.
- Blimkie, C.J. (1993). Resistance training during preadolescence. *Sports Medicine*, 15, 389 407
- Coulson, M., & Archer, D. 2009. *Practical fitness testing: Analysis in exercise and sport*. London: A. & C. Black.
- Davies, C. T. M., and C.Barnes,1972.Negative (eccentric) work. II. Physiological responses to walking uphill and downhill on motor-driven treadmill. *Ergonomics.* 15:121–131
- Docherty, D, Wenger, H, Collis, M, and Quinney, H. 1987. The effects of variable speed resistance training on strength development in prepubertal boys. *J Hum Mov Stud* 13: 377–382,
- EETC Inc., 2002. Exercise Programs for Children. *Journal of Sports Science*, 13(9):11-19.

- Enoka, R. M.: 1988. *Neuromechanical Basis of Kinesiology*. Champaign, IL: Human Kinetics, 31–64.
- Faigenbaum AD, Kraemer WJ, Blimkie CJ, .2009. Youth resistance training: updated position statement paper from the National Strength and Conditioning Association. *J Strength Cond Res* 23:S60–79
- Faigenbaum, A., & Bradley, D. 1998. Strength training for the young athlete. *Orthopaedic Physical Therapy Clinics of North America*, 7, 67-89.
- Faigenbaumad., 2000 Strength training for children and adolescents. *Clin Sports Med*;19(4)
- Falk, B., & G. Tenenbaum: 1996. The effectiveness of resistance training in children: A meta-analysis. *Sports Medicine*. 22(3):176– 186.
- Fleck, S. J. 1988. Cardiovascular adaptations to resistance training. *Medicine and Science in Sports and Exercise*, 20 (Suppl.), S146-S151.
- Haff, G. H. 2012. Resistance Training Program Design. In J. W. Coburn, M. H. Malek, J. W. Coburn, & M. H. Malek (Eds.), *NSCA's Essentials of Personal Training* (2nd ed., pp. 347-388). Champaign, IL: Human Kinetics
- Harris, K. A., and Holly, R. G. 1987. Physiological response to circuit weight training in borderline hypertensive subjects. *Medicine and Science in Sports and Exercise*, 19, 246-252.
- Haskell, W. L.,: 2007 Physical activity and public health: Updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. *Medicine and Science in Sports and Exercise*. 39(8):1423– 1434.
- Health and wellness for life. 2010. Champaign, IL: Human Kinetics.
- <https://en.wikipedia.org/wiki/MizanTeferi>.
- Hubley-Kozey, C. L.: Testing flexibility. In J. D. MacDougall, H. A. Weuger, and H. J. Green (eds.) 1991, *Physiological Testing of the High-Performance Athlete*. Champaign, IL: Human Kinetics.

- Jonatan, R., R. Francisco, B. Ortega, A. Gutierrez, D. Meusel, M. Sjostrom and J. Castillo, 2006. Health-related fitness assessment in childhood and adolescence. *Journal of Sports Science*, 1(12):344-348.
- Jones, C, Christensen, C, and Young, M. 2000 Weight training injury trends. *Phys Sports Med*, 28:61-72,
- Kamyabnia, M., M. Jourkesh and B. Keikha, 2011. Comparison of Physical Fitness level among normal weight and Obese Female University students. *Annals of Biological Research*, 2 (3): 126- 133.
- Kato, S., & Ishiko, T. 1964. Obstructed growth of children's bones due to excessive labor in remote corners. In S. Kato (Ed.), *Proceedings of the International Congress of Sports Sciences* (pp. 476). Tokyo: Japanese Union of Sports Sciences.
- Knudson, D., K. Bennett, R. Corn, D. Leick, and C. Smith. 2001. Acute effects of stretching are not evident in the kinematics of the vertical jump. *Journal of Strength and Conditioning Research*. 15(1):98–101
- Kraemer, W. J. 1994. General adaptations to resistance and endurance training programs. In T. Baechle (Eds.), *Essentials of strength training and conditioning* (pp. 127-150). Champaign: Human Kinetics.
- Kraemer, W. J., & N. A. Ratamess., 2004 Fundamentals of resistance training: Progression and exercise prescription. *Medicine and Science in Sports and Exercise*. 36(4):674–688.
- Liang, M. T.C., L. Quezada, W.J. Lau, B. Sokmen and T. W. Spalding, 2012. Effect of short-term upper-body resistance training on muscular strength, bone metabolic markers, and BMD in premenopausal women. *Open Access Journal of Sports Medicine*, 3: 201–208
- Lindsay, A.R., Hongu, N., Spears, K., Idris, R., Dyrek, A. and Manore, M.M. 2013. Field assessments for obesity prevention in children and adults: physical activity, fitness, and body composition. *Journal of nutrition education and behavior*, 45:6.:593–619

- Maddalozzo, G.F. and C.M. Snow, 2000. High intensity resistance training: Effects on bone in older men and women. *Calcified Tissue International*, 66: 399-404.
- Malina, R, Bouchard, C, and Bar-Or, O. 2004. *Growth, Maturation and Physical Activity* (2nd ed.). Champaign, IL: Human Kinetics, pp. 215–233.
- Malina, R., & Bouchard, C. 1991. *Growth, maturation, and physical activity*. Champaign, IL: Human Kinetics.
- Malina, R.M. 2006. Weight training in youth – growth, maturation, and safety:
- Moritani, T., and deVries, H. A. 1979. Neural factors versus hypertrophy in the time course of muscle strength gain. *American Journal of Physiological Medicine*, 58, 115-130.
- Morris FL, Naughton GA, Gibbs JL, Carlson JS, Wark JD., 1997. Prospective ten month exercise intervention in premenarchal girls: positive effects on bone and lean mass. *J Bone Miner Res.* 12(9):1453–1462
- Morris, F., Naughton, G., Gibbs, J., Carlson, J., and Wark, J. 1997. Prospective ten-month exercise intervention in premenarcheal girls: Positive effects on bone and lean mass. *Journal of Bone and Mineral Research.* 12, 1453- 1462.
- NHLBI. 1990. Workshop Summary. *American Review of Respiratory Diseases.* 142:474–480
- Ortega, F. B., J. R. Ruiz, M .J. Castillo, and M. Sjostrom, 2008. Physical fitness in childhood and adolescence: a powerful marker of health. *International Journal of Obesity*, 32: 1-11.
- Perrin, D. H.: *Isokinetic Exercise and Assessment*. Champaign, IL: Human Kinetics (1993)
- Pfeiffer, R., & Francis, R., 1986. Effects of strength training on muscle development in prepubescent, pubescent, and postpubescent males. *Physician & Sportsmedicine*, 14, 134-143.
- Plowman, S. A., and D. L. Smith, 2011. *Exercise physiology for health, fitness and performance*, 3<sup>rd</sup> edition. USA: Lippincott Williams & Wilkins book. 262-282.

- Poehlman, T., R. V. Dvorak, W. F. Denino, M. Brochu and P. A. Ades, 2000. Effects of Resistance Training and Endurance Training on Insulin Sensitivity in Non-obese, Ratamess NA, Alvar BA, Evetoch TK, 2009. Progression models in resistance training for healthy adults. *Med Sci Sports Exerc* ;41:687–708.
- Ratamess NA, Evetoch TK, Housh TJ, et al. Progression models in resistance training for healthy adults. *Med Sci Sports Exerc*. 2009;41(3):687–708.
- Rogers, M. A., & W. J. Evans.1993.Changes in skeletal muscle with aging: Effects of exercise training. In J. O. Holloszy (ed.), *Exercise and Sport Sciences Reviews* (Vol. 21). Baltimore, MD: Williams & Wilkins, 65–102
- Rowland, T. *Children’s Exercise Physiology* (2nd ed.). Champaign, IL: Human Kinetics, 2005. pp. 181–195
- Rowland, T. W.: *Children’s Exercise Physiology*. Champaign, IL: Human Kinetics 2005.
- Sadres, E., Eliakim, A., Constantini, N., Lidor, R., & Falk, B. 2001. The effect of long-term resistance training on anthropometric measures, muscle strength, and self-concept in pre-pubertal boys. *Pediatric Exercise Science*. 13, 357-372
- Schoenfeld, B. J. 2010, October. The Mechanisms of Muscle Hypertrophy and Their Application to Resistance Training. *Journal of Strength and Conditioning Research*, 24(10), 2857-2872.
- Scott,W.,2002.TheBenefitsof Stretching. [www.SubmitYourNewArticle.com](http://www.SubmitYourNewArticle.com)
- Seynnes, O., M. A. Singh, P. Legros, O. Hue, P. L. Bernand and P. Pras, 2004. Physiological and functional responses to low-moderate versus high-intensity progressive resistance training in frail elders. *Journal of Gerontology: Medical Sciences*, 59(5): 503–509
- Shahidi, F., A. G. Mahmoudlu, Y. M. N. P. Kandi and G. Lotfi, 2012. The effect of two resistance training types on muscle fitness and anaerobic capacity in 16-18 years old male soccer players. *Annals of Biological Research*, 3 (6):2713-2717

- Stone, M. H., Fleck, S. J., Triplett, N. T., and Kramer, W. J. 1991. Health- and performance-related potential of resistance training. *Sports Medicine*, 11, 210-231
- Strong, W.B, Malina, R.M, Blimkie, C.J., Daniels, S.R., Dishman, R.K., Gutin B., Hergenroeder, A., Must, A., Nixon, P.A., Pivarnik, J., Rowland, T., Trost, S.,2005
- Swain, D. P. (Ed.). 2014. ACSM's resource manual for guidelines for exercise testing and prescription (7th ed.). Philadelphia, PA: Wolters Kluwer Health/Lippincott Williams & Wilkins
- Tan, B. 1999. Manipulating Resistance Training Program Variables to Optimize Maximum Strength in Men: A Review. *Journal of Strength and Conditioning Research*, 13(3), 289-304.
- Tipton, C. M. 1984. Exercise training and hypertension. *Exercise and Sport Science Reviews*, 12, 245-307.
- Tony and A. Susana, 2006. *Physical Activity and Health in Children and Adolescents*. University of Bristol, U.K. 45p
- Trudeau, F.Evidence based physical activity for school-age youth. *J Pediatrics*, 146, 732-737, 2005.
- Waller, M., Miller,J., & Hannon, J. 2011, February. Resistance Circuit Training: Its Application for the Adult Population. *Strength and Conditioning Journal*, 33(1), 16-22. 3
- Weir, J. P., and Brown, L. E. 2012. Resistance Training Adaptations. In J. W. Coburn, & M. H. Malek, *NSCA's Essentials of Personal Training* (2nd ed., pp. 71-87). Champaign: Human Kinetics.
- Weiss, T., J. Kreitinger, H. Wilde, C. Wiora, M. Steege, L. Dalleck and J. Janot, 2010. Effect of functional resistance training on muscular fitness outcomes in young adults. *Journal of Exercise Science & Fitness*, 8(2): 113–122

Wernbom, M., J. Augustsson, & R. Thomee: 2007. The influence of frequency, intensity, volume and mode of strength training on whole muscle cross-sectional area in humans. *Sports Medicine*. 37(3):225–264 .

Willardson, J. M. 2008, June. A Brief Review: How Much Rest between Sets? *Strength and Conditioning Journal*, 30(3), 44-50.

Wilmore, J. H., and Costill, D. L. 1994. *Physiology of Sport and Exercise*. Champaign: Human Kinetics.

Young, D. R., and Steinhard, M. A. 1995. The importance of physical fitness for the reduction of coronary artery disease risk factors. *Sports Medicine*, 19, 303-310.

## **APPENDICES**

## 7. APPENDICES

### Appendix- A

#### Health History and Physical Readiness Questionnaire of the Participants.

This questionnaire is designed to obtain information on the health status and physical activity readiness of the subjects participating for the research project. Please read the questions

carefully and answer each one honestly by encircling it on the choice letter given and/ or describing your condition in the space provided. Common sense is your best guide when you answer these questions. Thanks for your genuine response!

1. Has a doctor ever said you have a heart condition and recommended only medically supervised physical activity?

A Yes B No

2. Do you have chest pain brought on by physical activity?

A Yes B No

3. Have you developed chest pain within the last month?

A Yes B No

4. Do you tend to lose consciousness/fall over as a result of dizziness?

A Yes B No

5. Do you have a bone or joint problem that could be aggravated by the proposed physical activity?

A Yes B No

6. Has a doctor ever recommended medication for your blood pressure or a heart condition?

A Yes B No

7. Are you aware, through your own experience or a doctor's advice, of any other physical reason why you should avoid exercising without medical supervision?

A yes      B No

8. Do you lose your balance because of dizziness or do you ever lose consciousness?

A. Yes B. No

9. Do you have a bone or joint problem (for example, ankle, knee, hip, back, shoulder, etc.) that could be made worse by a change in your physical activity?

A yes    B No

10. Do you participate Regular resistance training and physical exercise prior to this time?

A. Yes              B. No

Source (Canadian Journal of Sport Science 1992)

## **Appendix- B**

### **Consent to Participate Voluntarily in this Research Study**

Researcher's Name: Binalf Teshome

Major Advisor's Name: Shimelis Mekonnen ( PhD)

Co-Advisor'Name: Desta Enyew (PhD)

Thesis title: **Effect Of Selected Resistance Training On Health Related Physical Fitness Components Of Debrework Millennium Secondary School Male Students. In Case of Debub Bench Woreda, Mizan Aman, SNNPR, Ethiopia**

### **Purpose of the Study**

The purpose of this study is to examine the effect of selected resistance training on health related physical fitness components of Debrework millennium secondary male students using 12 weeks regular resistance training

### **Procedure and Duration.**

I was interviewed you using a questionnaire to provide me with pertinent data that is helpful for the study. In this study physical fitness tests was conducted before during as well as the end of training program. Participation in the study will not exceed 60 minutes per session and 3 days per week for training. The experiment study period will be for 3 months.

### **Risk and Benefits**

The risk of being participating in this study is very minimal, while testing procedure and during training session you may experience numbness, muscle soreness, muscle cramp, muscle strain and fatigue but no major injury. There would not be any direct payment for participating in this study and again you will not pay for your participation. But the findings from this research may reveal important information for the investigator.

**Confidentiality**

The information and data obtained from you will be kept confidential. However, you are free to disclose it to your own physician. The information will be used only for the sake of the research and it will not be personalized. The data will be reported and presented without reference to the individual identify

**Rights:** Your participation in this research study is voluntary. You may discontinue from the training program at any time from the study if you choose to do so and this will not label you for any loss of benefits which you otherwise are entitled

**Contacts address**

If there is any questions or inquires any time about the study or the procedures, please contact:

Binalf Teshome \_\_\_\_\_ (+251918577552)

E-mail: \_\_\_\_\_ binalfteshome2@gmail.com

Shemelis Mekonnen(PhD) \_\_\_\_\_ +251913893850

Desta Enyew (PhD) \_\_\_\_\_ +251938314092

## Appendix C

### Paired Sample T-test Results of each parameters

**Table 3. Paired t test result of push up**

Test	mean	Sd	Se	95%95% Confidence Interval of the Difference		t value	df	Sig	
				Lower bound	Upper bound				
				EG	Pot-dtt				5.35
	Pot-pt	9.0	2.6157	.5849	7.7758	10.2242	15.387	19	.000
CG	Pot-dt	1,0	.56195	.12566	.7370	1.2630	7.958	19	.000
	Pot-pt	1.75	.8507	.19022	1.35186	2.14814	9.200	19	.000

Std standard = deviation, Se= standard mean error/ df = degree of freedom , sig =significance

**Table4. Paired T Test Result of Sit up**

Test	Mean	Sd	Se	95%95% Confidence Interval of the Difference		t value	df	sig	
				Lower bound	Upper bound				
				EG	Pot-dtt				5.95
	Pot-pt	10.55	2.79991	.62608	9.2396	11.86040	16.851	19	.000
CG	Pot-dtt	1	.64889	.14510	.69631	1.30369	6.892	19	.000
	Pot-pt	2.3	.92338	.20647	1.86784	2.73216	11.139	19	.000

Std standard = deviation, Se= standard mean error, df = degree of freedom, sig =significance

**Table 5 Paired T Test Result of BMI**

Test	Paired Differences						t value	Df	sig
	Mean	Sd	Se	95%95% Confidence Interval of the Difference					
				Lower bound	Upper bound				
EG	Pot-dtt	.81959	.29586	.06616	.68113	.95806	12.389	19	.000
	Pot-pt	1.4257	.37784	.08449	1.2488	1.6025	16.875	19	.000
CG	Pot-dtt	.16544	.21953	.04909	.0627	.26818	3.370	19	.000
	Pot-pt	.29417	.30141	.06740	.15310	.43523	4.365	19	.000

Sd =standard deviation , Se= standard mean error/ df = degree of freedom , sig =significance

## **Appendix D**

### **Description of the training program**

American College of Sports Medicine (ACSM) position statements have provided recommendations for resistance training prescription targeting muscular strength. The most recent position statement recommends that individuals with no resistance training experience (i.e. novices) perform 1–3 sets of 8–12 repetitions at loads corresponding to 60–70 % of one repetition maximum (1RM) with 2–3 min recovery between sets/exercises, 2–3 times per week. (Ratamess NA, Evetoch TK, Housh TJ, et al.2009)

### **Guidelines for Youth Resistance Training Program**

The development of a youth resistance training program needs to follow the similar steps as that of an adult program, but it is important to remember that children and adolescents are not "miniature" adults. No matter how big and strong, they are still anatomically, physiologically, and psychologically immature. With proper and clear instruction and careful supervision, a youth resistance training program can be in aid of health and fitness improvement, and may develop a positive attitude towards strength training and a healthy lifestyle.

The following guidelines are the summary of general resistance training guidelines for youths:

- A young child should be physiologically and psychologically ready to participate in a resistance training program and should be evaluated by a sports medicine physician to identify any medical problems and musculoskeletal deficiencies.
- The program should start with a physical assessment where the trainer can evaluate the young athlete to help design a program based on the athlete's individual needs.
- The program should be implemented and closely supervised by a qualified strength and conditioning professional or personal trainer that understands the needs of young athletes.
- The instructions regarding the correct exercise technique, training guidelines, exercise room etiquette and spotting procedures must be clear and competent.
- The environment needs to be safe and free of hazards.
- When necessary, adult spotters should be nearby for safety.

- Youths should have realistic expectations and learn the benefits and risks associated with resistance training.
- The training session should start with a 5-10 minute warm-up.
- The training intensity and volume should be in line with what the child can cope with easily and safely.
- Resistance should be increased gradually as the strength improves
- Cool down with less intense exercises and stretching
- Support and encouragement from the parents and instructors will help maintain interest

**Source:** Physical Education and Sport Vol. 7, No 2, 2009, pp. 189 - 196

**Resistance training intensity:** There is an abundance of evidence to suggest that when appropriately performed resistance training is a safe and effective exercise to be engaged by children and youth. However, it would seem prudent for all children and most youth to avoid the performance of maximal lifts, especially maximal dead lifting. It is the position of the ASCA that the following training loading intensities and exercise selection strategies be adopted when training children and youth:

- **Level 1: 6-9 years of age:** modification of body weight exercises and light resistance (brooms and bands etc) work only for relatively high repetitions eg 15+ reps;
- **Level 2: 9-12 years of age:** 10-15 RM; (maximal loading approximately 60% maximum) using predominantly simple free weight exercises and machine exercises where the machine is an appropriate size for the child.
- **Level 3: 12-15 years of age:** 8-15 RM; (maximal loading approximately 70% maximum) using progressively more free weight exercises but avoiding complex lifts such as cleans, snatches, deadlifts and squats etc unless competent coaching is available from a coach with at least a Level 2 ASCA strength and conditioning accreditation.
- **Level 4: 15-18 years of age:** 6-15 RM; (maximal loading approximately 80% maximum) progressively moving towards an advanced adult program involving split routines where appropriate and complex multi-joint movements provided sound technique has been developed under competent coaching by a coach with at least Level 2 ASCA strength and conditioning accreditation.

The various levels and suggested age brackets will be discussed in more detail in the following section. The above maximal loading percentages relate to strength-based exercises (e.g., bench press) and not to velocity specific exercises such as medicine ball throws where higher percentages may apply. The ASCA does not advocate the use of one-repetition maximum (1-RM) testing to determine \ appropriate training loads or to monitor progression in training for Levels 1-3. Instead the repetitions maximum (RM) method is recommended. For example, with Level 3, 12-15 years of age, the appropriate training load is between 8 to 15 RM. If the individual can perform 15 repetitions using good form with a given load then that load may be increased on subsequent sets. However, if the individual can not perform 8 repetitions with good form then a lower load is recommended for subsequent sets. One-repetition maximum testing may be appropriate in certain instances where elite young athletes (e.g., swimmers) have a well developed training background with competent coaching.

## Appendix- E

**Table 6 Selected Resistance Training Program of first Month for week 1, week 2, week 3, week 4, (October, 2017)**

Day	Types of exercise	Time	Dosage		
		60 min	Set	Rep	Rest
Tuesday	Warm up	10min			
	Stretching exercise	5min			
	Push up	2min	3	max	30sec
	Parallel dips	2min	3	8	30sec
	Squat	2min	2	8	30sec
	Dumbbells press	2min	3	8	30sec
	Bench press	2min	2	8	30sec
	Arm curl	2min	3	8	30sec
	Cool down	5min			
Thursday	Warm up	10min			
	Stretching exercise	5min			
	Push up	2min	3	max	30sec
	Parallel dips	2min	3	8	30sec
	Squat	2min	2	8	30sec
	Dumbbells press	2min	3	8	30sec
	Bench press	2min	2	8	30sec
	Arm curl	2min	3	8	30sec
	Cool down	5min			
Saturday	Warm up	10min			
	Stretching exercise	5min			
	Push up	2min	3	max	30sec
	Parallel dips	2min	3	8	30sec
	Squat	2min	2	8	30sec
	Dumbbells press	2min	3	8	30sec
	Bench press	2min	2	8	30sec
	Arm curl	2min	3	8	30sec
	Cool down	5min			

## Appendix-F

**Table 7 Resistance Training Program of Second Month for Week 1, Week 2, Week 3, Week 4, (November, 2017**

Day	Types of exercise	Time	Dosage		
		60min	Set	Rep	Rest
Tuesday	Warm up	10min			
	Stretching exercise	6min			
	Squat	2min	3	10	30sec
	Push up	2min	max	10	30sec
	Pull up	2min	3	10	30sec
	Dumbbells lungs	2min	3	10	30sec
	Bench press	2min	3	10	1min
	Cool down	5min			
Thursday	Warm up	10min			
	Stretching	6min			
	Arm curl	2min	3	10	1min
	Bench dips	2min	3	10	30sec
	Lateral rise	2min	3	10	30sec
	Dumbbell press	2min	3	10	30sec
	Dumbbells lungs	2min	3	10	30sec
	Cool down	5min			
Saturday	Warm up	10min			
	Stretching	5min			
	Squat	2min	3	10	30sec
	Dumbbell press	2min	3	10	30sec
	Pull up	2min	3	10	30sec
	Lateral rise	2min	3	10	30sec
	Bench press	2min	3	10	1min
	Cool down	5min			

## Appendix-G

**Table 8 Resistance Training Program of Third Month for Week 1, Week 2, Week 3, Week 4 (December, 2017)**

Day	Types of exercise	Dosage			
		Time	Set	Rep	Rest
Tuesday	Warm up	10min			
	Stretching exercise	6min			
	Bench press	2min	3	12	1min
	Push up	2min	max	12	30sec
	Pull up	2min	3	12	30sec
	Squat	2min	3	12	30sec
	Parallel dips	2min	3	12	30sec
	Cool down	5min			
Thursday	Warm up	10min			
	Stretching	6min			
	Arm curl	2min	3	12	1min
	Bench dips	2min	3	12	30sec
	Dumbbells lunges	2min	3	12	30sec
	Lateral rise	2min	3	12	30sec
	Sit up	2min	3	12	30sec
	Cool down	5min			
Saturday	Warm up	10min			
	Stretching	6min			
	Squat	2min	3	12	30sec
	Dumbbell press	2m	3	12	30sec
	Pull up	2min	3	12	30sec
	Bench press	2min	3	12	1min
	Lateral rise	2min	3	12	30sec
	Cool down	5min			

The selection of resistance exercise modality was largely depending upon the technical ability and baseline fitness levels of the individual. And other remain years are rest days.

## Appendix- H

### The International Health Related Physical Fitness Awards or Qualifying Standards /Norms/ for all 3 Parameter

**Table 9: Parameters Used to Test Muscular Strength**

Performance Level	No. of push –ups (No. of maximum repetition)
	Males (15-17 age)
Excellent	>39
Above Average	29-38
Average	23-28
Below Average	18-22
Poor	<17

**Source:** The Canadian Physical Activity Fitness and Lifestyle Appraisal, 2nd edition.  
Canadian Society for Exercise Physiology. 2001.

**Table 10 Parameters Used to Test Muscular Endurance**

Performance Level	No. of sit -ups(1minute)
	Males (15-17 age)
Excellent	>48
Above Average	42-47
Average	38-41
Below Average	33-37
Poor	<32

**Source:** Canadian public health Association project (see Canadian home fitness Test)

**Table 11 Classification of BMI**

BMI	Classification
<18.5	Under weight
18.5-24.5	Healthy
25-29.9	Over weight
30-34.9	Grade 1 obesity
35-39.9	Grade 2 obesity
≥40	Grade 3 obesity

**Source:** ACSM (2001).

## Appendix- I

**Table 12 Row Data Recorded Sheet for Experimental Group**

Sub ject	Push up			Sit up( 1 minute)			Body weight(kg)			Heig ht	Age	BMI			
	PT	DT	PoT	PT	DT	Po T	Pt	DT	PoT			PT	DT	PoT	se x
S1	19	20	26	35	40	48	53	54	56	1.68	16	18.7	19.	19.8	M
S2	13	14	20	27	34	38	50	52	54	1.68	15	17.7	18	19.	M
S3	18	23	27	30	35	39	51	53	57	1.67	16	18.	19	20	M
S4	20	22	25	32	35	40	54	55	57	1.64	16	20.	20	21	M
S5	10	16	25	30	34	38	50	52	54	1.66	15	18	18.8	19.5	M
S6	16	20	24	23	27	33	49	51	53	1.65	16	17.9	18.7	19	M
S7	14	17	26	22	26	30	52	53	56	1.66	15	18.8	19	20.	M
S8	15	19	27	27	34	40	54	55	57	1.65	15	19.8	20	20.9	M
S9	16	18	23	20	25	36	58	60	62	1.64	16	21.5	22	23	M
S10	15	19	23	23	27	33	55	57	59	1.6	15	21	22	23	M
S11	21	24	26	32	36	42	54	55	55	1.59	15	21	21.7	21.7	M
S12	16	22	27	30	33	37	53	54	57	1.7	15	18	18.6	19.7	M
S13	16	22	28	32	36	41	60	62	64	1.66	15	21.7	22.	23	M
S14	16	19	24	25	27	32	56	58	60	1.68	16	19.8	20.5	21	M
S15	14	20	25	27	32	36	46	47	50	1.69	15	16	16	17.5	M
S16	15	19	24	33	37	42	58	60	61	1.64	16	21	22	22.6	M
S17	19	22	25	29	35	46	53	54	55	1.59	15	20	21	21.7	M
S18	20	24	30	32	39	44	51	54	56	1.63	16	19	20	21	M
S19	25	28	33	37	43	49	54	56	60	1.67	16	19.	20.	21.5	M
S20	20	23	30	34	37	47	56	58	61	1.64	16	20.	21	22.6	M

**Source:** Study Subjects

## Appendix- J

**Table 13 Raw Data Recorded Sheet for Control Group**

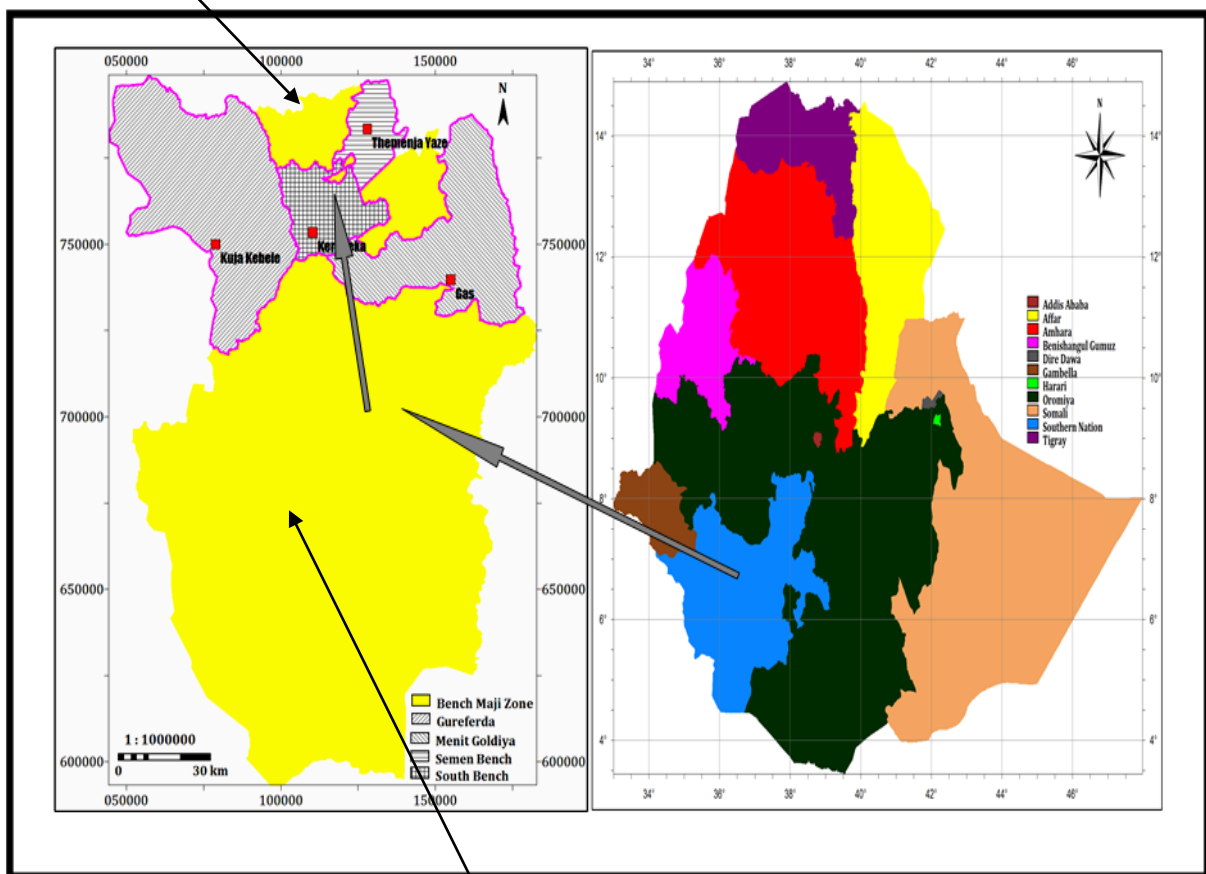
Subject	Push up			Sit up( 1min)			Body weight in kg					BMI( kg/h <sup>2</sup> )			
	PT	DT	PoT	PT	DT	PoT	Pt	DT	PoT	height	Age	PT	DT	Pot	sex
S1	13	14	15	25	25	27	50	51	51	1.64	16	18.5	18.9	18.9	M
S2	10	11	12	25	26	27	53	53	54	1.62	15	20	20	20.5	M
S3	16	17	17	25	27	28	48	49	49	1.65	15	17.	17.9	17.9	M
S4	20	22	23	30	31	33	54	55	56	1.67	16	19	19.7	20	M
S5	10	11	12	22	24	25	50	51	51	1.59	15	19.7	20	20	M
S6	15	17	18	25	26	26	49	50	51	1.61	16	18.9	19	19.6	M
S7	10	10	12	22	23	23	52	52	52	1.67	16	18.6	18.6	18.6	M
S8	14	15	16	21	22	24	55	55	55	1.58	15	22	22	22	M
S9	16	17	18	20	22	24	47	47	47	1.66	16	17	17	17	M
S10	12	12	14	23	24	25	55	55	56	1.67	16	19.7	19.7	20	M
S11	15	16	17	21	22	23	54	54	55	1.63	15	20	20	20.7	M
S12	17	17	17	30	33	34	53	53	53	1.7	16	18	18.	18	M
S13	16	17	18	24	25	26	60	61	61	1.68	15	21	21.6	21.6	M
S14	16	16	17	29	31	31	56	56	56	1.68	16	19.8	19.8	19.8	M
S15	17	17	18	21	23	24	55	54	55	1.64	15	20.4	20	20.4	M
S16	15	15	17	22	23	24	58	58	58	1.6	15	22.6	22.6	22.6	M
S17	14	15	16	22	24	25	53	54	56	1.69	16	18.5	18.9	19.6	M
S18	20	20	21	27	28	29	52	52	53	1.63	16	19.5	19	19.9	M
S19	14	16	17	19	20	20	52	52	52	1.68	15	18.4	18.4	18.4	M
S20	16	16	16	22	22	23	56	57	57	1.66	15	20.	20.6	20.6	M

**Source:** Study Subjects

# Appendix- K

## Figure1 Map of the Study Site

South Bench woreda



Bench maji Zone

Source: [https://en.wikipedia.org/wiki/Mizan\\_Teferi](https://en.wikipedia.org/wiki/Mizan_Teferi)

