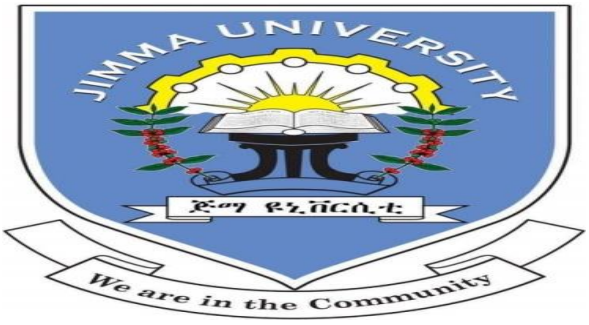

JIMMA UNIVERSITY

SPORT ACADEMY

DEPARTMENT OF SPORT SCIENCE

EFFECTS OF CIRCUIT TRAINING PROGRAM ON SELECTED PHYSICAL FITNESS VARIABLES OF FEMALE STUDENTS IN GORIKA SECONDARYSCHOOL

BY:

SIMACHEW TADESSE ZERU

A RESEARCH THESIS SUBMITTED TO JIMMA UNIVERSITY SPORT ACADEMY DEPARTMENT OF SPORT SCIENCE, IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF EDUCATION IN TEACHING PHYSICAL EDUCATION

SEPTEMBER/ 2021

JIMMA, ETHIOPIA

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APPROVAL SHEET

As thesis Research advisors, we hereby certify that we have read and evaluated this thesis entitled: "Effects of Circuit Training Program on Selected Physical Fitness Variables of Female Students in Gorika Secondary School" prepared by Simachew Tadesse Zeru. We recommend that it can be submitted as fulfilling the thesis requirement for **Masters Degree in Teaching Physical Education (MEd).**

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As member of the board of Examiners of the MEd thesis open defense Examination, we certify that we have read and evaluated the thesis work prepared by Simachew Tadesse Zeru and examine the candidate. We recommend that the thesis can be submitted as fulfilling the thesis requirement for **Masters Degree in Teaching Physical Education (MEd).**

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Effects of Circuit Training Program on Selected Physical Fitness Variables of Female Students in Gorika Secondary School

Degree Awarded: MEd/PhD (Encircle one)

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First I declare that this thesis is my work and all sources of materials used in this thesis have been duly acknowledged. I declare this thesis is not submitted to any other institution anywhere for the award of any academic degree, diploma, or publication.

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BIOGRAPHICAL SKETCH

Mr. Simachew Tadesse Zeru was born on January 26, 1993 G.C in Yejubie Kebele, Baso Liben Woreda, East Gojjam Zone of Amhara Regional State, from his Father Tadesse Zeru and his Mother Fasika Chanie. He attend his Elementary Education and Secondary School Education at Yejubie elementary school and Yejubie Secondary& preparatory school respectively. After completing High School Education, He joined Jimma University and graduated with B.Sc. Degree in sport science in 2014 G.C. Having graduated he was employed by the Government and worked for one year in Gorika Elementary School in Tercha ZuriyaWoreda of Dawro Zone. Then, he joined Dilla University in 2015G.C. for Post Graduate Diploma in Teaching (PGDT) to teach Physical Education for 1st cycle secondary school in summer program. Then after he joined Jimma University in 2017G.C. to pursue his Master of Education in Teaching Physical Education(MEd.) in summer program.

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Table of Contents

List of Tables

List of Figures

LIST OF ACRONYMS AND ABBREVIATIONS

ACSM	American College of Sport Medicine
BPM	Beat Per minute
CG	Control Group
CRF	Cardio Respiratory Fitness
CT	Circuit Training
CVE	Cardiovascular Endurance
DT	During Training
EG	Experimental Group
FIFA	Federation International de Football Association
H_0	Null Hypothesis
H_A	Alternative Hypothesis
MS	Muscular Strength
ME	Muscular Endurance
NASPE	National Association for Sport and Physical Education
PE	Physical Education
PoT	Post Test
PT	Pre Test
RM	Repetition Maximum
Rep/min	Repetition per minute
SNNPR	South Nations, Nationalities and Peoples Region.
SPSS	Statistical Package for Social Sciences.
USDHHS	United state Department of Health and Human Services.

Abstract

Circuit training is a type of interval training program that combines components of strength training as well as cardio vascular training and it is an excellent way to simultaneously improve mobility and build strength and stamina. *The main objective of this study was to examine the effects of circuit training on selected physical fitness components of grade 12 female students in Gorika secondary school. To achieve the objective of this study, the researcher used quantitative research method. In addition, true experimental research design was employed. For this study, 40 female students were selected as a target population of the study. The subjects were selected purposively and assigned in to two equal experimental group (20) and control groups (20) randomly. The experimental group participated in individualized and supervise moderate intensity circuit training program 3 days/week for 12 weeks. However, the control group didn't participate in training program designed for this study, but tests were conducted for both groups. The ages of the subjects were ranged from 18-19 years. Pre-test of two groups of 40 subjects (Cardio respiratory fitness was measured by step test, muscular strength was measured using trunk lift test, muscular endurance was measured using 60 second sit up test, explosive leg power was measured by vertical jump test and agility was measured by Illinois agility test) was recorded. After 12 weeks of circuit training, post-test measurements on the same parameter was taken. The difference between the tests were analyzed statistically by SPSS version 20 software, with paired sample t- test at level of significance $p<0.05$ to determine the difference between initial and final mean of participants. According to analyzed data, the mean difference of EG after 12-week circuit training program indicated that step test was decreased by -29.5BPM, trunk lift test was increased by 9.3RM, 60 second sit up test was increased by 8.9repetition/minute, vertical jump test was improved by 10.1cm and Illinois agility run test was decreased by -4.6 seconds. The result of this study proved that significant improvement was observed in CRF, muscular strength, muscular endurance, power and agility of female students at 0.05 level of significance ($p<0.05$) on EG. However, there was no significant difference and improvement recorded on CG. Based on these findings, the researcher concluded that circuit training was an effective method for improving physical fitness components of female students.*

Key words: - *Cardio respiratory fitness, muscular strength, muscular endurance, power, agility, circuit training*

CHAPTER ONE

1. INTRODUCTION

1.1. Background of the study

Physical fitness is a crucial pillar contributing a lot for the health of an individual so that it affects our ability to function and be physically active, and at poor levels is associated with such health outcomes as diabetes and cardiovascular diseases (Institute of Medicine, 2012).

Physical fitness according to the President's Council on Fitness is a broad quality involving medical and dental supervision and care immunization and other protection against disease, proper nutrition, adequate rest, relaxation, good health practices, sanitation and other aspects of healthful living. It further states that exercise is an essential element to achieving and maintaining physical fitness (Jourkesh *et al*, 2011). In order to live quality of life, an individual should develop overall fitness aspects (physical, psychological, social, spiritual…etc.). All-round fitness is a key to quality of life. To be able to carry out daily tasks without undue fatigue or to enjoy leisure-time pursuits require a certain degree of fitness. A physically fit person looks better, feels better, thinks better, and so lives better. Physical fitness, especially health-related physical fitness is one aspects closely associated with good health(Degele Shomoro, 2013).

Regular physical activity has long been regarded as an important component of a healthy lifestyle. This impression has been reinforced by new scientific evidence linking regular physical activity to a wide array of physical and mental health benefit. As a part of physical education, physical activity helps to maintain and increase muscle strength, improving cardio respiratory endurance, overall coordination, muscular endurance, reaction time and flexibility. Researchers suggest that regular physical activity reduces the risk of heart disease; diabetes, hypertension, stroke, osteoporosis, cancer and increases bone mass and longevity. Physical activity results in the strengthening of bones and muscles. It can substantially reduce the risk or arthritis and other bone diseases. Daily exercise helps us prevent fractures and bone injuries that take place due to weak bones (Pollock and Wilmore, 1990).

Training means various physical exercises and their objectives, methods and procedures, which are used for the improvement, maintenance and recovery of performance capacity and performance readiness. Training adaptation is the sum of transformations brought about by systematically

repeated exercises. These structural and physiological changes results from a specific demand that athletes place on their bodies by the activity they pursue depending on the volume, intensity and frequency of training. Physical training is beneficial as long as it forces the body to adapt to the stress of the effort (Tudor O. Bompa, 1999).

From many various training methods, Circuit training is a type of interval training program which combines components of both strength training and cardio vascular training. It is often a setup of stations or 'circuits' which individuals will complete before moving on to the next. Circuit training can be designed to develop strength, power, muscular endurance, speed, agility, neuromuscular coordination, flexibility and cardiovascular endurance. Thus circuit training combines a number of different components of training, thus the total fitness is emphasized. It provides an interesting training environment for the athlete, and there are established times and level to motivate the athlete to continue improving. It can be adapted within the time constrains of the individual in circuit training progression in all activities is assured. Circuit training is an excellent way to simultaneously improve mobility and build strength and stamina. Within each circuit, participants will perform exercises for a specific count or a specific time period before they venture to the next station. The circuit training format utilizes a group of 6 to 10 strength exercises that are completed one exercise after another. Each exercise is performed for a specified number of repetition or for a given time period before moving on to the next exercise. The goal of circuit training is to increase strength and agility at the same time as increasing fitness. Some studies have even found that circuit training is the most efficient way to enhance cardiovascular training and muscle endurance(Vinayagamoorthi and A. Sakthivel, Aug ; 2014).

The circuit training mode is one of the ways that take in to account the individual differences, the trainees' levels and abilities, and the possibility of gradually upgrading the load grade. Additionally, it provides a chance to focus on a specific physical fitness component which needs to be promoted; there by it avails chances for self-assessment. In addition, it is a system that helps in saving time and effort. Many individuals can be trained at the same time, because achieving the performance in the shortest time possible is the initial objective of the performance (Oudat & Ghassab, 2007).

The literature review (Al-Rashidi, 2006; Oudat & Ghassab, 2007; Hamoudat, 2008) reveals that there is a decline of the physical fitness components among the college students. The researcher,

through his work within the education and training domains, finds a decline in the components of the physical fitness among students who are enrolled in the Faculty of Physical Fitness and Sports Science. This researcher also observed physical fitness weaknesses on Gorika secondary school females students during physical education practical class. Therefore, the researcher was applied on a training program using the circuit training method to identify the improvement degree in the components of the physical fitness of female students. This was achieved by taking pre-post measurements of the tests that measured the physical fitness components of female students.

1.2. Statement of the Problem

Now a days, physical exercise is the best therapy that treats people without giving medication. Although many studies believe that regular physical exercises can give health benefits by positively affecting physical fitness and physiological development for males and females.

According to American College of Sports Medicine (2009) participation in at least 30 minutes of moderate physical activity per day, carried out three days a week will yield significant health benefits, while the world health organization (2009) suggests that one should take at least 10,000 walking step counts per day for health promotion. According to U.S. Department of Health and Human Services, children and teens should be physically active for at least 60 minutes on most, if not all days of the week. Current recommendations also suggests 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).

Moreover, Circuit training can be used for general fitness purposes or can be adopted as a conditioning medium for various grounds sports. Circuit training enables large numbers of performer, to train at the same time by employing a circuit of consecutively numbered exercises around which each performer progresses doing a prescribed allocation of work at each exercise, and checking his progress against the clock. It is performing the prescribed exercise at each station before moving on to the next one. Participation in this circuit training program should have caused the girls to improve progressively. Performance was improved and girls were motivated to try to complete three circuits. Circuit training became an important device in conditioning girls for participation in track and field activities as well as in other sports activities (Global Journals Inc. US, 2013).

Based on the above studies, regular physical activity can have immediate health benefit by positively affecting individuals' physical fitness improvement to be physically healthy, active and competent citizen in any sports arena. Besides this, circuit training can be used as a general fitness development program which motivates in performing exercises at each section values to progressive improvement on females' fitness. However, Gorika secondary school female students value in participating regular physical activity was unknown neither theoretically nor practically. No research has been done on the effect of circuit training on female students' physical fitness variables in case of Gorika secondary school and it was identified by the investigator as a main gap to be researched.

What initiates the researcher to conduct a study was that female students were passive during physical education practical class and face challenges in executing skills. Hence, the researcher considered it was appropriate to conduct a study entitled "Effects of circuit training program on selected physical fitness components of grade 12 female students in Gorika secondary school."

1.3. Hypothesis

To examine the effects of circuit training program on selected physical fitness components of female students, the researcher was testified the following null hypothesis (H_0):

1. H_0: Circuit training has no effect on cardio respiratory fitness of female students.
2. H_0: Circuit training has no effect on muscular strength of female students.
3. H_0: Circuit training has no effect on muscular endurance of female students.
4. H_0: Circuit training has no effect on explosive leg power of female students.
5. H_0: Circuit training has no effect on agility of female students.

1.4. Objectives of the study

1.4.1. General Objective

The general objective of this study was to examine the effects of circuit training on selected physical fitness components of grade 12 female students in Gorika secondary school.

1.4.2.Specific Objectives

1. To examine the effect of circuit training on cardio-respiratory fitness of female students.
2. To evaluate the effect of circuit training on muscular strength of female students.
3. To measure the effect of circuit training on muscular endurance of female students.

4. To examine the effect of circuit training on explosive leg power of female students.
5. To assess the effect of circuit training on agility of female students.

1.5. Significance of the study

The main aim of this study was to investigate the effect of circuit training program on selected physical fitness variables (cardio respiratory fitness, Muscular strength, Muscular endurance, power, and, agility) of grade 12 female students in Gorika secondary school. So the outcome of this study might have the following significances:

- It might encourage and motivate participation of female students in circuit training program to boost their physical fitness.
- It might increase awareness of female students to participate in regular physical activities to improve their performance.
- Might help physical education teachers to know further about the effect of circuit training, the methods of evaluating students' physical fitness and provide them to assess and compare the performance of their students on schools.
- It may be serve as a starting point for those who want to pursue similar studies.

1.6. Delimitation of the Study

In order to make the study more specific and manageable, this study was delimited on grade 12 female students who fulfill the health history questioner, whose age from 18-19 years old and non-athletes (students who didn't engage in regular physical activity before a study) to be part of the study. The study also delimited on selected physical fitness variables like cardiorespiratory fitness, muscular strength, muscular endurance, explosive leg power and agility of female students.

1.7. Limitation of the study

The researcher believed that the following conditions might be limiting factors that influence the process of the investigation and the findings of the study

- All the students attended this study from their respective homes, therefore diet, and rest is beyond the control of researcher.
- Test administration area might affect the accuracy of the result.
- Atmosphere, climatic conditions and percentage of humidity could not be controlled.

- Regular activities pertaining to their day-to-day affairs, which might affect the results, were considered as the limitations of this study.

1.8. Operational Definitions of terms

Agility-is the ability to stop, start and change the direction of the body or body parts rapidly under control (Baechle,1994).

Cardiovascular endurance- is the ability of the circulatory and respiratory systems to supply oxygen during continuous physical activity. Such as 1.6 kilometer run or walking, 12 minutes run or walking (Thomas et al., 2009).

Circuit training- is simply defined as a series of physically, resistance-based and aerobic activities, separated by short defined time period to complete each station. (Grice, 2003).

Muscular strength (MS) is the amount of force that can be exerted by a muscle, or a group of muscles, in one single, maximal effort (Exercise Science & Wellness Department, 2012).

Muscular endurance-is the ability of a muscle to repeatedly apply a sub maximal force or to sustain a sub maximal muscular contraction for a certain period of time (Walls, 2007).

Non-athletes-is defined as individuals that doesn't participate in regular physical activities and sport competitions.

Physical activity- is defined as any bodily movement by the contraction of skeletal muscle that increases energy expenditure above a basal level (Degele, 2013).

Physical Fitness- is defined as a condition in which an individual has enough energy to avoid fatigues and enjoy life (NASPE, 2009).

Power- is the ability to transfer energy explosively into force. It is a combination of strength and speed (USDHHS, 1996).

CHAPTER TWO

2. REVIEW OF RELATED LITERATURE

2.1. The concept of Circuit Training

Circuit training is simply defined as a series of physical, resistance-based on aerobic activities, separated by short defined time period to complete each station. Circuit training is a method of fitness training that is designed to develop general, all-round physical and cardiovascular fitness. It is based on sound anatomical, kinesiological and physiological principles designed to increase strength, power, flexibility, quickness and cardiovascular endurance. Circuit training provides a strenuous workout entirely suited to an individual's specific needs, existing capacity and rate of adjustment to progressive vigorous exercises. They also stressed the principles of overload and progression. It consists of a series of exercises arranged in order and designed to develop general fitness, physical fitness and/or skill-related fitness specific to a particular sport, depending on the exercises chosen. The great advantage of circuit training is that depending on the exercises chosen, it can be used to develop strength, power, muscular endurance, agility, aerobic endurance and anaerobic endurance (the ability to work without burning oxygen for an extended period of time; top class 800m runners can work an-aerobically for approximately 90 seconds) in a limited time and limited space. It can also involve large numbers of Participants in a relatively small space and participants of different fitness levels can train to get her. The basic assumption underlying circuit training is that improvement takes place either by doing the same amount of work in a shorter period of time or by doing more work in a given time. It utilizes three variables of load, repetition and time and this places it on an advantage over other training methods. The circuit training program is given in the form of number of exercises for different body parts in single circuit training. Single circuit training may involve the exercise for various fitness components (Hockey, 1981; Scholich, 1990; Howell & Morford, 1998).

Circuit training is a number of routine with specified objectives which takes into consideration its design, rationing, and resistance difference in principle of individual difference among the clients. This can be succeed either by time-specific exercises with continuous rest periods, or by time routines involved during the shortest possible time within the whole circuit of routines (cycle), where the first goal of the performance is succeeding it within the shortest possible period (Reddy

& Jyoti, 2012). When designing the circuit training units, changing the load through the stations should be taken into consideration in a manner compatible to the basic muscle groups.

Circuit training is the best ground for the enhancement of the educational aspects. In this concern, self-dependence, work, and self-assessment are broadly available in the circuit training. Circuit training has various educational benefits such as availing mutual respect opportunity among the individuals and respecting those with lower abilities and capabilities equally at the same level of respect to those of higher abilities (Reddy& Jyoti, 2012).

Researchers like Marcinik*et al*., (1985) work different researches about circuit training. Marcinik *et al*., (1985). First selected 43 navy men aged 32.1 years and assigned to one of three exercise training protocols: circuit weight training performed at either 40 or 60% of determined one-repetition maximum strength or aerobic/calisthenics training. During the 10 weeks study, each exercise group participated in three training sessions per week performed on alternate days. The results of this study indicate that dynamic strength (both upper and lower) increased for the aerobic/circuit weight training groups but not for the aerobic/calisthenics group. With the exception of bench press endurance for the aerobic/calisthenics group, all groups showed significant increases in muscular endurance and stamina. No significant changes were seen in static strength or flexibility in any of the groups.

Marcinik *et al.,(*1985).Secondly selected 87 male navy personnel aged 19.8 years receiving basic training at the recruit training command. One company of recruits (N=41) participated in an experimental aerobic/circuit weight training program at 70% of determined one-repetition maximum. A second company (N=46) received the standard navy recruit physical training program (aerobic/calisthenics training). During the 8 weeks study, both groups participated in an identical running program performed three times per week on alternate days. Additionally, aerobic/circuit weight training participants completed two circuits (1circuit=15 exercises) three times per weeks on alternate days to running. Study findings show the experimental aerobic/circuit weight training program produced significantly greater dynamic muscular strength and muscular endurance changes than the standard aerobic/ calisthenics program. Recruits following the standard training program showed decrements in several muscular strength and muscular endurance measures.

2.2. Benefits of Circuit Training on Physical Fitness Variables

Study show that circuit training helps women to achieve to their goals and maintain them longer than other forms of exercise of diet. Morgan and Anderson(1953) claim from a health perspective is that this investigation clearly shows that performance of this circuit of exercise .This level of intensity elicited oxygen consumption value (39% to 51.5% of Vo2max) that meet establish guidelines of America collage of sport medicine (ACSM) for the recommended intensity (40% to 85% of Vo2max) of exercise for developing and maintaining cardio respiratory fitness (Klika, 2013). Thus this circuit not only provides a suitable muscular fitness stimulus but also helps to meet ACSM cardio vascular guidelines and the newly published dietary guidelines for America 2005 to physical activity (Kraviz, 1996). One disadvantage is that reduced station time will encourage the participant to lift heavier weight, which means they can achieve overload with smaller number of repetition, typically in the range of 25 to 50depending on their training goals (Robert, 2005).

2.3. Circuit Training and Health

Circuit training appears to have multiple benefits on health and fitness, as various studies have shown that it may elicit significant increases in aerobic capacity muscular strength, muscular endurance, lean body weight, and significant decreases in resting diastolic blood pressure and body fat. The effect of Circuit training (CT) on some other Cardio Vascular Disease (CVD) risk factors such as fasting blood glucose, and blood lipids and lipoproteins remain under-investigated. Since CT has been associated with increases in aerobic capacity and as aerobic training has been shown to increase resting HRV measures, we hypothesized that CT may increase resting HRV measures in healthy un- trained adults aged 18 - 35 years old. In addition, given that CT has been shown to improve various CVD risk factors and fitness components, we tested another hypothesis, that CT improves some other CVD risk factors and fitness components(Klika, B. and Jordan, C., 2013).

2.4. Circuit Training Methods

2.4.1. General Fitness/Aerobic Circuits

General fitness/aerobic circuits are simply to raise work capacity, improve fitness, and can also be used as a recovery modality on days when the athlete is beat up and needs to back off. The intensity of these circuits is low and the rest interval between movements is minimal, allowing the athlete

to move from one exercise to the next at their own pace. The only time I assign a rest interval for this circuit is if we use resistance and the individual is performing 8-12 repetitions using a 15-20RM load, followed by 30-60sec rest. However, if we are doing these circuits for recovery purposes, we rarely approach intensity/effort like that, usually just performing various mobility drills and/or core work. The exercise selection is up to you as a coach. I find that the exercises in this circuit can range from the normal resistance training exercises, body weight exercises, specific mobility/corrective exercises (FMS correctives fit in well here), or core work. We are looking to work for > 30min in a circuit workout and they are allowed to take a little bit longer rest at the end of a complete circuit (90-120sec) before starting over. The number of circuits you do in this time will depend on the number of exercises you use and how long you plan to work for. Commonly, a workout using this format would consist of a warm up (10-15min), 30min of circuit work, and then 30-40min of tempo work on the bike or running in a field. When using this method of circuit training for recovery purposes, we tend to focus more on joint mobility exercises, various stretches (yoga type sequences), and dynamic mobility activities (Patrick 2006, Tempe, AZ.2009).

2.4.2. Strength Circuits

Strength circuits are focused on improving strength, just as the name implies. Usually I go to a superset of two main exercises with a mobility or core exercise in between them or I do a circuit of push, pull, legs, and core. The important thing here is the rest interval, which so many do not obey. If you are able to perform this sort of work with no rest interval or very little rest then you probably need to place more weight on the bar and work towards getting more strength. Reps in this circuit are < or = 5 per set and the rest interval is anywhere from 3-5min. Rest can be active rest, which is why I use the mobility or core work in between; however, there are times when complete rest is going to be desired in order to allow for full recovery. Additionally, I do not pressure the individual to move rapidly from one movement to the next, rather, I allow them to take their time when moving to the mobility/core exercise so that they can get sufficient rest and prepare for the next exercise or next set. The rest interval is very important here to allow for recovery and allow them to output as much force as they can (Patrick 2006, Tempe, AZ.2009).

2.4.3. Lactic-Aerobic Circuits

Lactic aerobic circuits are used to try and improve the individual's ability to repeat their effort in an explosive task. You wouldn't really be at this type of circuit if the athlete does not have a well-

developed work capacity to tolerate this sort of activity. However, you can scale back the intensity and perform aerobic plyometrics. Aerobic plyometrics can be good for preparing an athlete to develop a sport specific work capacity. These are similar to the lactic-aerobic circuits; however, the intensity of the jumping activities you choose is much lower. For example, when using aerobic plyometrics, I am a fan of the skipping activities that Gary Gray/Todd Wright have talked about (multi-directional skips and hops) and various medicine ball throws. You would perform these in a work to rest ratio of 6-10sec or 8-10 reps of work followed by 10-30sec rest and you would do this continuously for 5-10min. This is a great way to train sports and athletic movements in the initial phases of training when an athlete may not be prepared to tolerate more intense methods of jumping or plyometrics and may need to work on more general type movements. The a lactic-aerobic circuit can be performed in a similar fashion however the intensity of the activities will be greater --more intense jumps, skips, hops, or sprints. The work period is again around 6-10sec or8-10 reps followed by a rest interval of 20-40sec depending on the intensity of the exercises chosen and your ability to recover. For example, 10yrd sprints with30secrecovery, or a circuit of jumps and/or hops for a desired number of repetitions (Patrick 2006, Tempe, AZ.2009).

2.4.4. Anaerobic-Glycolytic Circuits

These are what most people think about when they hear the word "circuit". These sorts of circuits have gained popularity recently with the various boot camps and cross fit type of training methods out there. Oftentimes people refer to these as "metabolic circuits" or "metabolic training". The intensity of these types of circuits can take their toll on the body and this type of work is not a great starting point for someone beginning training with a limited training background. Anaerobic circuits can be divided into extensive or intensive. These can be timed sets of work or they can consist of lifting weights to failure or near failure in the 6-8 rep range. If the sets are timed they can be anywhere from 30sec to 2min. The 30-60sec intervals and the 75-120secintervals are more extensive. The rest interval in with these circuits is typically a 1:1,1:2, or 1:3 work to rest ratio (so work for 30sec rest for 30sec or work for 30sec rest for 60sec, or work for 30sec rest for 90sec). This type of work would be used only at the appropriate time in the training program. (if you are using 6-8reps to failure or 1-rep shy of failure), some sort of complex or sprinting activities (bike or running). The important thing with anaerobic-glycol tic circuits in the intensity you are working at. This method could easily fall under the general fitness circuit method if the intensity is too low. Medicine ball circuits can be used in either an aerobic or anaerobic fashion as can various

complexes depending on the weight on the bar and how hard you are working. However, if the goal is to develop the anaerobic-glycolytic system then the intensity needs to be appropriately chosen for the given work duration (Patrick 2006,Tempe, AZ. 2009).

2.4.5. Rest Intervals

The rest interval for the various circuits is essential! Too often coaches and athletes cut their rest interval short in order to try and "do more work" or just get things done in a faster period of time. If you want to properly develop some of these energy systems then the rest interval is an important rule to follow as it will ensure that you are able to put the greatest amount of effort into the work interval. There are times when doing things under fatigue and trying to repeat your effort in this manner are important, however, you should work up to this sort of training by first making sure that you can give 100% and slowly lowering the rest interval until you can repeat maximal or near maximal efforts with minimal rest (Patrick 2006, Tempe, AZ. 2009).

2.5. The Concept of Physical Fitness

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

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

2.6. Physical fitness components

Physical fitness is an umbrella term which captures both the variety of components which are assessed as motor and/or health related fitness and the different motor abilities (e.g. endurance, speed, strength, power, flexibility, coordination) which need to be maintained or developed by physical activity and exercise (Brett Schneider and Naul, 2004).

According to National Association for sport and physical education (NASPE, 2009), Physical fitness is divided into health and skill related physical fitness. Skill - related physical fitness are fitness types which enhance one's performance in sport settings. Health - related physical fitness is the ability to become and stay physically healthy. It also focuses on factors that promote optimum health and prevent the onset of disease and problems associated with in activity. Agility and power are skill-related physical fitness components which are basic skills in performing different sport activities in speed, acceleration, changing direction, jumping and weight lifting. Cardio respiratory endurance, muscular strength and muscular endurance are health-related physical fitness components. The level of Cardio respiratory endurance, muscular strength and muscular endurance affects an individual's ability to perform daily functions and various physical activities throughout the entire life of an individual. They also assist in preventing chronic diseases, injuries and osteoporosis. Players need to maintain their Cardio respiratory endurance, muscular strength and muscular endurance to be elite sport women and preventing themselves from chronic diseases as well as to maintain their health. They also need to be agile, speedy and power full to apply their skill in a proper way (American College of sport medicine, 2003).

2.6.1. Health Related Physical Fitness

Health related fitness components are those which focuses on optimum health benefits and prevents the onset of disease and problems associated with insufficient movement. According to Garzón (2009), health related physical fitness includes those components of physical fitness that have shown to be more clearly related to health status and it could also relate to well-being and happiness. Health-related fitness considered as the ability to perform daily activities with vigor, alertness and without undue fatigue, as well as traits and capacities that are associated with a low risk of chronic diseases and premature death (Caspersen et al., 1985). Having an appropriate level of health-related fitness allows a person to: meet emergencies, reduce the risk of disease and injury,

work efficiently, participate and enjoy physical activity (sports, recreation leisure) and be ones physical best (Connecticut State Department of Education, 2009).

In addition to improving quality of life, health-related fitness: increases muscle tone and strength, decreases susceptibility to injuries and illness, improves bone mineral density, reduces risk of osteoporosis, improves posture, increases efficiency of the respiratory and circulatory systems, decreases risk of cardiovascular disease and stroke, improves blood pressure, decreases risk of diabetes and some cancers, improves self-esteem and self-confidence, decreases body fat and improves metabolism; and increases energy level and academic achievement. (Virginia Department of Education, 2006). According to Sunni (1996), the following five components of health related fitness are basic:-

2.6.1.1. Cardio-Respiratory Fitness

Cardiovascular endurance (sometimes called aerobic fitness or cardio respiratory fitness) is considered to be a key component of health related physical fitness. It is a measure of the hearts ability to pump oxygen-rich blood to the working muscles during exercise. It is also measure of muscles ability to take up and use the delivered oxygen to produce the energy needed to continue exercising. In practical terms, cardio respiratory endurance type exercise includes, jogging, distance running, cycling, swimming, rope skipping and others. Cardio respiratory fitness lowers the risk of heart disease and increased longevity, reduce the risk of type II diabetes, lower blood pressure, and increase bone density in weight-bearing bones (Bouchard et al., (1990).

In general, aerobic endurance is the most critical element of physical fitness. Research indicates that healthy levels of aerobic endurance are associated with reduced risk of high blood pressure, coronary heart disease, obesity, diabetes, some forms of cancer, and other health problems in adults (U.S. Department of Health and Human Services, 1996). According to a recent report from the surgeon general lack of regular exercise and physical activity contribute to the development of other coronary heart disease risk factors. Research suggests that by engaging in regular exercise and physical activity that improves the cardiovascular system, the individuals can reduce many risk factors associated with coronary heart diseases. A VO_2 max test in the laboratory setting is considered to be the best measure of cardiovascular fitness. Commonly administered field tests include the One mile run/walk, the 12-minute run, step test, 1.5 mile run test and treadmill tests (Sunni, 1996).

Exercise increases heart rate as the heart needs to pump more blood to the different muscles than the usual condition. This increment of heart rate is directly related to the increase of intensity of exercise. Average heart rate is 60-72 beat per minute, and but during exercise it increases to 165-190 beat per minute. Aerobic exercise as being long in duration and low in intensity, resting heart rate decreases as a result of endurance training. Heart rate during sub maximal exercise also decreases about 20-40 beat per minute following regular aerobic exercise. Participating in aerobic exercise with the involvement of large muscle groups for a period of 15-20 minutes or longer while maintaining 60-80% of maximum heart rate, maximum heart rate remains either unchanged or decreases slightly with training (Shephard, R., 2001, cited in Alemayehu Ayalew 2006).

2.6.1.2. Muscular strength

According to Insel & Roth (2002), muscular strength is health-related component of physical fitness that relates to the ability of the muscle to exert force and it is the amount of force a muscle can produce with a single maximum effort. Strong, powerful muscles are important for the smooth and easy performance of everyday activities, such as carrying groceries, lifting boxes, and climbing stairs, as well as for emergency situations. They help keep the skeleton in proper alignment, preventing back and leg pain and providing the support necessary for good posture and it can be developed by training with weights or by using the weight of the body for resistance during callisthenic exercises such as push-ups and sit-ups. This can be measured by how much weight that an individual can lift during one maximal effort. According to (Stone, 1990), muscular strength exercise helps to reduce the occurrence of joint and muscle injuries that may occur during physical activity. Muscular strength is improved by performing strength training. Associated with increased muscular tone and strength, it improves personal appearance and self-esteem. This type of exercise is developed by performing different activity like push-up, sit-up, to lift heavy weight, and others (Stephens, 1988).

Strength is specific in nature and for true assessment it would be necessary to test each major muscle group of the body. Lab and field tests are similar and involve the assessment of one repetition maximum (the maximum amount of resistance you can overcome one time). 1RM tests are typically conducted on resistance machines. Strength can also be assessed using dynamometers. In the absence of the above measurement we can also use field tests such as wall-sit test. In this case we simply hold in the correct position as much as possible, and record the time in seconds (Mc.Eachen, 2004).

2.6.1.3. Flexibility

Flexibility is a health-related component of physical fitness that relates to the range of motion available at a joint. According to Franks (1997) & Intel (2001) specify that flexibility requires range of motion without discomfort or pain. Flexibility as the ability to move the joints through their full range of motion. Another form of flexibility training is known as Self-Myofascial Release, which involves putting pressure on tight muscles in order to work out knots. Yoga and Pilate‘s classes‘ also great ways to gain flexibility (Tyler Read, 2017).

Flexibility is useful in preventing some types of muscle tendon injuries and may be useful in reducing low back pain). The many benefits of increased flexibility include: increased joint mobility, resistance to muscle injury, prevention of low back problems, efficient body movement, and good posture, which results in improved personal appearance. Flexibility is measured by the "sit-and-reach" test (Clark et al., 1989).

2.6.1.4. Muscular Endurance

Muscular endurance is the ability of a muscle to perform an activity for a long period of time without fatigue. According to Corbin (2003), muscular endurance as the maximum number of repetitions or muscle contractions one can perform against a given resistance. Muscular endurance is specific in nature. For true assessment of muscular endurance it would be necessary to test each major muscle group of the body. Lab and field tests of muscular endurance are similar and are based on the number of repetitions that can be performed by the specific muscle group being tested (example: repetitions of push-ups or abdominal curls). Muscular endurance is important in sports, such as football (repeated running and kicking), tennis (repeated swinging of the arm to hit the ball) and swimming (repeated the stroke). Muscular endurance can be developed through push-up, sit-up, rope skipping, jogging, and others. Lee et al., (1997), Insel and Roth, (2002) also defined muscular endurance as the ability to sustain a given level of muscle tension i.e., to hold a muscle contraction for a long period of time, or to contact a muscle over and over again. Muscular endurance is important for good posture and for injury prevention and copes with the physical demands of everyday life and enhances performance in sports and work. Like muscular strength, muscular endurance developed by stressing the muscles with a greater load (weight) than they are used to (Insel and Roth, 2002).

2.6.1.5. Body Composition

Body Composition is the body's relative proportion of fat tissue to lean tissue. Lean tissue includes muscle, bone, skin, internal organs and body water whereas fatty tissue includes those composed of body fat (subcutaneous fat) as well as internal essential fat surrounding organs. Body composition will typically be displayed as either a percentage of fat (body fat percentage or %fat) or as a percentage of lean body mass (LBM).Those with optimal body composition are typically healthier, move more easily and efficiently, and in general, feel better than those with less-than-ideal body composition. Achieving a more optimal body composition goes a long way toward improving quality of life and overall wellness (Welborn et al., 2003).

The most accurate assessment of your ideal weight takes into account the composition of your body – how much of your weight is lean body mass (muscle and bone) and how much is body fat. Fat is produced by the body when an excess intake of calories in the form of food or drink occurs. When the diet provides the body with more calories than it needs for general maintenance and its current level of physical activity, this excess energy is stored in the form of body fat. Females tend to accumulate fat around their thighs and hips and males accumulate fat around the midriff. An increase in regular exercise will help to increase your calorie expenditure. The more physical activity you do the more calories you will burn. Accordingly, if you increase your physical activity, and do not increase your intake of food, you will draw the extra energy needed from your stored body fat (Leeigh Peele, 2010).

In terms of health, fat is the main point of interest and everything else is termed lean body tissue. The amount of fat we carry varies from person to person and healthy averages vary with gender and age. Being over fat or under fat can result in health concerns. A healthy amount of fat for a man is between 15 and 18% and for women is higher at 20-25%.An optimal ratio of fat to lean mass is an indication of fitness, and the right types of exercises will help you decrease body fat and increase or maintain muscle mass (Head Quarters Department of the US Army, 1998).

There are standards to determine the levels of body fat that individuals should possess. It is essential to maintain a minimal amount of body fat (percent body fat) for good health, but an excess level as well as a very low body fat level can cause serious health risk. The proper way to determine recommended weight is by finding out what percent of total body weight is fat and what amount is lean tissue. Body composition can be assesses through several techniques (Hoeger& Hoeger,

1999). FITNESSGRAM provides three test options to estimate body composition: Skin folds Measurements, Bioelectric Impedance Analyzer, and Body Mass Index (California department of education, 2012).

2.6.2. Skill or performance related physical fitness

KoKo (1985) has pointed out that skill-related physical fitness is components of fitness that have a relationship with enhanced performance in athletic activities. Skill- related fitness abilities increases one‘s ability to perform in various activities and only has an indirect connection with health. The skill-related components of physical fitness are considered to be agility, balance, coordination, power, speed, and reaction time.

2.6.2.1. Speed

According to Cronin & Hansen (2005) Speed refers to a person‘s ability to move fast or to cover a distance in a short period of time. When speed combined with strength it provides power. Running a fast break basketball, moving a racquet fast through hitting zone to hit the ball harder in racquet game, sprinting in short sprint running and fast reaction in soccer needs speed. Speed can be improved by increasing a play‘s power by using training like counter movement jumps, and squat jumps are effective for improving speed. Mackenzie (2002) pointed out speed enables a player to move from one point to another with faster response time. It has been shown that to improve speed each athlete needs to work on acceleration, starting ability, stride rate, speed endurance, and stride length.

Baechle, et al., (2000) noted that the transition speed is the player's ability to perform sequential and similar movements in the shortest possible time, while it is agility to change the conditions in the air, and the ability of the motor speed is the maximum contraction or motor response to muscle in as little time as possible. The difference between the transitional speed and speed motor that transition speed need time to reach the maximum speed of which must be incremental, and this is evident in the running races in which the player for a time sufficient needs to get from speed zero to maximum speed, while speed motor. They do not need to this time, but the maximum muscle contraction in the shortest possible time and appear in the explosive movements of some sports (Vikram, 2008).

2.6.2.2. Agility

Agility is the ability to rapidly change the position of the entire body in time and space with speed and accuracy (Verschuren,et al, 2009). So, agility is the ability of the body or parts of the body to change directions rapidly and accurately. This is the combination of speed and coordination. It allows you to efficiently change direction and body position at speed.

Agility refers to a common screening test among sports teams, a shuttle or zigzag run is examples of exercises that develop agility. Critical periods of development for agility occur between the ages of 9 and 12 years old, with complexity and specificity beginning around the ages of 16 to 17 years. An athlete that displays good agility will most likely possess other qualities such as, dynamic balance, spatial awareness, rhythm, as well as visual processing. So while agility can be simply defined as an ability to quickly stop and re-start motion, there is a high degree of complexity to this motor skill (Dawes, 2008).

2.6.2.3. Balance

It is the ability to control or stabilize the body when a person is standing still or moving. for example in-line skating. Coordination is the ability to use the sense together with body parts during movement. For example, dribbling a basketball using hands and eyes together is called hand-eye coordination (Topped sports network, 1997-2011).

2.6.2.4. Power

Power is a combination of strength and speed as well as a measurement of an ability to exert force at higher speeds. It is the product of the force exerted on an object and the velocity of the object in the direction in which the force is exerted. Understanding power capacity and how it can be created is one of the primary keys to optimizing athletic performance. Power is the capacity to do a given amount of work as rapidly as possible. It includes the elements of strength and speed. Speed is the ability to apply force rapidly when snatching, cleaning, throwing or sprinting. There are a few lifts that qualify as an evaluation for power is the Olympic style lifts: the snatch, push jerk and the power clean (Baechle, 1994; O'Shea, 1999).

2.6.2.5. Reaction of time

Reaction time is one's ability to respond quickly to what you hear, see or feel. For example, an athlete quickly coming off the blocks in a swimming meet, a track competitor exploding off the line during

the race, or a baseball player reading the pitcher to steal a base. Almost every athletic skill/ competition has some sort of need for reactions A great partner activity that focuses and emphasizes reaction time is to practice the tennis ball drop game. In pairs, elementary-aged students can hold a tennis ball in each hand, with arms extended to the sides of their body. Their partner will start 2 feet away from them, with their hands on their knees. As the partner holding the tennis balls releases one ball, the other partner must run to the ball, and catch it before it bounces one time. If the person successfully catches the tennis ball, the partner will take one small step backward, making it more challenging. This will continue until the partner is unable to reach the ball. After 10–20 attempts students can switch roles. Another great partner activity is having both partners standing face to face with 2 feet between them. One partner will be holding two tennis balls with arms extend in front of themselves, shoulder height. The other partner will have their hands behind their back. Once Partner 1 drops 1 of the tennis balls, Partner 2 will then catch it with the same-sided hand, before it hits the ground. Tis can be done with many rounds in a short period of time. After a few successful attempts, the students can try catching both tennis balls at the same time (Corbin, et al., 2014).

2.7. Factors Influencing Fitness

Physical fitness is influenced by various factors. According to Sharkey (1990), physical fitness is mainly influenced by the following factors.

1. **Heredity:** Genetically we inherit many factors that contribute to aerobic fitness, including the maximal capacity of the respiratory and cardiovascular systems, a larger heart, more red blood cells and hemoglobin and a high percentage of slow oxidative and fast oxidative-glycolytic muscle fibers. Mitochondria, the energy producing units of muscle and other cells, are inherited from the maternal side. Recent evidence indicates that the capacity of muscle to respond to training may also be inherited.
2. **Training**: Training improves the function and capacity of the respiratory and cardiovascular systems and boosts blood volume, but the most important changes takes place in the muscle fibers that are used in the training. Aerobic training improves muscles ability to produce energy aerobically and shifts metabolism from carbohydrate to fat, which may produce the single most important health effect of exercise. Burning fat reduces fat storage, blood fat levels, and cardiovascular risk. It also improves insulin sensitivity and reduces the risk of some cancers.

Of course, training enhances the ability to perform, but the improvement is limited to the activity used in training.

3. **Gender:** Before puberty, boys and girls differ a little in aerobic fitness, but from then on girls fall behind. Young women average 15 to 25% less than young men in aerobic fitness, depending on their level of activity. But highly trained young female endurance athletes are but 10% below male endurance athletes of the same age in vo_2max and performance times.

2.8. Effects of Training

Training might be considered as having three level of effect.

1. Immediate:-The immediate effect of training is the body's reaction to the stressor of the training stimulus's they include increased heart rate, perspiration, increased blood locates, high endurance system involvement and fatigue.

2. Residual;- The residual effect of training is what might be considered as the body's recovery and preparation response. The recovery response is seen in raised general metabolism of sometime after exercise is concluded. During this time the body's resting state is restores with products of energy expenditure removed, and are stressors related effects gradually eliminated. The preparation response is seen in the heightened level of adaptation to future training stimulus, the body organizes itself to insure that next time it will not be stressed so much by the same stimulus! Put another way, this effect of training ensure the body's prepared for a greater training stimulus next time.

3. Cumulative:-The cumulative effect of training is the body's progressive adaptation through the preparation response. This is what is measured in fitness monitoring tests are over period of months or even years(Drnheim,et al, 2000).

2.9. Development of an Effective Training Program

According to Mohamed (2008) explains the steps involved when developing a training program. The process of creating a training program to help develop and individual's fitness comprises 6 stages.

Stage 1: Gather details about the individuals age, reasons for wanting to get in to the training, current or recent injuries , health problems , the sports they played and how often , their dislike with regards training and sports facilities have access to gym, sport centers etc.

Stage2: Determine components of fitness they need to improve this could depend on what individuals want to get fit.

Stage 3: Identify appropriate terser that can be used to initially determined the individual‘s level of firms and the to monitor progress during the training.

Stage 4: level offenses; We need to conduct a gap analysis of the individuals current fitness and target fitness levels, the result of this previous will assist in the design of the training so that desired level.

Stage 5: prepare a training program using the rests of the gap analysis and'' FITT'' principles.

- F- Frequency – how often should the individual exercise?
- I - Instancing- how hard should the individual exercises?
- T- Time – how long should each session last?
- T- Type- of training activity

Stage 6: The program has now been agreed and the individual can undertake the program. Every four weeks meet and discuss the individual how the training has gone, the test results, progress towards target fitness level and adjustments to the training program.

2.10. The Recommended Quantity of Exercise For Healthy Adults

Increasing numbers of persons are becoming involved in endurance training and thus the need for guidelines for exercise prescription is apparent. Based on the existing evidence concerning exercise prescription for healthy adults and the need for guidelines, the American College of Sports Medicine (1978) makes the following recommendations for the quantity and quality of training for developing and maintaining cardio-respiratory fitness and body composition in the healthy adult:

1. Frequency of training: 3 to 5 days per week.

2. Intensity of training: 60 % to 80% of maximum heart rate reserve, or 50% to 85% of maximum oxygen uptake (VO2 max).

3. Duration of training: 15 to 60 minutes of continuous aerobic activity. Duration is dependent on the intensity of the activity, thus lower intensity activity should be conducted over a longer period of time. Because of the importance of the "total fitness" effect and the fact that it is more

readily attained in longer duration programs, and because of the potential hazards and compliance problems associated with high intensity activity, lower to moderate intensity activity of longer duration is recommended for the non-athletic adult.

4. Mode of activity: Any activity that uses large muscle groups, that can be maintained continuously and is rhythmical and aerobic in nature, e.g. jogging, walking, hiking, swimming, skating, bicycling, rowing, cross-country skiing, rope skipping, and various endurance game activities (ACSM, 1978).

According to Shepherd (2001), many countries have implemented programs to increase the physical activity levels of their populations. The main population health message is that adults should undertake at least 30 minutes of moderate intensity physical activity on most, if not, all days of the week. It was first developed in 1995 by ACSM and was based on numerous physiological, epidemiological, and clinical studies confirming the health benefits accrued from this duration and intensity level of physical activity (Mahecha and Rodrigues). This activity can be done in smaller sessions of 10 minutes, three times per day. Where possible, people should include some vigorous activity for extra health benefits. The specific health outcomes that are being pursued for particular population groups will determine what type, intensity, frequency, duration and context of activity is most appropriate (Ministry of Health of New Zeland, 2003). An important but less clearly heard component of the current message is that aerobic activity should be supplemented by at least two days of resistance exercises per week (Shephard, 2001).

In 2000, the U.S Department of Health and Human Services stated that adults can achieve significant health benefits from participating in vigorous intensity activity for at least 20 minutes per day for a minimum of 3 days a week (Butler et al.., 1998 in Transportation Research Board, 2005). The ACSM recommends that most adults without symptoms of coronary heart disease do not need a formal medical examination and exercise testing if moderate –intensity exercise is prescribed. However, for older individuals with heart disease or for individuals who are over 45 years of age with two or more risk factors for cardiovascular disease, most experts recommend a pre-exercise assessment including a complete medical history and physical examination and an exercise stress test in most cases (Joseph et al., 2005).

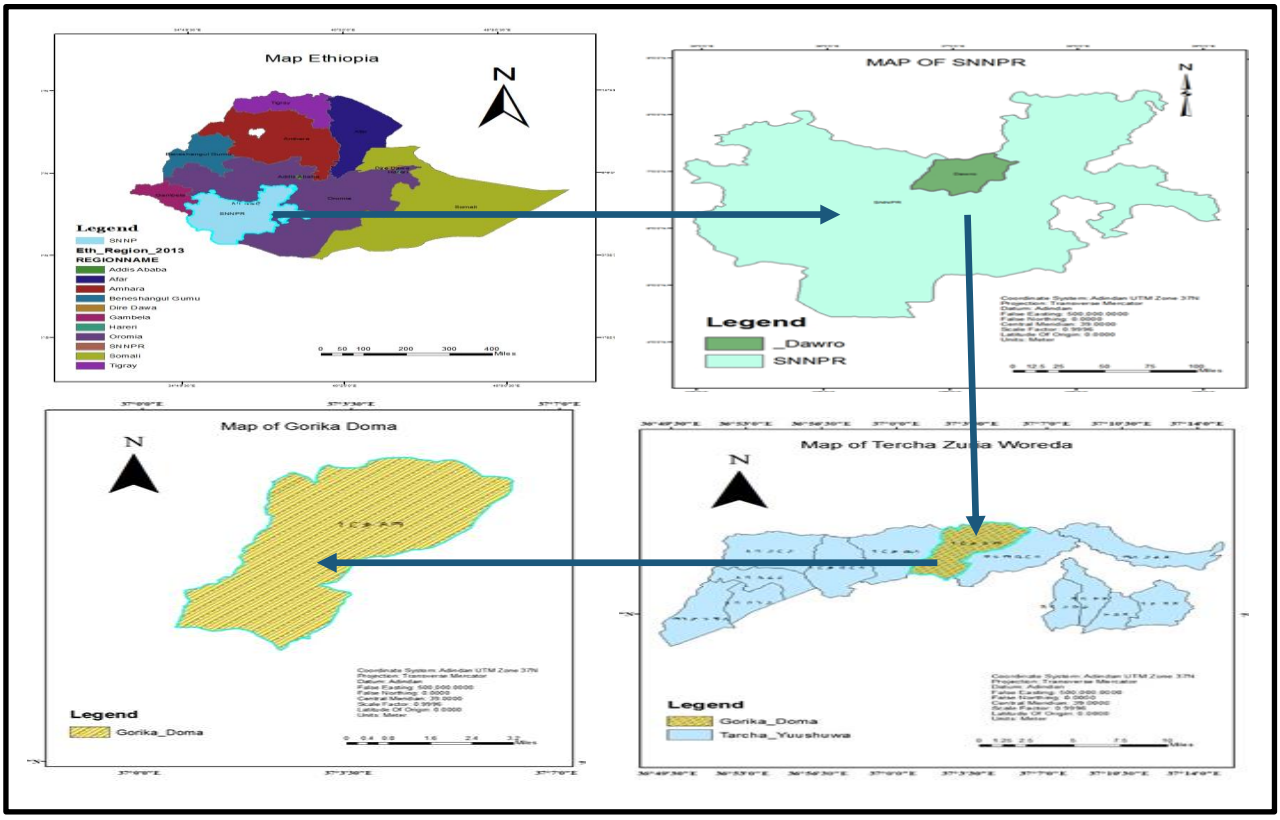
CHAPTER THREE

3. RESEARCH METHODOLOGY

3.1. Description of the Study Area

The study was conducted in Gorkia Doma Kebele, Tarcha Zuriya woreda in Dawro zone, S.N.N.P.R; Ethiopia. Tarcha was the dual administrative center of both Tarcha zuriya woreda and Dawro zone, which lies 319 k.m south west of Hawassa (the regional capital of SNNPR). The town was located at the south west 500 km far from the capital city of Ethiopia, Addis Ababa via Jimma, and 145 km away from Jimma. Tarcha Zuriya woreda was surrounded by Mareka woreda at the south east, Tocha & Kechi woredas at the south west, Konta special woreda at the west, Genna woreda at the east, and Gojeb river at the north direction. So, the study was undertaken in Gorika town which fars 30 km from Tarcha Zuriya woreda at Gorika secondary school grade 12 female students. The school located at north of Gorka town, which was established in 2005 E.C (Dawro zone map, 2021).

Figure 1. Locational Map of Study Area (Gorika Town)



Source: extracted from ArcGIS version10.4 (2021).

3.2. Research Design

Since the focus of this study was to examine the effects of circuit training program on selected physical fitness components of female students, this research study followed a quantitative research approach.

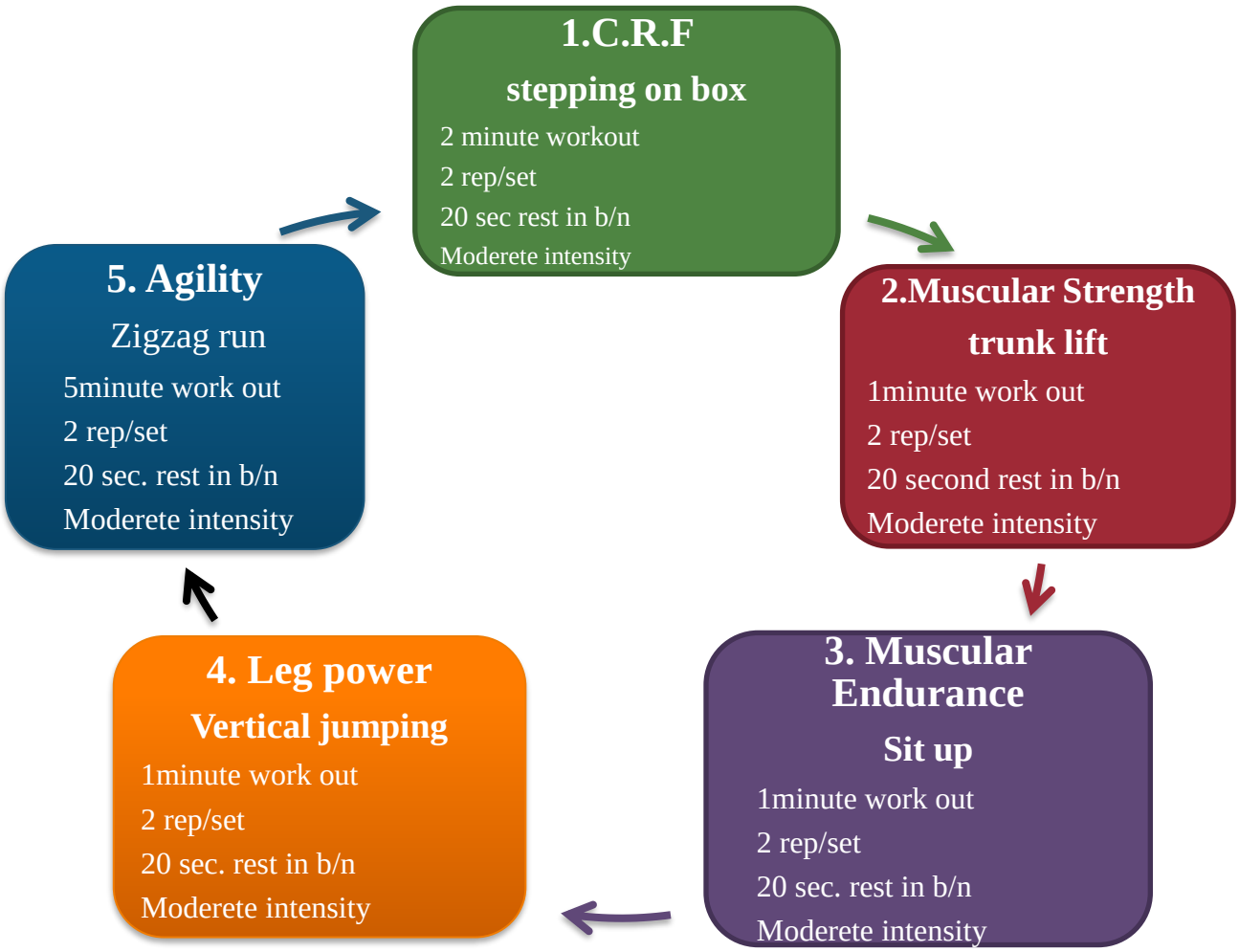
Depending on the nature and appropriateness for allocating participants to examine the pretest and post-test data, this study was employed true experimental research design **(**pretest-posttest control group design**).** It gives a chance for assigning participants randomly as EG and CG in order to measure, assess, evaluate and analyze the effects of circuit training program on selected physical fitness variables; these variables were cardio respiratory fitness, muscular strength, muscular endurance, power and agility.

According to Markovic (2007) and de Villarreal et al. (2009), 8 to 12 weeks of the training program is essential to maximize individuals' ability. In this study the investigator applied circuit training program planned for a period of 12 weeks, administered 3 days a week (Monday, Wednesday and Friday) and 40-60 minutes each day with moderate intensity on experimental group. However, the Control group didn't perform the additional training designed for this study.

The Study design lay out

Treatment	Circuit training
Frequency	3 days/week
Total duration	12 weeks
Duration/Session	40-60 minutes
Intensity	Moderate
Exercise days	Monday, Wednesday, Friday
Training Time	Morning, After noon, Morning

Figure 2: Circuit training model lay out designed for 40 minute duration



3.3. Study population

Gorika secondary school has a total 150 grade 12 students. From this 65 were females and the rest 85 were males. Since the research was experimental, to monitor training as well as to manage the test administrations and data analysis the researcher took these 65 female students as a total population of the study.

3.4. Sample size and Sampling Techniques

3.4.1. Selection criteria

For this study, purposive and simple random sampling techniques were applied to select participants. According to the criteria required for the study and the entire questionnaire, purposive

sampling technique was used to select the total sample from the population. Besides this, simple random sampling technique was used to assign participants in to experimental group and control group. Based on this, from the total of 65 female students, 13 students were age greater than 19 years old; 3 students were athletes, 9 students whose age 18-19 years had health problems. Therefore, the researcher selected 40 female students whose age 18-19 years old, healthy, non-athletes and volunteers as the total sample size of the study purposively (refer Appendix- C), and the researcher assigned 20 participants for control group and the other 20 participants for experimental group randomly by using lottery method.

3.4.2. Inclusion and exclusion criteria

Female students who fulfill the health history questioner, whose age from 18-19 and non-athletes (students who doesn't engage in regular physical activity before a study) were part of the study. However, individuals with chronic conditions and taking medications were not admitted to the study. In addition, students who had any recent physical injury and medical conditions restricted by physicians were excluded.

3.5. Research Variables

This research study cosists of independent and dependent variables. According to Saul McLeod, (2019), independent variable is the variable the experimenter manipulates or changes, and is assumed to have a direct effect on the dependent variable. Where as dependent variable is the variable being tested and measured in an experiment, and is 'dependent' on the independent variable. In this study, the independent variable was 12-week circuit training and also the dependent variables were selected physical fitness components namely, cardio respiratory fitness, muscular strength, muscular endurance, power and agility.

3.6. Source of Data

In this study the researcher used primary source of data to gather relevant information from study participants. Primary data was obtained from pre and posttests of experimental variables according to designed parameters (3-minute step test, 60 sec. sit up test, trunk lift test, vertical jump test and Illinois agility run test).

3.7. Instruments of data collection

In order to conduct this study, the researcher used Gorika secondary school sport field to conduct tests and for training. The main instruments of data collection for this study were a valid predetermined fitness tests (3-minute step test for cardio respiratory fitness, trunk lift test for muscular strength, 60 sec. sit-up test for muscular endurance, vertical jump test for power, and Illinois agility run test for agility). For the success of the study necessary materials such as test score sheet, cones, 30-40 cm steeper, stop watch, chalk, whistle, and measuring tap (meter), were also used for data collection.

3.8. Methods and procedures of data collection

The data was collected from a pre and post treatment fitness tests of selected physical fitness variables (3-minute step test for cardio respiratory fitness, trunk lift test for muscular strength, 60 second sit-up test for muscular endurance, vertical jump test for explosive leg power, and Illinois agility run test for agility). Therefore, the researcher used quantitative data collection method to collect data from the subjects. The procedure of data collection was gathered through the following valid pre-determined fitness tests.

3.8.1. The valid predetermined fitness tests

Testing and measurement are the means of collecting information upon which subsequent performance evaluations and decisions had made but in the analysis, we need to bear in mind the results.

3.8.1.1. Test for Cardio Respiratory Fitness (3-minute Step test)

Figure 3: Three minute step test (Adopted from Mackenzie, 2005: 101 performance evaluation test)

Purpose: The objective of the test is to measure the recovery rate of heart after exercise.

Equipment required: Stopwatch or wrist watch, 12 inch high bench and data recording sheet.

Procedures:

- The subjects were conducted warming up exercises for five minutes.
- The subjects were started by steps up and down on the plat form at a given rate for three minutes.
- In time with the beat one foot up on the bench (1st beat), step up with the second foot (2n beat), step down with one foot (3rd beat), and step down with the other foot (4th beat). The subjects were maintained a steady four beat cycle by saying" up, up, down, down".
- The action will be repeated, and test continued until the given time is completed. The results were based on the stepping time and/or heart rate after exercise.

Scoring: After completing the test, subjects' were located radial artery using index finger. After finding radial pulse, the assistance counted the number of heart beat (pulses) that occur during a 30 seconds period. Heart rates for 1 minute was computed by multiplying the number of heart beats counted in 30 seconds by 2.

3.8.1.2. Test for muscular strength (Trunk lift test)

Figure 4: Trunk Lift test (Sharkey B.J,1997).

Purpose: The objective is to measures the strength of upper back and neck muscles

Equipment required: To administer trunk lift test, flat surface, mat and assistant are required.

Procedure: the aim of the test is to lift the upper body off the floor using the muscles of the shoulder, neck & back then return to the starting position to repeat it as many as possible. To conduct the trunk lift test, it is necessary to follow the following steps.

- The subject conducted warming up exercise for 10 minutes.
- The subject lies prone (face down) position with toes pointed back behind the body.
- Place hands placed under the thighs or hands clasped behind the neck.
- Place the shoulder blades together off the floor.
- Slowly raise the head and chest from the floor by arching the upper back.
- Return to the starting position and repeat it as many as possible.

Scoring: The test will be assessed by counting maximum number of trunk lifts correctly executed.

3.8.1.3. Test for muscular endurance (60 sec. Sit up test)

Figure 5. Sit up test (Tirtonadi.com, 2021)

Purpose: Sit-up test measures the abdominal muscular strength and endurance of the abdominals.

Equipment required: mat and stop watch.

Procedure:

- The subject conducts warming up exercise for 10 minutes.
- The investigator will tell participant to lie on her 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 her 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 will be scored (Kamyabnia. *et al*., 2011).

Scoring: The test will be assessed by counting the number of sit ups correctly executed for 60 seconds.

3.8.1.4. Explosive leg power (Vertical jump) Test

Figure 6. Vertical Jump Test Source: ILEA: vertical jump in.gov

Purpose: To monitor the development of the athlete's elastic leg strength:

Equipment Required: To undertake the test Wall, Tape measure (meter), Chalk and Assistant are required.

Procedures: to conduct the vertical jump test, it is necessary to follow the following steps.

- The subject conducts warming up exercise for 10 minutes.

- The subject chalks the end of her fingertips.
- The subject stands side on to the wall, keeping both feet remaining on the ground, reaches up as high as possible with one hand and marks the wall with the tips of the fingers (M1).
- The subject from a static position jumps as high as possible and marks the wall with the chalk on his fingers (M2).
- The assistant measures and records the distance between M1 and M2.
- The subject should perform three trials.
- The assistant calculate and recording the highest jump from the three trials.

Scoring: the test score is assessed by taking the range of the static position record from the highest possible jumping record.

3.8.1.5. Illinois Agility Run Test

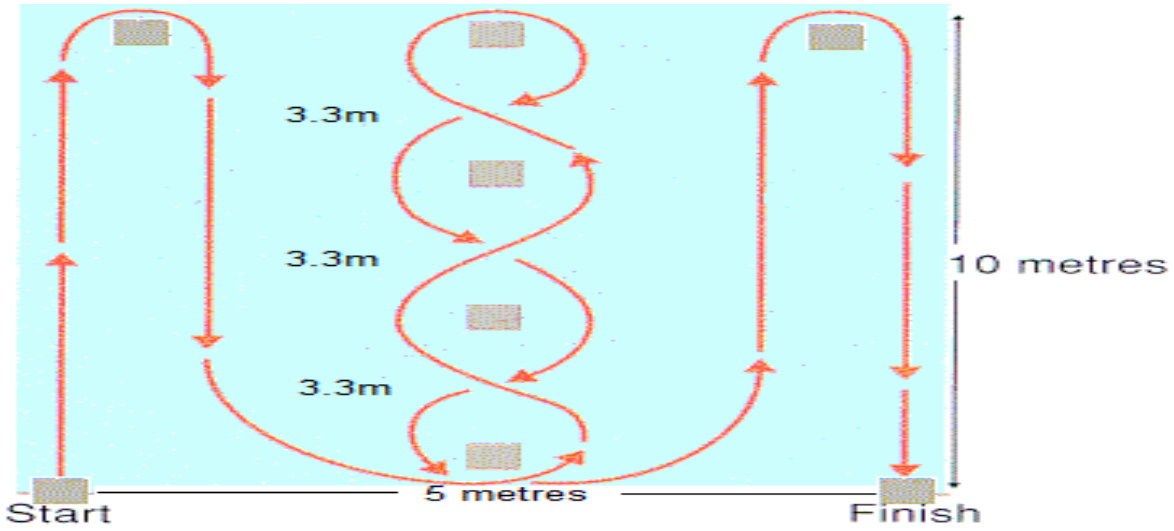


Figure 7. Illinois Agility Test (Source: Davis et al. 2000)

Purpose: The objective of the Illinois Agility Run Test (Getchell, 1979) is to monitor the development of the athlete's agility.

Required Resources: Flat non-slip surface, Measuring tape, 8 cones, Stopwatch, Assistant will be required.

Procedures to conduct the test: This test requires the athlete to run the lines route in the diagram above as fast as possible.

- The subject conducts warming up exercises for 10 minutes.
- The assistance sets up the course as detailed in the diagram
- The subject lies face down on the floor at the "Start" cone
- The assistant gives the command "GO" and starts the stopwatch.
- The subject jumps to her feet and negotiates the course around the cones following the line route shown in the diagram to the finish
- The assistant stops the stopwatch and records the time when the subject passes the "Finish" cone.
- Three successful trials were completed
- Finally, the assistant uses the fastest recorded time.

3.9. Methods of Data Analysis

The data collected from pre and post-tests was analyzed by using descriptive and inferential statistical models. In descriptive statistics, the data collected from a series of fitness tests was presented as a group mean value, standard deviation and mean difference. The effect of circuit training on selected physical fitness variables was analyzed in separate two pre coded groups experimental (EG) and control group (CG) two times, pre and post-tests. By using inferential statistics, the difference between pre-test to post-test result of each variable was analyzed with "paired sample t-test" at $p < 0.05$ using computerized Statistical Package for Social Sciences (SPSS) version 20 software. But if $p \geq 0.05$ the investigator would accept the null hypothesis. Therefore, the researcher used quantitative method of data analysis in order to analyze the data collected from pre and post fitness tests.

3.10. Data Quality Control

To ensure the data quality, all the test procedures, collection of data and handling information was carried out in accordance with standard protocols and measurements. The researcher used two assistances to collect data, in order to avoid errors; training was given for assistances on how to use data collecting instruments and measurements before data collection. Additionally, all the aforementioned tests were recorded with photograph. The researcher had given awareness for the students about the test and recommended pre conditions while the test administered as well as the objective of the study to contribute something that expected from them. To ensure the reliability

and validity of the result the pre-test was administered 2 days before the treatmen began and the post-test was taken place two days after their treatment terminated. The researcher tried to prevent the Control Group (CG) from participating any special treatment or training that might prescribe for the Experimental Group (EG) in addition to their physical education practical class to increase the validity and reliability of the test results. In addition to the above points, to increase validity and reliability of the test analysis the data was recorded and inserted in to the software twice with different individuals.

3.11. Protocol and Ethical Consideration

The study was dealt with the ethical issue related to the investigation. It protected the privacy of research participant and made guaranty and confidentiality of the information that was given to the study, and risk harm due to participation. Participation of subjects in this study was purely a voluntary based activity and their right not to participate and can resign at any time of training session was respected. Therefore, the study was conducted all actions based on the Jimma university rule, code of conduct and policies concerning research ethics.

CHAPTER FOUR

4. RESULTS AND DISCUSSION

4.1. Introduction

This part of the study deals with presenting, analyzing and discussing the data collected through pretest and post test results of cardio respiratory fitness, muscular strength, muscular endurance, power and agility for individual students from Experimental Group(EG) and Control Group(CG). So, the researcher used quantitative research method.

The main objective of this study was to find out the effect of circuit training on selected physical fitness components among participants of Gorika secondary school grade 12 female students. To achieve its objective, 40 female students were selected purposively as subjects of the study. They were divided randomly into two groups equal in number EG (n=20) and CG (n=20); their age was 18-19 years old. Circuit training was given for 12 consecutive weeks (three months -November, December, and January) for experimental groups. The variables selected for this study were physical fitness components such as cardio respiratory fitness, muscular strength, muscular endurance, power and agility. The training included three days per week; with duration of 40-60 minutes and moderate intensity. Marking cones, stopwatch, record sheets, paper, pen, 30-40 cm bench, chalk, whistle, and measuring tap (meter) were used during training and treatment.

Pre and post-tests were conducted for all 40 subjects on selected physical fitness components and the scores were recorded. The collected data was presented as a group mean value, standard deviation and mean difference. The difference between pre-test and post-test result in each test was analyzed with paired sample t-test using SPSS version 20 software. The results for each fitness variables were discussed below.

4.2. Results of the Study

4.2.1. Characteristics of study participants

Table 1 shows demographic characteristics of 40 study participants from Gorika secondary school measured in EG and CG. The mean of age (EG=18.70 year, CG=18.65year), weight (EG=58.10kg, CG=57.90kg) and height (EG=1.61m, CG= 1.60m) was recorded. Based on the findings, participants have relatively the same age, weight and height at the experimental group and control group variables.

Table 1. Demographic Characteristics of the study participants

Group	N	Age (year)		Weight (kg)		Height (m)	
		Mean	S.D	Mean	S.D	Mean	S.D
EG	20	18.70	0.47016	58.10	2.44734	1.606	0.02644
CG	20	18.65	0.48936	57.90	1.86096	1.597	0.03097

Key: *EG= Experimental Group, CG= Control Group Kg= Kilogram m= meter*

4.2.2. Effects of Circuit Training on Cardio Respiratory Fitness

Table 2 presents 3-minute step test result measured in EG and CG in the pre-test and post-tests. The average pretest score of mean value of EG (N=20) was found to be 136.55BPM with the standard deviation of 3.02 and CG (N=20)= was founded to be 136.75BPM with a SD of 3.16. From this data we can see that the scores in the pre-test for both groups were close. After twelve weeks circuit training, the average post test score of EG was found out 107.20BPM with SD of 3.29 and for CG mean of 136.55BPM with SD of 3.35. From this data we can see that the scores in the post-test for both groups (EG and CG) were very different. One can pick up that these numbers in pre-test and post-test mean scores (achievement levels) are different. These data indicate that there is a significant difference and gradual decrement between PT and PoT test results of EG. In contrast, there is insufficient decrement between PT and PoT results of CG.

Table 2. The mean value of CRF (step test) for EG and CG

Group	Test	PT (X±SD)	PoT(X±SD)	ΔX(PT and PoT)	t-value	p
EG	Step test	136.55±3.02	107.20±3.29	-29.5	62.97	.000
CG	Step test	136.75±3.16	136.55±3.35	-0.2	0.81	.428

Key: *CRF=Cardio Respiratory Fitness, EG= Experimental Group, CG= Control Group, PT= pre-test, PoT= Post-test, X= mean value of each tests, SD= Standard deviation, ΔX= (MD) mean difference, p= significance level.*

4.2.3. Effect of Circuit training on Muscular Strength

Table 3 describes trunk lift test result measured in EG and CG in the pre-test and post-test. The average pre-test score of mean value of EG (N=20) was recorded to be 17.5RM with the standard deviation of 1.05 and CG (N=20)= mean value was recorded to be 17.1RM with SD of 0.97. From this data we can see that the scores in the pretest for both groups were relatively close. After twelve weeks training, the average post-test score of EG was found out 26.8RM with SD of 1.79 and for CG mean 17.35RM with SD of 1.27. From this data we can see that the scores in the post-test for both groups (EG and CG) were very different. Hence, this data indicates that there was significant difference and gradual improvement between PT and PoT results of EG. In contrast, there was no significant improvement between PT and PoT results of CG.

Table 3. The mean value of MS (trunk lift test) for EG and CG

Group	Test	PT (X±SD)	PoT (X±SD)	ΔX (PT and PoT)	t-value	p
EG	Trunk lift test	17.5±1.05	26.8±1.79	9.3	-40.34	.000
CG	Trunk lift test	17.1±0.97	17.35±1.27	0.25	-1.31	.204

Key: *MS= Muscular Strength, EG= Experimental Group, CG= Control Group, PT= pre-test, PoT= Post-test, X= mean value of each tests, SD= Standard deviation, ΔX=(MD) mean difference, p= significance level.*

4.2.4. Effects of circuit training on muscular endurance

Table 4 presents 60 second sit up test result measured in EG and CG in the pre-test and post-tests. The average pretest score of mean value of EG (N=20) was found to be 9.25rep/min with the standard deviation of 0.85 and CG (N=20)= was found to be 8.95rep/min with SD of 1.0. From this data we can see that the scores in the pretest for both groups were relatively close. After twelve weeks training, the average post test score mean value of EG was found out 18.15rep/min with SD of 1.63 and for CG the mean value was found to be 9.00rep/min with SD of 0.92. From this data, one can easily understand that these numbers in pre-test and post-test mean scores (achievement levels) for both groups (EG and CG) were different. Hence, these data indicates that there was significant difference and gradual improvement between PT and PoT test results of EG. In contrast, there was deficient improvement between PT and PoT results of CG.

Table 4. The mean value of ME(60 sec. sit up test) for EG and CG

Group	Test	PT (X±SD)	PoT (X±SD)	ΔX (PT and PoT)	t-value	p
EG	60 sec. sit up test	9.25±0.85	18.15±1.63	8.9	-41.12	.000
CG	60 sec. sit up test	8.95±1.0	9.00±0.92	0.05	-0.27	.789

Key: *ME= Muscular Endurance, EG= Experimental Group, CG= Control Group, PT= pre-test, PoT= Post-test, X= mean value of each tests, SD= Standard deviation, ΔX= (MD) mean difference, p= significance level.*

4.2.5. Effects of Circuit Training on Power

Table 5 describes vertical jump test result measured in EG and CG in the pre-test and post-tests. The average pre-test score of mean value of EG (N=20) was found to be 24.95cm with the standard deviation of 1.0 and CG (N=20)= was founded to be 24.35cm with a SD of 1.04. From this data we can see that the scores in the pre-test for both groups were close. After twelve week training, the average post-test score of mean value of EG was found out 35.05cm with SD of 1.64 and for CG mean 24.6cm with SD of 1.23. From this data we can see that the scores in the posttest for both groups (EG and CG) were very different. One can easily identify that these numbers in pre-test and post-test mean scores (achievement levels) were different. Hence, these data suggests that

there was significant difference and gradual improvement between PT and PoT results of EG. In contrast, there was no significant improvement between PT and PoT results of CG.

Table 5. The mean value of Explosive leg Power(Vertical Jump test) for EG and CG

Group	Test	PT (X±SD)	PoT (X±SD)	ΔX(PT and PoT)	t- value	p
EG	Vertical Jump test	24.95±1.0	35.05±1.64	10.1	-42.17	.000
CG	Vertical Jump test	24.35±1.04	24.6±1.23	0.25	-1.16	.262

Key: *EG= Experimental Group, CG= Control Group, PT= pre-test, PoT= post-test, X= mean value of each tests, SD= Standard deviation, ΔX= (MD) mean difference, p= significance level.*

4.2.6. Effects of Circuit Training on Agility

Table 6 shows Illinois agility run test results measured in EG and CG in the pre-test and post-tests. the average pretest score of mean value of EG(N=20) was found to be 24.84 with the standard deviation of 1.23 and mean value of CG (N=20) was 24.35 with a SD of 0.83. From this data we can see that the scores in the pre-test for both groups were close. After twelve weeks circuit training, the average post test score of EG was found out 20.24 with SD of 1.25 and for CG mean value was 24.29 with SD of 1.08. From this data we can see that the scores in the post-test for both groups (EG and CG) were very different. One can pick up that these numbers in pre-test and post-test mean scores (achievement levels) were different. Hence, these data indicates that there was significant difference and gradual decrement between PT and PoT test results of EG. In contrast, there was no suffecient decrement recorded between PT and PoT test results of CG.

Table 6. The mean value of Agility (Illinois agility run test) for EG and CG

Group	Test	PT (X±SD)	PoT (X±SD)	ΔX(PT and PoT)	t- value	P
EG	Illinois test	24.84±1.23	20.24±1.25	-4.6	30.30	.000
CG	Illinois test	24.35±0.83	24.29±1.08	-0.06	0.70	.493

Key: *EG= Experimental Group, CG= Control Group, PT= pre-test, PoT= post-test, X= mean value of each tests, SD= Standard deviation, ΔX= (MD) mean difference, p= significance level.*

4.3. Comparison of Selected Fitness Tests (3-minute step test, trunk lift, 60 sec. sit up, vertical jump and Illinois test) results of EG

Table 7 presents comparisons among physical fitness tests (3- minute step test, trunk lift test, 60 sec. sit up test, vertical jump and Illinois agility tests) in the EG. During the 12 weeks of circuit training, the improvement of subjects' performance was significantly increased from pre training to post training on experimental groups.

All tests had changes due to circuit training in which they were engaged in. The mean value of CRF pre-test before training was 136.55 BPM and post-test after training was 107.20 BPM. CRF pre-test to post-test mean difference value of EG was decreased by -29.5BPM (the decrease in the time of recovery period indicates improvement in physical fitness). Whereas the mean value of muscular strength from pre-test 17.5RM increased to 26.8RM post-test result. Muscular strength score of pre-test to post-test mean difference value of EG increased by 9.3RM record. Table 7 shows that, the mean value of muscular endurance from pre-test 9.25rep/min increased to 18.15rep/min. Muscular endurance score of pre-test to post-test mean difference value of EG was increased by 8.9rep/min record. Explosive leg power also showed an increased value of mean score from the pre-test value 24.95cm to post-test value of 35.05cm. This indicates that the explosive leg power score of pre-test to post-test mean difference value of EG was increased by 10.1cm record. Lastly, agility test scored with the mean value of EG from pre-test 24.84second decreased to 20.24second post-test result. Agility score of pre-test mean to post-test mean difference value decreased by -4.6seconds. The decrease in mean value of agility (completing agility run test in short time) indicates an improvement in performance due to circuit training.

When we compare the pre-test and post-test results of mean difference values in each test of 12 week circuit training intervention on experimental groups, the first better change was observed on CRF= -29.5BPM, secondly explosive leg power= 10.1cm, thirdly muscular strength= 9.3RM, fourthly muscular endurance=8.9rep/min and fifthly the lowest score of mean difference value was agility= -4.5seconds. The improvement rate of this data was one indicator of the great circuit training effect on CRF, explosive leg power, muscular strength, muscular endurance and agility of female students. Generally circuit training was an effective method for improving selected physical fitness components (CRF, MS, ME, Power and Agility) according to the results on this study.

Table 7. Changes of 12 week circuit training on selected physical fitness variables (CRF, MS, ME, power and Agility) on EG

Type of test	PT(X±SD)	PoT(X±SD)	ΔX(PT and PoT)	t-value	P
CRF(step test)	136.55±3.02	107.20±3.29	-29.5	62.97	.000
MS(trunk lift test)	17.5±1.05	26.8±1.79	9.3	-40.34	.000
ME(60 sec. sit up test)	9.25±0.85	18.15±1.63	8.9	-41.12	.000
power(vertical jump test)	24.95±1.0	35.05±1.64	10.1	-42.17	.000
Agility(Illinois test)	24.84±1.23	20.24±1.25	-4.6,	30.30	.000

Key: *EG= Experimental Group, CRF= Cardio respiratory fitness, MS= Muscular strength, ME= Muscular endurance, PT= pre-test, PoT= post-test, X= mean value of each tests, SD= Standard deviation, ΔX= (MD) mean difference, p= significance level.*

4.4. Discussions

The purpose of this study was to examine effects of 12 week circuit training on selected physical fitness variables of grade twelve female students in Gorka secondary school. Circuit training can be used for general fitness purposes or can be adopted as a conditioning medium for various grounds of sports. Circuit training became an important device in conditioning girls for participation in track and field activities as well as in other sport activities. Participation in this circuit training program should have caused the girls to improve progressively (Global Journals Inc. US 2013). Circuit training has also many educational advantages such as availing mutual respect opportunity among the individuals and respecting those with humble abilities and capabilities equally at the same level of respect to those of higher abilities (Reddy &Jyoti, 2012). In this study circuit training showed effective improvement on selected physical fitness variables (cardio respiratory fitness, muscular strength, muscular endurance, explosive leg power and agility) of female students. The finding of this study in each variable were discussed as follows.

In case of cardio respiratory fitness, there was significant difference in between the pre and post test scores of the participants in step test of the EG. The result indicated in the above “table 2,” suggested that the participants significantly decreased on the results of cardio respiratory fitness

from PT (mean value 136.55BPM with SD of 3.2) to PoT(mean value 107.20BPM with SD 3.29). The MD decreased by -29.5BPM with p= 0.000, (significant at 0.05 level of confidence) and t-value of 62.97. The improvement of the participants recovery rate of pulse rate after exercise was due to twelve week circuit training in which they were engaged in (the decrease in recovery rate of heart rate is the indicator of improvement in physical fitness). The finding of this study was in agreement with Mayorga-Vega et al. (2013) study on the effects of a circuit training program on muscular and cardiovascular endurance and found the training group significantly improved cardio respiratory endurance in school children.

In case of muscular strength, there was significant difference between the pre and post test scores of the participants in trunk lift test on EG. As proved in table 3, EG significantly improved muscular strength in trunk lift test from PT (mean value 17.5RM with SD of 1.05) to PoT(mean value 26.8RM with SD 1.79). The MD increased by 9.3RM with p= 0.000, (significant at 0.05 level of confidence) and t- value of -40.34. The result suggested that twelve week circuit training was an effective method for improving muscular strength of female students.

In case of muscular endurance, there was significant difference between the pre and post test scores of the participants in 60 sec. sit up test on EG. As shown in table 4, the EG significantly improved muscular endurance in 60 second sit up test from PT (mean value 9.25 rep/min with SD of 0.85) to PoT(mean value 18.15rep/min with SD 1.63). The MD increased by 8.9rep/min with p= 0.000, (significant at 0.05 level of confidence) and t- value of -41.12. The result indicated that twelve week circuit training positively affect muscular endurance of female students.

The results of muscular strength and muscular endurance in this study were in line with the findings of Klika, B. and Jordan, C. (2013) suggested that "Circuit training appears to have multiple benefits on health and fitness, as various studies have shown that it may elicit significant increase in aerobic capacity muscular strength, muscular endurance, lean body weight, and significant decreases in resting diastolic blood pressure and body fat".

In case of power, the data (table 5) showed that there was significant differences before and after 12 weeks of circuit training on explosive leg power of female students. The result suggested that significant improvement was shown on explosive leg power in vertical jump test from PT (mean value 24.95 cm with SD of 1.0) to PoT(mean value 35.05cm with SD 1.64). The MD increased

by10.1cm with p= 0.000, (significant at 0.05 level of confidence) and t- value of -42.17. The result marked that twelve week circuit training significantly improve explosive leg power of females.

In case of Agility, as shown on the above table 6, there was significant change between pre and post test result of the participants. The result suggested that the participants were significantly decreased in Illinois agility run test from PT (mean value 24.84second with SD of 1.23) to PoT(mean value 20.4 second with SD 1.25). The MD decreased by-4.6 second with p= 0.000, (significant at 0.05 level of confidence) and t- value of 30.30. The result proved that twelve week circuit training has a positive effect on improving agility of female students.

The results of power and agility was agreed with the findings of Manohar and Sarvesh, (2011) who carried out their study on selected circuit training exercises that contribute positively towards the improvement in performance of cardiovascular endurance, vertical jumping ability, agility, muscular endurance and skill ability of football players as tested by shuttle run test, bent knee sit up test, 30m running with the ball test and kicking accuracy test. Associated physical fitness variables of football players were also improved significantly as a result of selected circuit training exercises.

4.5. Hypothesis Testing

The outcome of the proposed hypothesis on the effects of circuit training program on selected physical fitness variables of female students was testified and discussed as follows.

1. The mean difference of EG from pre-test to post-test result was significantly decreased at 0.05 level of confidence ($p< 0.05$) in 3 minute step test. Therefore, the formulated null hypothesis that twelve week circuit training has no effect on cardio respiratory fitness of female students was rejected at 0.05 level of confidence when assessed in step test. This indicates that circuit training program proved to be a useful exercise modality for improving cardio respiratory fitness.
2. The mean difference of EG from pre-test to post-test result was significantly increased at 0.05 level of confidence ($p< 0.05$) in trunk lift test. Therefore, the formulated null hypothesis that twelve week circuit training has no effect on muscular strength of female students was rejected at 0.05 level of confidence when assessed in trunk lift test. This shows that circuit training program was an effective method of improving muscular strength.

3. The mean difference of EG from pre-test to post-test result was significantly increased at 0.05 level of confidence ($p< 0.05$) in 60 second sit up test. Therefore, the formulated null hypothesis that twelve week circuit training has no effect on muscular strength of female students was rejected at 0.05 level of confidence when assessed in 60 second sit up test. This indicated that circuit training program was an effective method for improving muscular endurance.
4. The mean difference of EG from pre-test to post-test result showed significant improvement at 0.05 level of confidence ($p< 0.05$) in vertical jump test. Therefore, the formulated null hypothesis that twelve week circuit training has no effect on explosive leg power of female students was rejected at 0.05 level of confidence when assessed in vertical jump test. This indicates that circuit training program was an effective exercise modality for improving explosive leg power of female students..
5. The mean difference of EG from pre-test to post-test result was significantly decreased at 0.05 level of confidence in Illinois agility run test. Therefore, the formulated null hypothesis that twelve week circuit training has no effect on agility of female students was rejected at 0.05 level of confidence when assessed in Illinois agility run test. This shows that circuit training program was an effective method for improving female students' agility.

CHAPTER FIVE

5. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

The primary purpose of this study was to examine the effects of circuit training on selected physical fitness components of grade 12 females students in Gorika secondary school. True experimental study design **(**pretest-posttest control group design) was employed for this study. Purposive sampling technique was used to select participants and simple random sampling technique was applied to assign participants. Primary source of data was used to gather information from pre-test and post-test results of selected physical fitness variables and the collected data was analyzed with descriptive and inferential statistical models. Hypothesis was testified based on the results and discussions of the study. To this end, this chapter deals with summary, conclusion and recommendation.

5.1. Summary

The main objective of this study was to examine the effects of circuit training on selected physical fitness components of grade 12 females students in Gorika secondary school. To achieve its objective, this study from the total of 65 female students, 40 female students were selected by purposive sampling technique and 20-20 tie(equal) participants were allocated as Experimental Group and Control Group randomly by using lottery method. The exercise program was designed to 20 experimental groups for 12 weeks, three times per week with 40-60 minute duration and moderate intensity. Each session was divided again in to warming up, main part (circuit training) and cooling down phase. The data collected from the pre and post-tests was analyzed through paired sample t-test using SPSS version 20 software. Based on the analysis made on SPSS software, the following findings were investigated from the results of EG and CG.

- The finding of this study indicated that significant improvement on cardio respiratory fitness was observed in the experimental groups. Despite, there was no significant improvement observed in cardio respiratory fitness of control groups.
- The Finding of this study revealed that there was a significant improvement in muscular strength of female students on EG as a result of circuit training. However, there was no significant improvement in muscular strength on female students of the CG.

- The finding of this study showed that significant changes were observed in muscular endurance of female students from pre to post test results on EG. But there was no significant improvement recorded on muscular endurance of female students on CG.
- The finding of this study indicated that there was a significant improvement in explosive leg power of female students on EG. However, there was no significant improvement made in explosive leg power on female students of the CG.
- The finding of this study also showed that significant changes were made on agility of female students from pre to post test result on EG. But there was no significant improvement on female students' agility result of the CG.

5.2. Conclusion

Based on the major findings of the study, the following points were stated as a conclusion:

- ✓ Physical fitness of female students, like cardio respiratory fitness, muscular strength and muscular endurance, brought a radical change in circuit training program. This showed that circuit training is an effective method to keep individuals health and fitness.
- ✓ From the results of the research findings, it was shown that decrement in recovery rate of heart rate of the participants in 3- minute step test. The main reason for the result of decreasing was 12 weeks circuit training designed for this study.
- ✓ Based on the result obtained, circuit training was an effective method for improving explosive leg power, and agility of female students. Thus, circuit training was essential for improving skill and performance of female students.
- ✓ It was observed that there was an intimate difference between pre and post physical fitness performances on EG rather than CG variables.
- ✓ To improve students physical fitness, programmed fundamental training method plays a great role.
- ✓ Generally, the present study indicated that 12-weeks of well-designed circuit training enhanced the performance of the trainer.

5.3. Recommendations

The findings of this research proved that twelve weeks circuit training significantly improved the performance of female students on selected physical fitness variables. Based on these results, discussions and findings of the study, it is important to state the following points as a recommendation:

- For better improvement of physical fitness, students should be active participant in circuit training program at least 3 days per week for 60 minutes each day.
- Circuit training had a positive effect on cardio respiratory fitness, muscular strength, and muscular endurance; so far circuit training is essential for keeping individuals health.
- Circuit training had also positive effect on power and agility of female students. This indicates that circuit training may serve as a conditioning medium for students who wants to participate in different sports.
- Physical education teachers as a means to improve the physical fitness status of students, it is better to initiate students to participate in circuit training programs among various classes and grade levels.
- Efforts through physical education teachers should be made in advocating the importance of circuit training for students, since it has enormous benefits.
- It is also better, if teachers design training programs for female students to participate freely in different physical fitness trainings and sport competitions.
- Circuit training can also be used by fitness programmers, coaches, athletic trainers and instructors to improve their trainees of cardio respiratory fitness, muscular strength, muscular endurance, power and agility.
- Although physical training especially, circuit training is vital for improving students health and performance, school administrators should encourage and finance student's sport club, school sport trainings and competitions to have more participation of students and to monitor their fitness status.
- This study was conducted on cardio respiratory fitness, muscular strength, muscular endurance, power and agility only. So it is recommended for other researchers to evaluate the effects of this training method on other fitness elements.

References

Alemayehu Ayalew. (2006). The impact of physical fitness training on health related fitness trainees: the case of Assosa town fitness centers.

American College of Sports Medicine. (ACSM) (2009). ACSM Guidelines for Exercise Testing and Prescription (9th ed.). Philadelphia: Lippincott Williams & Wilkins.

American College of Sports Medicine. 1978. "Position Statement: The Recommended Quantity and Quality of Exercise for Developing and Maintaining Fitness in Healthy Adults." Medicine and Science in Sports and Exercise 10 : vii-x.

Andersen, L. B. (2003). Cardiovascular risk factors cluster in children and adolescents with low physical fitness. The European Youth Heart Study (EYHS).

Bachle T., Earle R., Wathen D.(2000). Essentials of Strength Training and Conditioning, second edition. China: Human Kinetics.

Baechle, T.R., 1994. Essentials of Strength Training and Conditioning. Champaign, IL: Human Kinetics, Inc, 167, 57-68.

Baltimore, William and Wilkins.(1995).Guidelines for Exercise Testing and Prescription.

Bouchard, C., R. J. Shephard, T. Stevens, J. R. Sutton and B. D. McPherson.(1990). Exercise fitness and health, Human Kinetics, Champain, IL.

Brett Schneider, W. &Naul, R.(2004). Study on Young People's Lifestyles and Sedentariness and the Role of Sport in the Context of Education and as a Means of Restoring the Balance: FINAL Report, Paderborn.

Butler, N. 1998. 2005. Transportation Research Board. Does the Built Environment Influence Physical Activity? Washington, D. C: TRB.org.

Cady L., D. Bischoff., E. O'Connell., P. Thomas and J. Allan.(1979). Strength and fitness and California Department of Education, (2012).Reference Guide, 2012–13 California Physical Fitness Test. http://www.pftdata.org/.

California Department of Education, (2012).Reference Guide, 2012–13 California Physical Fitness Test. http://www.pftdata.org/.

Casperson, C.J., K.E. Powell and G.M. Christenson.(1985). Physical activity, exercise and physical fitness: definitions and distinctionsfor health-related research. Public Health Rep., 100(2): 126-131.

Clark B, Osness W, Adrian M,Hoeger WWK, Raab D, Wiswell R.(1989). Tests for fitness in older adults: AHHPERD fitness task force. J. Phys. Edu. Recreation Dance, 60(3): 66-71.

Connecticut State Department of Education.(2009).The Third Generation Connecticut Physical Fitness Assessment Test Administrator's Manual.

Corbin, C.B., Welk, G.I., Lindsey,R. and Corbin, W.R. 2003. Concepts of Physical Fitness. Dubuque: Mc Graw Hill (p.6)

Corbin, C.B., Welk, G.I., Lindsey.(2006).Concepts of physical fitness. Active lifestyles for wellness.13th edition. New York: McGraw-Hill.

Corbin, C. B., & Le Masurier, G. (2014). Fitness for life, 6E. Champaign, IL: Human Kinetics.

Cronin & Hanson, (2005); a study of the relationship between physical fitness and speed performance, p-4.

Davis, B. Et Al. (2000). Physical Education and the Study of Sport Uk: Harcourt Publishers Ltd.

Dawes J., 2008. One on one: Creating open agility drills. Strength and Conditioning Journal of Sport Medicine.30: 5.

Dawro Zone map 2021.Internet accessed sept.2, 2021 @2:00 P.M. https:// en.wikipedia.org/wiki/ Dawro- Zone.

De Villarreal, E.S., Kellis, E., Kraemer, W.J., & Izquierdo, M. (2009). Determining variables of plyometric training for improving vertical jump height performance: a meta-analysis. J Strength Cond Res, 23(2), 495-506.

DegeleShoromo.(2013). Comparative Relationships Of Selected Physical Fitness Variables Among Different College Students.

DeVries H., and T. Housh.(1994).Physiology of exercise.5th ed. Brown and Benchmark, Dubuque, IA.

District Columbia State Board of edu. (December 13, 2007). The Physical Education standards.

Exercise Science and Wellness Department. (2012). The Way to a Long & Healthy Life (6th Edition), Grossmann College. Web: http://www.grossmont.edu/es.

Franks, (1997); the Impact of Physical Fitness on flexibility of secondary School youth: Journal of Education and Practice Vol.5, No.19.

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

Golding, Mussel, Dsnowsorm, M.(1986).the youth's way to physical fitness for overweight and obesity .journal of sport med.37:533-545.(3rd ed.).

Grice, T.(2003).The development of Kid Test: A talent identification inventory for predicting success in sports for children. Applied Research in Coaching and Athletics Annual, 18-229.

Hamoudat M.(2008). Effect of the Circuit Training Using the Low Intensity Interval Training Method in the Development of Certain Physical Fitness Elements. Al-Rafidain Sports Science Journal, 14, 216-231.

Hawley E.T. and Franks B.D. (2001). Health fitness instructor's handbook (4th Ed.). Champaign, IL: Human Kinetics Publishers

Headquarters Department of US the Army.(1998).Physical Fitness Training. Washington, DC.

Hockey, R. V., 1981. Physical Fitness: The Pathways to Health. St. Louis: C. V.

Hoeger W.W.K &Hoeger S.A. (1999). Principles and labs for fitness & wellness, 5thed,: Morton Publishing Company.925W.Kenyon.Unit 12 Englewood,Colorado 80110.

Howell, M. L. And W. R. Morford, 1998. Circuit Training For College Fitness Program.

Insel P.M & Roth W.T.(2002). Core concepts in health, Stanford University; McGraw Hill. (9thed.).

Institute of Medicine. (2012). Fitness measures and health outcomes in youth. Washington, DC: The National Academies.

Joseph, L.J.O.; Blumenthal, J.; Katzel, L.I. and Goldberg. A.P. 2005 Successful Aging Exercise Training and Cardio-vascular Health with Aging Volume 13, Number 4.

Jourkesh.(2011). Comparison of Physical Fitness Level among the Students of Islamic Azad University, ShabestarBranch.*Annals of Biological Research*, 2: 460-467.

Kaikkone.H.M.yrjama .E sijander .P.Byman and .R.laukkanen 2000. The Effect of heart rate controlled low resistance circuit weight training and endurance training on maximal aerobic power in sedentary adults. Scandinavian Journal.

Klika, B. and Jordan, C. (2013). High-Intensity Circuit Training Using Body Weight: Maximum Results with Minimal Investment. ACSM's Health and Fitness Journal, 17, 8-14.

Koko, (1985); Effects circiut training on skill related physical fitness. Journal of exercise physiology, 8(1), 11-25.

Lee I., R.Paffenbarger and C. Hennekens. (1997).Physical activity, physical fitness, and longevity.Aging Milano 9.P. 2-11.

Mackenzie, B. (2002). "Sports Coach Plyometrics."Plyometrics.[Hyperlink http://www.brianmac.demon.co.uk/plyo.htm]. 17 April 2002.

Manohar, M. N. and Sarvesh. (2011). The Effects of Circuit Training for the Development of Vertical Jumping Ability, Endurance, Agility and Skill Ability in Football Players' Boys Aged 10 To 12 Years. Variorum, Multi Disciplinary e-Research Journal 4(01): 1-8.

Marcinik, J. Edward, Hodgdon, A. James, Mittleman, Karen, O'brien and J. James.(1985). Aerobic/callisthenic and aerobic/ circuit weight training programs for navy men:a comparative.

Markovic, G. (2007). Does plyometric training improve vertical jump height? a meta-analytical review. Br J Sports Med, 41(6), 349-355.

Mayorga-Vega, D., Viciana, J., & Cocca, A. (2013). Effects of a circuit training program on muscular and cardiovascular endurance and their maintenance in schoolchildren. J Hum Kinet, 37, 153–160.

Ministry of Education Ethiopia. (2006). Health and physical education Textbook: Kuraz International Publisher and Educational Consultant Enterprize, Addis Ababa.

Ministry of Health of New Zealand. 2003. DHB Toolkit: Physical Activity. Wellington.

National Association for Sport and Physical Education.(2009, 2012). Instructional Framework fitness education in physical education. Retrived from.http://www.aahperd.org/NASPE/publications/ upload/ Instructional- Frame work-For-Fitness-Education-in-PE-2012-2.pdf.

O'Shea, P., 1999. Toward an Understanding of Power. Strength and Conditioning Journal.21 (5): 34-36.

Oudat, M., &Ghassab, I.(2007).Proposed Training Program Using the Circuit Training Method and its Effects on the Development of Certain Physical Attributes in the Physical Education Lesson. Scientific Journal for Physical Education Science, 3,7698.

Patrick. (2006)., Tempe, AZ.(2009).Created Optimum Sports Performance LLC and opened his training facility in the summer He runs the popular blog site Optimum Sports Performance, and is also co-host of the Reality Based Fitness Podcast.

Pollok M., and J.Wilmore, 1990. Exercise in health and disease. W. B. Saunders, Philadelphia.

Reddy, M., &Jyoti.(2012).Comparison of Circuit Training Methods on Performance Variables of Sc/St Non-Sc/St Boys.International Journal of Multidisciplinary Research, 2, 221.

Robert.(2005). Concepts of Physical Fitness: Active Lifestyle for Wellness. Boston: McGraw-Hill Companies, Inc.

Saul McLeod. (2019). Independent and Dependent variables. Internet accessed 04Oct, 2021 @3:00 P.M. https://www.simplypsychology.org/variables.html

Sharkey B.J. (1990). Fitness and Health: University of Montana by human kinetics. (4thed.).

Sharkey B.J. (1997).Fitness and Health, University of Montana by human kinetics. (4thed.).

Shephard, R. (2001). Communicating Physical Activity and Health Messages: Science in to Practice. Toronto.

Singapore Ministry of Education.(2005).Curriculum Planning & Development Division Ministry of Education, Physical Education Syllabus (Primary, Secondary, Pre-University).

Singh A. et al. (1999). Peak performance through nutrition & exercise, university of the health sciences, depart. of military and emergency medicine uniformed services.

Singh C. (2014). A Thesis on "A comparative study of cardiovascular fitness of male basketball and handball players of different age groups", Punjabi university, Patiala, Punjab (India),Class m. p. ed.

Stephens T. (1988). Physical activity and mental health in the United States and Canada: Evidence from four population surveys. Preventive Medicine17:35-47

Stone M. H. (1990). Muscle conditioning and muscle injuries. Medicine and Science in Sports subsequent back injuries in fire-fighters. Journal of Occupational Medicine.P.269-272.

Sunni. (1996).Giftedness, Excellence and sport.Report of a small scale research project for the Scottish Sports Council.The Scottish Sport Council.

Taskin H.(2009). Journal of strength and conditioning research ,Effects of circuit training on the sprint, agility and anaerobic endurance, volume: 23,Issue;6,p 1803-1810

Thomas, R., M. Tessa and W. Greg, 2009. The specificity of training prescription and physiological assessment: A review, Journal of Sports Sciences, 27(6): 575- 589.

Topped sport network. (1997-2011). http://www.physicalfitness.org, (Accessed on November 2011)

Tirtonadi.com. (2021). Internet. Accessed 25sept, 2021@ 2:24AM; https://springerplus.springeropen.com/articles/10.1186/s40064-015-1023-6.

Tudor O. Bompa. (1999). Periodization: theory and methodology of training, (4thed.): Champaign, Illinois: human kinetics publishers,, p.54.

United States Department of Health and Human Services (USDHHS). (1996). Physical activity and health: A report of the Surgeon General. Atlanta

Vikram S.(2008). Effect of S.A.Q. drills on skills of volleyball players, A Thesis, Submitted to the Lakshmibai National Institute of Physical Education.

Vinayagamoorthi and Sakthivel A.(Aug , 2014) “Effect of cardiac circuit training on selected physical and physiological variables of high school boys:” academic sports scholar.

Virginia Department of Education. (2006). Health related fitness testing guidelines.

Walls, M. D. (2007). Heart Rate Response during Hatha Yoga and the Effects of Hatha Yoga on Health-Related Physical Fitness, State University of New York College at Cortland.

Welborn T. A., S. D. Satvinder and A. B. Stanley.(2003). Waist-hip ratio is the dominant risk factor predicting cardiovascular death in Australia. The Medical Journal of Australia, 179(11): 580-585.

APPENDECES

Appendix- A

Participants Information Record Form

The questionnaire prepared for studying the Effects of Circuit Training Program on Selected Physical Fitness Variables of Female Students in Gorika Secondary School. So you are kindly requested to give appropriate information for the following questions regarding to health status.

Thank you!

I. Participant's personal information

NAME: _____ telephone number _____

Sex:_____ your typical food _____

Age _____ time gap b/n meals _____

EMERGENCY CONTACT information

Name _____ address _____

Relationship _____ telephone number _____

II. Personal health history

Please answer the following questions by saying ''**Yes''** or ''**No''** and add description by the blank space provided if it is necessary).

1. Is this your first visit to the exercise program? ----------if not please brief description of what lead to the administration ----------

2. Have you ever been treated for internal organs? If yes, when and give details problems-

---

3. Have you ever appeared irregular heart beat on your heart? If yes when and give Details----------

4. Have you ever fainted or bad concussion? ----------If yes kindly write when and how you fainted out ----------

5. Do you have any allergies? If yes kindly list them----------

6. Are currently undergoing any medical treatment or under observation? ----------

7. Have you fallen sick in the past 6 month?----------If problem----------

8. Have you had any injury in the past 5 years? ---------- If yes write the problem ----------

9. Have you ever had major surgery performed on you in the last year?---------- If yes when write the problem ----------

10. Does your family have a history of any genetic disease?----------If yes, write the problem----------

11. Do you have any of the following disease?

Asthma ---------- cancer ----------

Heart disease ---------- stroke ----------

Diabetes---------- skin infection----------

12. Would you expect that this exercise program service will address satisfactory? ----------

I have read and understand the form and have given accurate information in regard to any my health

Name ----------

Signed----------date ----------

Initial Weight (Kg) ---------- Height (Meter) ----------BMI----------

Source: Tomas (2000) USC, accessed on, October, 25, 2013E.C

Appendix - B

Fitness Training and Test Consent Form

Researcher's Name: Simachew Tadesse

Major Advisor's Name: Tesfaye Damena (Ass.prof.)

Co-Advisor's Name: Merera Negassa (M.Ed)

Thesis title: Effects of Circuit Training Program on Selected Physical Fitness Variables of Female Students in Gorika Secondary School

Purpose of the study:

The purpose of this study is to examine the effects circuit training on some Selected Physical Fitness components of grade 12 female students.

Procedure and duration:

You are kindly requested to participate in this researchstudy as described below. This study will be governed by the regulation on humanbeings. These regulations require that researcher should obtain a signed agreement from you/the students / to participate in this research project.

Risk and safeguard

The risk of being participating in this study is very minimal. Since while in the application of circuit training and administering the tests you may experience sport related injuries like muscle fatigue, muscle soreness, little sprain etc.due to intense nature of the exercise but not the test only.But if anyunexpected physical injuries occur, appropriate first aids will be provided, but nofinancial compensation will be given.

Confidentiality:

The information obtained from the participants (you) will be keptin confidence, but it will be free to release to their own owners, to the local District,zone as well as regional sport federation offices if it is needed. And all the collectedinformation will be used only for scientific purpose through grouping withoutidentifying them as an individual.

Rights:

Participation in this study will be a fully voluntary based. You have the rightto declare to participate or not in the study. And if you decide to participate, you havethe right to withdraw from the study at any time and this will not label you for any lossof benefits which you otherwise are entitled.

Contact address

If there is any questions or enquires any time about the study or the procedures, pleasecontact in the following address:

TesfayeDamena(Ass.prof) (Advisor) +251946400641, Email: tesfaye.damena@gmail.com

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SimachewTadesse (Investigator) +251936726018, Email: simachewt2020@gmail.com or simachewtadesse@yahoo.com

Appendix- C

Appendix table 1: Analysis of Participants Information record form

№	Questions	Students' Response		
			№	%
1	Age of participants	<18 years	-	-
		18-19 years	52	80
		>19 years	13	20
2	Q1. Is this your first visit to the exercise program?	Yes	64	98.46
		No	3	4.62
3	Q2. Have you ever been treated for internal organs?	Yes	1	1.54
		No	64	98.46
4	Q3. Have you ever appeared irregular heart beat on your heart?	Yes	1	1.54
		No	64	98.46
5	Q4. Have you ever fainted or bad concussion?	Yes	1	1.54
		No	64	98.46
6	Q5. Do you have any allergies?	Yes	1	1.54
		No	64	98.46
7	Q6. Are currently undergoing any medical treatment or under observation?	Yes	2	3.08
		No	63	96.92
8	Q7. Have you fallen sick in the past 6 month?	Yes	3	4.62
		No	62	95.38
9	Q8. Have you had any injury in the past 5 years?	Yes	3	4.62
		No	62	95.38
10	Q9. Have you ever had major surgery performed on you in the last year?	Yes	1	1.54
		No	64	98.46
11	Q10. Does your family have a history of any genetic disease?	Yes	0	-
		No	65	100
12	Q11. Do you have any of the following disease? Asthma, Heart disease, Diabetes, cancer, stroke, skin infection	Yes	2	3.08
		No	63	96.92
13	Q12. Would you expect that this exercise program service will address satisfactory?	Yes	65	100
		No	0	-

Note

- № of students who fulfill the criteria = 40
- № of students who didn't fulfill the criteria= 25; These are:
  - ✓ Students ''age > 19'' = 13
  - ✓ Athletes = 3
  - ✓ Students who have health problems = 15 (5- from ''age >19'', 1- from ''athletes'' and 9- from age of ''18-19'')

Appendix- D

Appendix Table 2: Students' personal characteristics record sheet

No	Subeject's Code	Age (year)	Weight(kg)	Height(m)
1	EG-1	18	56	1.58
2	EG-2	19	55	1.58
3	EG-3	19	55	1.57
4	EG-4	19	56	1.59
5	EG-5	19	56	1.62
6	EG-6	18	57	1.63
7	EG-7	19	59	1.61
8	EG-8	19	57	1.58
9	EG-9	18	60	1.65
10	EG-10	18	59	1.58
11	EG-11	19	58	1.63
12	EG-12	18	55	1.57
13	EG-13	19	58	1.62
14	EG-14	19	58	1.63
15	EG-15	19	63	1.65
16	EG-16	19	61	1.63
17	EG-17	18	60	1.59
18	EG-18	19	62	1.61
19	EG-19	19	56	1.58
20	EG-20	19	61	1.62

EG= Experimental Group Kg= Killo gram m= meter

Students' personal characteristics record sheet

No	Subeject's Code	Age (year)	Weight (kg)	Weight(m)
1	CG-1	19	56	1.60
2	CG-2	19	58	1.62
3	CG-3	18	59	1.57
4	CG-4	19	61	1.63
5	CG-5	19	57	1.55
6	CG-6	18	56	1.58
7	CG-7	18	60	1.61
8	CG-8	19	58	1.64
9	CG-9	19	58	1.63
10	CG-10	18	55	1.53
11	CG-11	19	59	1.58
12	CG-12	19	58	1.58
13	CG-13	18	56	1.63
14	CG-14	19	60	1.65
15	CG-15	19	54	1.57
16	CG-16	19	55	1.59
17	CG-17	18	53	1.56
18	CG-18	19	58	1.63
19	CG-19	19	56	1.59
20	CG-20	18	57	1.55

CG= Control Group Kg= Killo gram m= meter

Appendix- E

Fitness test record sheet

Appendix Table 3: Test code: T_1 (3-minute step test) for Cardio Respiratory Fitness

No	Subeject's Code	Test score		
		PT (BPM)	PoT(BPM)	Diffrence (BPM)
1	EG-1	137	102	-35
2	EG-2	138	104	-34
3	EG-3	130	103	-27
4	EG-4	130	101	-29
5	EG-5	135	108	-27
6	EG-6	136	108	-28
7	EG-7	139	109	-30
8	EG-8	138	108	-30
9	EG-9	137	107	-30
10	EG-10	136	108	128
11	EG-11	132	103	-29
12	EG-12	134	105	-29
13	EG-13	139	108	-31
14	EG-14	138	108	-30
15	EG-15	136	107	-29
16	EG-16	140	112	-28
17	EG-17	139	110	-29
18	EG-18	138	109	-29
19	EG-19	139	111	-28
20	EG-20	140	113	-27

EG= Experimental Group PT= Pre Test PoT= Post Test BPM= Beat Per Minute

Fitness test record sheet

Test code: T_1 (3-minute Step test) for Cardio Respiratory Fitness

No	Subeject's Code	Test Score		
		PT(BPM)	**PoT(BPM)**	**Diffrence (BPM)**
1	CG-1	138	137	-1
2	CG-2	140	141	-1
3	CG-3	135	135	0
4	CG-4	135	137	2
5	CG-5	136	135	-1
6	CG-6	139	138	-1
7	CG-7	134	133	-1
8	CG-8	140	139	-1
9	CG-9	133	132	-1
10	CG-10	130	130	0
11	CG-11	141	142	1
12	CG-12	139	140	1
13	CG-13	134	135	1
14	CG-14	142	140	-2
15	CG-15	132	131	-1
16	CG-16	137	138	1
17	CG-17	139	140	1
18	CG-18	138	137	-1
19	CG-19	136	135	-1
20	CG-20	137	136	-1

CG= Control Group PT= Pre Test PoT= Post Test BPM= Beat Per Minute

Fitness test record sheet

Appendix Table 4: Test code: T_2(Trunk lift test) for Muscular Strength

No	Subeject's Code	Test score		
		PT (RM)	PoT (RM)	Diffrence (RM)
1	EG-1	18	28	10
2	EG-2	16	25	9
3	EG-3	17	26	9
4	EG-4	18	27	9
5	EG-5	17	25	8
6	EG-6	18	29	11
7	EG-7	16	26	10
8	EG-8	18	27	9
9	EG-9	19	30	11
10	EG-10	18	27	9
11	EG-11	15	23	8
12	EG-12	16	24	8
13	EG-13	18	28	8
14	EG-14	18	27	9
15	EG-15	17	25	8
16	EG-16	18	28	10
17	EG-17	18	26	8
18	EG-18	19	28	9
19	EG-19	18	28	10
20	EG-20	18	29	11

EG=Experimental Group PT= Pre Test PoT= Post Test RM= Repetition Maximum

Fitness test record sheet

Test code: T_2 (Trunk lift test) for Muscular Strength

No	Subeject's Code	Test Score		
		PT (RM)	PoT (RM)	Diffrence (RM)
1	CG-1	18	18	0
2	CG-2	17	18	1
3	CG-3	17	16	-1
4	CG-4	16	17	1
5	CG-5	17	17	0
6	CG-6	17	18	1
7	CG-7	16	15	-1
8	CG-8	18	18	0
9	CG-9	18	19	1
10	CG-10	18	18	0
11	CG-11	17	18	1
12	CG-12	15	16	1
13	CG-13	17	18	1
14	CG-14	17	16	-1
15	CG-15	18	19	1
16	CG-16	16	15	-1
17	CG-17	18	19	1
18	CG-18	19	18	-1
19	CG-19	17	18	1
20	CG-20	16	16	0

CG=Control Group PT= Pre Test PoT=Post Test RM= Repetition Maximum

Fitness test record sheet

Appendix Table 5: Test code: T_3 (60 sec. sit up test) for Muscular endurance

No	Subeject's Code	Test score		
		PT (Rep/min)	PoT (Rep/min)	Diffrence (Rep/min)
1	EG-1	9	17	8
2	EG-2	8	17	9
3	EG-3	8	16	8
4	EG-4	9	18	9
5	EG-5	10	21	11
6	EG-6	8	15	7
7	EG-7	10	19	9
8	EG-8	11	21	10
9	EG-9	9	18	9
10	EG-10	10	19	9
11	EG-11	10	20	10
12	EG-12	9	17	8
13	EG-13	9	18	9
14	EG-14	10	18	8
15	EG-15	9	17	8
16	EG-16	10	19	9
17	EG-17	10	20	10
18	EG-18	9	19	10
19	EG-19	9	18	9
20	EG-20	8	16	8

EG= Experimental Group PT= Pre Test PoT= Post Test Rep/min= Repetition per minute

Fitness test record sheet

Test code: T_3 (60 sec. sit up test) for Muscular endurance

No	Subeject's Code	Test Score		
		PT (Rep/min)	PoT (Rep/min)	Diffrence (Rep/min)
1	CG-1	9	8	-1
2	CG-2	8	9	1
3	CG-3	8	8	0
4	CG-4	9	10	1
5	CG-5	7	8	1
6	CG-6	8	8	0
7	CG-7	8	9	1
8	CG-8	10	9	
9	CG-9	9	10	1
10	CG-10	9	9	0
11	CG-11	9	8	-1
12	CG-12	9	9	0
13	CG-13	11	10	-1
14	CG-14	8	8	0
15	CG-15	9	8	-1
16	CG-16	11	11	0
17	CG-17	9	10	1
18	CG-18	9	10	1
19	CG-19	9	9	0
20	CG-20	10	9	-1

CG= Control Group PT= Pre Test PoT= Post Test Rep/min= Repetition per minute

Fitness test record sheet

Appendix Table 6: Test code: T_4 (Vertical jump test in cm) for Power

No	Subeject's Code	Test score		
		PT (cm)	PoT (cm)	Diffrence (cm)
1	EG-1	25	36	11
2	EG-2	25	35	10
3	EG-3	23	32	9
4	EG-4	23	34	11
5	EG-5	25	36	11
6	EG-6	26	37	11
7	EG-7	24	34	10
8	EG-8	24	34	10
9	EG-9	25	36	11
10	EG-10	26	37	11
11	EG-11	26	36	10
12	EG-12	24	32	8
13	EG-13	24	33	9
14	EG-14	26	35	9
15	EG-15	26	37	11
16	EG-16	25	33	8
17	EG-17	26	35	9
18	EG-18	25	36	11
19	EG-19	25	36	11
20	EG-20	26	37	11

EG= Experimental Group PT= Pre Test PoT= Post Test cm= centi meter

Fitness test record sheet

Test code: T_4 (Vertical jump test in cm) for Power

No	Subeject's Code	Test Score		
		PT (cm)	PoT (cm)	Diffrence (cm)
1	CG-1	23	24	1
2	CG-2	22	23	1
3	CG-3	24	25	1
4	CG-4	24	24	0
5	CG-5	25	24	-1
6	CG-6	25	25	0
7	CG-7	25	26	1
8	CG-8	26	25	-1
9	CG-9	25	26	1
10	CG-10	24	23	-1
11	CG-11	23	22	-1
12	CG-12	25	25	0
13	CG-13	24	26	2
14	CG-14	24	25	1
15	CG-15	25	26	1
16	CG-16	23	24	1
17	CG-17	24	23	-1
18	CG-18	26	26	0
19	CG-19	25	24	-1
20	CG-20	25	26	1

CG= Control Group PT= Pre Test PoT= Post Test cm= centi meter

Fitness test record sheet

Appendix Table 7: Test code: T_5 (Illinois agility run test) for Agility

No	Subject's Code	Test score		
		PT (sec.)	PoT (sec.)	Diffrence (sec.)
1	EG-1	25.2	20.9	-4.3
2	EG-2	26.6	21.5	-5.1
3	EG-3	27.1	23.1	-4
4	EG-4	24	19.8	-4.2
5	EG-5	23.5	20.5	-3
6	EG-6	23.6	18.6	-5
7	EG-7	23.4	19.3	-4.1
8	EG-8	24.4	19.6	-4.8
9	EG-9	23.9	19.7	-4.2
10	EG-10	25.1	20.8	-4.3
11	EG-11	26.2	21.2	-5
12	EG-12	26.8	22.1	-4.7
13	EG-13	24.8	19.8	-5
14	EG-14	24.6	19.7	-4.9
15	EG-15	23.9	18.5	-5.4
16	EG-16	23.5	20.2	-3.3
17	EG-17	24.8	19.4	-5.4
18	EG-18	23.9	18.3	-5.6
19	EG-19	24.7	20.1	-4.6
20	EG-20	26.8	21.7	-5.1

EG= Experimental Group PT= Pre Test PoT= Post Test sec.= second

Fitness test record sheet

Test code: T_5 **(**Illinois agility run test) for Agility

No	Subeject's Code	Test Score		
		PT (sec.)	**PoT (sec.)**	**Diffrence (sec.)**
1	CG-1	22.9	22.8	-0.1
2	CG-2	23.4	23.1	-0.3
3	CG-3	24.6	23.8	-0.8
4	CG-4	25.2	25.8	0.6
5	CG-5	24.9	24.6	-0.3
6	CG-6	25.8	26.1	0.3
7	CG-7	23.6	23.7	0.1
8	CG-8	24.3	24.5	0.2
9	CG-9	24.3	23.9	-0.4
10	CG-10	23.3	22.8	-0.5
11	CG-11	23.7	23.8	0.1
12	CG-12	25.8	25.9	0.1
13	CG-13	23.8	24.2	0.4
14	CG-14	24.5	24.7	0.2
15	CG-15	24.6	24.2	-0.4
16	CG-16	24.9	25.1	0.2
17	CG-17	25.1	24.7	-0.4
18	CG-18	23.9	24.1	0.2
19	CG-19	23.4	23.2	-0.2
20	CG-20	24.9	24.8	-0.1

CG= Control Group PT= Pre Test PoT= Post Test sec.= second

Appendix-F

Test protocols/ norms

Appendix table 8: Normative standard of sit up per minute value

Age	16-19	
Gender	Female	Male
Excellent	>25	>30
Above average	21-25	26-30
Average	15-20	20-25
Below average	9-14	17-19
Poor	<9	<17

Source: Mackenzie, B. (2000)

Appendix Table 9: Normative standard for females step test

1Minute Step Test (Women) - HR

Age	18-25	26-35	36-45	46-55	56-65	65+
Excellent	<85	<88	<90	<94	<95	<90
Good	85-98	88-99	90-102	94-104	95-104	90-102
Above Average	99-108	100-111	103-110	105-115	105-112	103-115
Average	109-117	112-119	111-118	116-120	113-118	116-122
Below Average	118-126	120-126	119-128	121-129	119-128	123-128
Poor	127-140	127-138	129-140	130-135	129-139	129-134
Very Poor	>140	>138	>140	>135	>139	>134

Source: adapted from Golding, *et al.* (1986). The Y's way to physical fitness (3rd ed.)

Appendix table 10: Normative data of Illinois Agility Run Test for 16 to 19 years old

Gender	Excellent	Above average	Average	Below average	Poor
Male	<15.2 sec	15.2 - 16.1 sec	16.2 - 18.1 sec	18.2 - 19.3 sec	>19.3 sec
Female	<17.0 sec	17.0 - 17.9 sec	18.0 - 21.7 sec	21.8 - 23.0 sec	>23.0 sec

Source: Davis et al. 2000

Appendix table 11: Normative data of Vertical Jump Test for 16 to 19 years old

Gender	Excellent	Above average	Average	Below average	Poor
Male	>65cm	50-65cm	40-49cm	30-39cm	<30cm
Female	>58cm	47-58cm	36-46cm	26-35cm	<26cm

Source: Davis et al. 2000

Appendix table 12: Rating Scale of Trunk lift Test for men and women

Age	**High performance zone**	**Good fitness zone**	**Marginal zone**	**Low zone**
17-26	31^{+}	24-30	19-23	<19
27-39	28^{+}	22-27	17-21	<17

SOURCE: Ethiopia physical Education text book grade 12, 2006 E.C

Appendix- G
Circuit training schedule for three months

Appendix table 13: First Month Training Schedule

Week pre a month	Days	Type of exercise	Time(min)	Rep/set	Rest	Duration	Exercise intensity
1st month first week	Monday, Wednesday& Friday	Warming up: walking, jogging ,running	5min		20sec. for each activity	40min	Low intensity (40-54.9% ofHRmax)
		Stretching	1 min	2			
		Sit up	1 min	2			
		Trunk lift	1 min	2			
		Stepping on box	3 min	2			
		Vertical jump	1 min	2			
		Zigzag run	5 min	2			
		Cooling dawn	3 min				
1st month second week	Monday, Wednesday& Friday	Warming up walking, jogging ,running	5 min		20sec. for each activity	40min	Low intensity (40-54.9% of HRmax)
		Stretching	1 min	2			
		Sit up	1 min	2			
		Trunk lift	1 min	2			
		Stepping on box	3 min	2			
		Vertical jump	1 min	2			
		Zigzag run	5 min	2			
		Cooling dawn	3 min				
1st month third week	Monday, Wednesday& Friday	Warming up walking, jogging ,running	5 min		20sec. for each activity	40 min	Low intensity (40-54.9% of HRmax)
		Light Stretching	1 min	2			
		Sit up	1 min	2			
		Trunk lift	1 min	2			
		Zigzag run	3 min	2			
		Vertical jump	1 min	2			
		Stepping on box	5 min	2			
		Cooling dawn	3 min				
1st month forth week	Monday, Wednesday& Friday	Warming up walking, jogging,running	5 min		25sec. for each activity	45min	Low intensity (40-54.9of HRmax)
		Stretching	1 min	2			
		Sit up	1 min	2			
		Trunk lift	1 min	2			
		Zigzag run	5 min	2			
		Vertical jump	1 min	2			
		Stepping on box	3 min	2			
		Cooling dawn	3 min	2			

Appendix table 14: Second Month Training Schedule

Week pre a month	Days	Type of exercise	Time(min)	Rep/set	Rest	Duration	Exercise intensity
2nd month first week	Monday, Wednesday& Friday	Warming up: walking, jogging ,running	5 min		30sec. for each activity	50min	Moderate intensity (55-69% of HRmax)
		Stretching	1 min	1			
		Sit up	2 min	2			
		Trunk lift	2min	2			
		Zigzag run	5 min	2			
		Vertical jump	2 min	2			
		Stepping on box	4 min	2			
		Cooling dawn	4 min				
2nd month second week	Monday, Wednesday& Friday	Warming up walking, jogging ,running	5min		30sec. for each activity	50 min	Moderate intensity (55-69% of HRmax)
		Stretching	1 min	1			
		Sit up	3 min	2			
		Trunk lift	4 min	2			
		Zigzag run	2 min	2			
		Vertical jump	1 min	2			
		Stepping on box	5 min	2			
		Cooling dawn	4 min				
2nd month third week	Monday, Wednesday& Friday	Warming up walking, jogging ,running	5 min		30sec. for each activity	50min	Moderate intensity (55-69% of HRmax)
		Light Stretching	1 min	1			
		Sit up	5 min	2			
		Trunk lift	2 min	2			
		Zigzag run	4 min	2			
		Vertical jump	1 min	2			
		Stepping on box	3 min	2			
		Cooling dawn	4 min				
2ndmonth forth week	Monday, Wednesday& Friday	Warming up walking, jogging , running	5 min		30sec. for each activity	50min	Moderate intensity (55-69% of HRmax)
		Stretching	1 min	1			
		Sit up	2 min	2			
		Trunk lift	2 min	2			
		Zigzag run	5 min	2			
		Vertical jump	1 min	2			
		Stepping on box	5 min	2			
		Cooling dawn	4 min	2			

Appendix table 15: Third Month Training Schedule

Week pre amonth	Days	Type of exercise	Time(min)	Rep/set	Rest	Duration	Exerciseint ensity
3rd month first week	Monday, Wednesday& Friday	Warming up: walking, jogging ,running	5 min		30sec. for each activity	60 min	Moderate intensity (55-69% of HRmax)
		Stretching	1 min	1			
		Sit up	2 min	3			
		Trunk lift	3 min	3			
		Zigzag run	2 min	2			
		Vertical jump	3 min	2			
		Stepping on box	5 min	3			
		Cooling dawn	4 min				
3rd month second week	Monday, Wednesday& Friday	Warming up walking, jogging ,running	5 min		30sec. for each activity	60 min	Moderate intensity (55-69% of HRmax)
		Stretching	1 min	1			
		Sit up	2 min	3			
		Trunk lift	2 min	3			
		Zigzag run	5 min	2			
		Vertical jump	1 min	3			
		Stepping on box	5 min	3			
		Cooling dawn	4 min				
3rd month third week	Monday, Wednesday Friday	Warming up walking, jogging ,running	5 min		30sec. for each activity	60 min	Moderate intensity (55-69% of HRmax)
		Light Stretching	1 min	1			
		Sit up	2 min	3			
		Trunk lift	2 min	3			
		Zigzag run	5 min	2			
		Vertical jump	1 min	3			
		Stepping on box	5 min	3			
		Cooling dawn	4 min				
3rd month forth week	Monday, Wednesday& Friday	Warming up walking, jogging ,running	5 min		30sec. for each activity	60min	Moderate intensity (55-69% of HRmax)
		Stretching	1 min	1			
		Sit up	2 min	3			
		Trunk lift	2 min	2			
		Zigzag run	5 min	3			
		Vertical jump	1 min	3			
		Stepping on box	5 min	3			
		Cooling dawn	4 min	2			