



DILLA UNIVERSITY
SCHOOL OF GRADUATE STUDIES

**EFFECTS OF TWELVE WEEKS CIRCUIT
TRAINING PROGRAM ON PHYSICAL FITNESS OF
MERAWI SECONDARY SCHOOL STUDENTS**

Med THESIS

BY
FIREW BEYENE

MAY 2013, DILLA



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BIOGRAPHICAL SKETCH

The researcher was born at a place called Merhabete Woreda in North Shewa Zone Amhara region state in Aug, 1976 E.C. He learnt his elementary School from grade 1-8 in Alem Ketema elementary school and he learnt 9-12 Arbegnoch secondary schools. He joined his higher education institution in Bar Dar University for his higher education in Sport Science program in the year of 1996 E.C and graduate in 1998 E.C. In July 2009 E.C, he joined Dilla University to pursue his Med program in teaching Physical education. The researcher has 15 years of teaching experiences.

ACRONYMS AND ABBREVIATION

ACSM	-American College of Sport Medicine
CRE	-Cardio Respiratory Endurance
CVD	-Cardio vascular diseases
CDC	-Center for Diseases Control and Privation
CG	-Control Group
COVID -19	-Corona virus diseases 2019
EG	-Experimental Group
HPE	-Health and Physical Education
MD	-Mean Difference
MHR	-Maximum Heart Rate
PT	-Pretest
POT	-Post Test
RHR	-Resting Heart Rate
SD	-Standard Difference
NASPE	-National Association for Sport and Physical Education
USDHHS	-United state Department of Health and Human Services

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ABSTRACT

The purpose of this study was to investigate the effect of circuit training on cardio respiratory fitness, flexibility and speed variables. The design of this research was experimental method. Thirty male students of Merawi secondary school aged 15-16 years had divided randomly into 2 equal groups. Both the exercise group (n = 15) and control group (n = 15) participated in the typical 1 classes of 40-minute Physical education per week in schools, but only participated in additional 2 sessions per week of 40 minutes per session of exercise training, which comprised as jumping jack, wall sit, push up, abdominal crunch, squat, triceps dips, jumping rope, side lifts, side plank, step up, lung and plank. Both groups had taken pre and post-testing and all the subjects participated in physical fitness tests: cardio respiratory fitness was measured using 12 minute run and flexibility was measured using sit and reach test and speed was by 60 meter speed test. The collected data was analyzed using statistical method Analysis of paired t-test with level of significant 0.05. The results showed circuit training significantly improved cardio respiratory fitness, flexibility and speed in at $p > 0.05$ but in no significant change was observed in all the variables. Therefore, this research confirmed as circuit training could improve the cardiovascular, flexibility and speed of high school students. Hence the allocated physical education period in Ethiopian education system is very low and high school students should get additional times to improve their fitness and health.

Key words: *physical fitness, circuit training, physical education, cardiovascular endurance flexibility and speed.*

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Physical education is process of learning, the context being mainly physical. The purpose of this process is to develop specific knowledge, skill, and understanding and to promote physical competence. Different sporting activities can and do contribute to this learning process, and the learning process enables participation in sports. The focus however, is on the child and his or her development of physical competence.

Physical education is a course taught in school that focuses on developing physical fitness and the ability to perform and enjoy day to day physical activities with ease. Kids also develop skills necessary to participate in a wide range of activities. Regular physical education classes prepare kids to be physically and mentally active, fit and healthy into adult hood. An effective physical education program should include engaging lesson, trained physical education teacher adequate instructional periods, and student evaluation. (Rickettes, 2013)

According to the centers for diseases control and prevention (CDC), physical fitness is defined as the ability to carry out daily takes with cider and alertness without undue fatigue and with sample energy to enjoy laser time pursuits, fitness involves everything from getting out of bed to hiking to performing CPR.

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. 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 (Scholich, 1990).

To make a nation strong physically, mentally, spiritually and socially, education must take place largely through the formal process of physical education in schools (Buchres, 1975). Physical education has long and established tradition in schools being linked to with an Aristotelian concept of harmonious development of both body and mind. In other word, it is an important component of the overall school program and integral part of the educational program that contributes, primarily through physical activity experiences, to the total growth and development of all students (Pangrazi & Darst, 2002). As noted, Brubaker (2011) it provides students with many opportunities to improve their overall lifestyle; first and foremost, it provides students the opportunity to improve their physical fitness, development and health.

Schools have the potential to improve the health of students by providing instruction in physical education that promotes enjoyable lifelong physical activity. Unfortunately, many schools have reduced physical education opportunities in order to dedicate more class time to meet these academic standards (Lavall, 1984). Similarly, Ethiopian Ministry of Education has been developing physical education curriculum in secondary schools with a one day class schedule in a week 40 minutes long. It is limited class compared with other academic subjects to ensure and develop students optimal physical fitness; to achieve their personal goals for various work related, sport, and leisure activities (Virginia department of education, 2006) Despite, the main aim of Ethiopian education system provision for quality education for all is to strive productivity, social and individual problem solving capacity (Ministry of Education, 1994).

The reality in Merawi secondary school shows low time allotment of physical education than other subjects. Because of these students showed limitations on their physical fitness status when the researcher evaluates in his physical education practical classes particularly in grade nine students. The researcher thought that if the number of periods given in one week was increased with contents of calisthenics circuit training, it would have influence on physical fitness qualities otherwise the situation made students to have

poor physical fitness. Due to this, the aim of the study was to evaluate the effect of circuit training on selected physical fitness variables on secondary school students.

1.2 Statement of the problem

As the topic is “Effects of 12 weeks circuit training program on physical fitness of Merawi secondary school students”, this research was conducted to show that scheduled circuit training programs for Merawi secondary school students may lead an increase in cardio respiratory endurance, flexibility and speed.

Circuit training program can have miraculous health benefits on cardio respiratory endurance, flexibility and speed improvement. It is expected that after this scheduled circuit training program the students will recognize the importance of circuit training and choose to participate regularly in physical activities designed to maintain and enhance healthy lifestyles (Connecticut State Department of Education, 2009) and students want to be fit and active, but the opportunities offered in secondary schools has been decreased in providing physical fitness lessons (Pangrazi & Darst, 2002). In addition to this the time allocated to physical education in the majority of schools has declined with a consequent increase in time allocation for other academic subjects (Hillman *et al.*, 2008). As such, in Ethiopian secondary school physical education curriculum developed one credit hour per week (40 minutes) for classroom as well as practical sessions. This is too little to improve the physical fitness components required to meet in the grade level with regard to set norms and standards of physical fitness at different age and sex levels.

According to a study done by UCAM research center for high performance sport in Spain, participation in circuit training 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. But, the reverse is true where the researcher employed and working in Merawi school secondary observed poor status of physical activity and physical fitness qualities when measuring during their physical education classes. Even

though male students particularly show high motivation to participate in physical education classes the time allocated in Merawi secondary school had few credits than any other subjects that might limit them further progression and intensity of exercise. This trend might made students developing poor fitness levels against expected norms in each grade level.

Many research studies show the effect of different exercises for the development of physical fitness but now a day's few studies were done specifically on the area of circuit training program on selected physical fitness variables. Circuit training program are one of important physical activities which are at center of attention in recent years (Yildirim, 2012). Today, most students aware of circuit training program can positively affect physical fitness. Unfortunately, they do not engage in circuit training and their physical fitness quality, especially health related fitness quality, which they are expected to achieve, is poor.

Many research studies circuit training are important for the development of all physical fitness qualities but no research was done in North Mecha Woreda especially in secondary school students on their physical fitness problems. However, the improvement and development of physical fitness quality of students is the responsibility of every physical education teachers in the school. In addition to this, it is our obligation to create conducive environment for students to participate in calisthenics circuit training so as to improve their physical fitness quality. Due to this the researcher wanted to investigate the effect of three months circuit training program of consists jumping jack, wall sit, push up, abdominal crunch, squat, triceps dips, step-up, lung, side plank, side-lifts and plankofon selected physical fitness variables such as cardio respiratory fitness, flexibility and speed. Among the endless number of possible tests and measurements the fitness test fall 12 minute run test, sit and reach test, and 60m speed test.

1.3 Objective of the Study

1.3.1 General Objective

- ✚ To investigate the effect of twelve weeks circuit training program on physical fitness of Merawi secondary school students.

1.3.2 Specific Objectives

The research addressed the following specific objectives:

1. To evaluate the effect of twelve weeks circuit training on cardio respiratory fitness.
2. To measure the effect of twelve weeks circuit training on flexibility.
3. To determine the effect of twelve weeks circuit training on speed.

1.4 Hypotheses

The study has attempted to test the following hypotheses.

1. **H1 (alternative hypothesis):** Twelve weeks circuit training would have significant effect on cardio respiratory fitness.
2. **Ho (null hypothesis):** Twelve weeks circuit would have no significant effect on cardio respiratory fitness.
3. **H1 (alternative hypothesis):** Twelve weeks circuit training would have significant effect on flexibility.
4. **Ho (null hypothesis):** Twelve weeks circuit training would have no significant effect on flexibility.
5. **H1 (alternative hypothesis):** Twelve weeks circuit training would have significant effect on speed.
6. **Ho (null hypothesis):** Twelve weeks circuit training would have no significant effect on speed.

1.5 Significance of the Study

The main benefit of any research is the increase in knowledge, the study which carried out by one researcher may be further studied and would be studied by others many times which is the increase in knowledge upon a specific issue. The main aim of this study is to investigate effects of circuit training program on physical fitness variables to improve fitness levels of secondary school students. Generally, this study will have the following significances.

- Helps to improve cardio respiratory fitness, flexibility and speed
- It motivates and encourages students to engage in circuit training to boost their physical fitness.
- It may provide meaningful information for students who involves on circuit training program for the improvement of selected physical fitness variables.
- May help PE teachers to know further about the effect of circuit training and the methods of evaluating students' physical fitness and Provide to assess and compare the performance of their students on schools.
- May help curriculum developers and policy makers to depend on context of our student's physical fitness status to develop norms and appreciate more circuit training to be found in school physical education lessons and programs. This also provides an opportunity to review and improve physical education programs.
- It will serve as an important resource for those who want to pursue similar studies.
- May give additional knowledge to area of research

In general, the researcher believes students, physical education teachers, curriculum developers, and policy makers', experts in general will be beneficiaries from this study.

1.6 Delimitation of the Study

In research, delimitations address how the study is narrowed in scope (Creswell, 1998). The study was designed to investigate the effects of twelve weeks circuit training in Merawi secondary school students. This study was delimited in the following areas.

- Subjects were selected at Merawi secondary school students. And healthy, untrained that has not any physical disabilities or medical conditions and volunteers participated in this study.
- Selected physical fitness variables were cardio respiratory fitness measured using 12 minutes run test, flexibility measured using sit and reach and speed measured using 60 meters.
- Circuit trainings were jumping jack, wall sit, push up, abdominal crunch, lung, step up, squat, side plank, triceps dips, side lifts, and plank.
- The time of training was limited to two days per week and 40 minutes per sessions.

1.7 Limitations of the Study

In this research, COVID 19 pandemics was the main problems the reason why the activities need personal contacts. Lacks of update literature in the same study area on the issue were not available. The subjects that were undertaken may not have previous knowledge about exercise training in a regular basis. Some of the tests were limited to specific tests that are easily monitored and administered in the students and school context. In addition, lack of internet access, metrological variations, scarcity of sufficient books and references were the major factor that the researcher encountered during the execution of the study

1.8 Operational Definitions

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. (Grice2003).

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

Cardiovascular endurance - the ability of your heart and lungs to efficiently transport oxygen to exercising muscles (also referred to as aerobic fitness). (Bouchard *et al.*, (1990)

Flexibility - the range of motion around a joint. (Cady *et al.*, 1979)

Static Stretch- sustained stretch that is held for 10 to 30 seconds. (Riana Rohamann 2011)

Dynamic Stretch – moving quickly and using momentum to produce a stretch. (Riana Rohamann 2011)

Passive Stretch – moving through the range of movement with no contribution by the participant. (<https://www.topendsports.com>)

Speed - the ability to cover distance or perform a motor skill as quickly as possible. It is generated by a combination of the skills listed above (e.g., sprints). (Fitness zone online)

1.9 Organization of the Study

This study was organized on the basis of the common scientific procedures. The research consisted of five chapters. Chapter one deals about introduction, consisting of background, statement of the study, objectives, hypothesis, significance, delimitations, and limitation of the study & definition of terms. Chapter two is all about the reviews of related literature. Chapter three deals about methodology of the study, the research area, research design, population and sampling technique, inclusion and exclusion criteria, source of data, instrument of data collection, and data analysis method. The fourth chapter deals with results & discussions and in chapter five summery, conclusion & recommendation are made and cited.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 The Concept of Physical Fitness

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

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

2.2 Objective of Physical Fitness Development

The long term, overall objective of physical education program is to maintain and improve the health of human beings. This refers to all aspects of health including physical, mental, social, and emotional. It applies to all individual, regardless of race, color, economic students, and creed and national origin. Physical development objective help build big muscles and develop the human organic system. (Organic refers to the digestive, circulatory, excretory, heart regulatory, respiratory and other systems of the human body). As Charles Bucher (1993) stated as in his book it results in the ability to

sustain adaptive efforts, to recover, and to rest fatigue this objective also as physical fitness, physical conditioning organic development or biological development is concerned with increasing the capacity of the body for movement. The short term and long term physiological and psychological benefits of physical fitness and exercise are well documented. This section will define the components of physical fitness and review current research across all of these components. Physical fitness is divided into three components: health-related, skill-related, and physiologic components. The health related components of physical fitness are cardiovascular endurance, muscular strength, muscular endurance, flexibility, and body composition. The physiologic components of fitness are metabolic fitness, morphologic fitness, and bone integrity. The skill related components of physical fitness are speed, power, agility, coordination, balance, and reaction time (Whaley 2006, 3). These definitions of the physical fitness components come from the American College of Sports Medicine (ACSM), the largest sports medicine and exercise science organization in the world and widely accepted as the standard for information and reference in sports medicine. Crossfit.com is an on-line fitness community that has become extremely popular for its daily workouts based on a concept of functional movements that are constantly varied and performed at high intensity. Cross fit emphasizes the importance of functional fitness and has modified the ACSM definitions of skill and health related components of fitness to arrive at the components of functional fitness: cardiovascular endurance, stamina, strength, flexibility, power, speed, coordination, accuracy, 23 agility and balance. The Cross fit information was obtained during a two-day certification course conducted at Ft. Leavenworth, KS in December 2008 and is also available at www.crossfit.com. A sustained physical fitness program has many long term benefits. Regular physical activity results in a stronger heart muscle than a sedentary lifestyle. A stronger heart is capable of a greater stroke volume which means with each beat of the heart, more oxygen carrying blood reaches the body (Corbin 2008). A higher stroke volume reduces the number of beats per minute (bpm) required by the heart. A person with a high stroke volume will, therefore, have a lower resting heart rate (RHR). An individual's maximum heart rate (MHR) is largely dependent on his age which can roughly be determined with the equation: $220 - \text{age} = \text{MHR}$. The difference between an individual RHR and MHR is considered the heart rate

reserve (HRR). The HRR is an indicator of an individual's capacity for work (Fahey 2007). An individual's work capacity is further determined by his maximal oxygen consumption (VO₂max). VO₂ max is a measure of the endurance capacity of the cardiovascular system and the muscular system and is influenced by genetics, gender, fitness status, and age (Powers 2006, 89; Fahey 2007). The increased blood flow caused by increased fitness levels can also increase blood and oxygen flow to the brain increasing mental capacity. Increased blood flow to the skin increases the amount of sweat produced and reduces the time before onset of sweating thus reducing core body temperature. Increases in total blood flow increases endothelium function resulting in better control of blood pressure and increases in nitric oxide secretion (Johnson 1980). The increase in nitric oxide secretion positively affects energy levels (Fahey 2007) In addition to the physiological advantages of exercise; individuals can experience many psychological and emotional benefits from physical training.

2.3 Benefits of Physical Fitness

Physical fitness includes physical abilities such as body composition and neuromuscular coordination, cardiovascular capacity, stamina, speed, flexibility and overall strength. Physical fitness contributes a lot to maintain an optimal state of health. Among the many benefits, it prevents the occurrence of a variety of diseases, develops a capacity to fight infections and certain other diseases, and helps to prevent many of the major cardiovascular disease. Moreover, physical fitness is responsible for the postponement of the process of aging. A healthy body contributes a lot for a healthy mind. Physical fitness prevents mental disease by facilitating a sound psychological state (Corbin, 1997).

2.3.1 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.

2.3.2 Cardio Respiratory Fitness

According to Bouchard *et al.*, (1990), CVE (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.

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 VO₂ 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. 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, 2001, cited in Alemayehu Ayalew 2006)

2.3.3 Muscular Strength

Muscular strength refers to the maximal ability of a muscle to generate force at a single muscle contraction (De Vries and Housh, 1994). This can be measured by how much weight that an individual can lift during one maximal effort. According to (Stone, 1990), muscular strength exercises help 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).

2.3.4 Flexibility

Flexibility refers to the range of motion around the joint. As Cady *et al.*, (1979) noted, everyone needs some flexibility in order to perform daily activities. 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, 1989)

2.3.5 Muscular Endurance

Muscular endurance is the ability of a muscle to perform an activity for a long period of time. 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. Insel&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 contract 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 & Roth, 2002).

2.3.6 Agility

Agility refers to a person's ability to move their body quickly and easily change direction with maintaining balance. Enhanced agility also helps to improve performance in basic activities of daily living and even assist in the prevention of some types of injuries, especially fall. It recommended that agility drills must be trained progressively and slowly with an emphasis on techniques mastery, before learning the speed of movements and adding complex variations, such as open or none programmed agility training. Moreover, sports men need agility for best performance. This research used 4x10 m shuttle run as a parameter for assessing trainee's agility (Dawes, 2008).

2.3.7 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, 2000).

2.3.8 SPEED

Speed is the ability to perform movement quickly. It is the time takes us to respond to stimulus. John (1996) also state that speed is basically how fast you can move partial your body or the whole your body, and is measured in meters per second, therefore, speed is the rate of movement and often refers to the ability to move rapidly and it is an important factor in all explosive sports and activates that require sudden changes in place. Timing: is the ability to perform movements and actions of the body or body parts at a particular movement to produce to best effect. This is the time between stimulus being perceive and the first movement made in response to it. It also depends on how long you take to process the information and this can be improved with practice.

2.4 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.

2.5 Circuit Training

Circuit training is a method of fitness training that is designed to develop general, all-round physical and cardiovascular fitness. Morgan and Adamson at the University of Leeds first developed circuit training in the 1950s. It is a versatile training method as it can be adapted for many different situations, sections of the population and fitness requirements, and can be used at any time of the year. While the exercises are normally laid out in a circular pattern, the pattern can be varied for motivational purposes to that of a star, square, semi-circle, V-shape, line or zigzag. The athlete and his or her background, the sport, the time of year and the facilities available will dictate the type of circuit that is designed and implemented. Circuit training can be designed to develop a number of fitness components, including cardiovascular endurance (CVE), muscular endurance (ME), power, and anaerobic endurance. All of these components of fitness are extremely applicable to team sports. (Morgan and Adamson 1950s)

In addition, sport-specific circuits can be designed to address the specific skill and fitness requirements of a sport. Information related to the design of the various types of circuit is contained in this fact sheet. The instruction and delivery of circuit sessions is a key element in the effectiveness of this training method, and important relevant information is also provided at the end of the fact sheet (Scholich, 1990).

2.5.1 Progressive Overload and Variation in Circuit Training

The principles of progression and overload are important to consider when planning a circuit training program. The principle of overload indicates “your body systems must be stressed beyond their normal levels of activity if they are to improve.”

The three main dimensions of overload are intensity (how hard?), time (how long?) and frequency (how often?). These dimensions are altered to ensure overload occurs, e.g. increasing the ‘time on’ for each exercise.

During the alarm, or shock, phase, the body experiences a new or more intense stress, such as during the first circuit training session of the training year. The response to the new stimulus is generally shock, and the athlete experiences soreness, stiffness and a temporary drop in performance. (Williams, 1993)

The principle of progression deals with the manner in which this overload is applied. Highlighted the importance of this principle when, he said that it is “necessary to provide a progressive heightening of the stressor to oblige the body to seek a higher status of adaptation.” The stressor is the exercise stimulus; circuit training in this case. (Dick, 2002)

It is necessary to apply this principle to circuit training to ensure that physiological adaptations continually occur. General Adaptation Syndrome (GAS) model, which refers to the manner in which humans react to stress. Selye’s GAS model contains three stages: Alarm, Resistance and Exhaustion.

During the alarm, or shock, phase, the body experiences a new or more intense stress, such as during the first circuit training session of the training year. The response to the

new stimulus is generally shock, and the athlete experiences soreness, stiffness and a temporary drop in performance.

During the resistance phase, however, the body begins to adapt to the repeated stressor. Initially the body will return to a normal functioning level and if the stressor continues, the physiological changes will go to a higher level. This phase of adaptation is often called super-compensation

If the stressor is continually applied or the intensity continually increased for prolonged periods, the athlete will reach the exhaustion phase. At this point physiological functioning drops below that which would be considered to be normal functioning levels, i.e. the athlete underperforms. The athlete is now beginning to over-train, and the same symptoms experienced during the alarm phase will reappear.

Selye's GAS model has to be applied to the principle of progressive overload to ensure that the athlete reaches the super-compensation phase, while avoiding the exhaustion phase. The following guidelines relate the application of this principle to circuit training.

Progression in circuit training is achieved by altering the frequency, intensity or time dimensions of overload. Specifically, progression is achieved by: Increasing the number of repetitions of each exercise Increasing the amount of time on Increasing the number of circuits Increasing the degree of difficulty of each exercise Decreasing the time off between exercises Reducing the recovery time between circuits Making the recovery time more active Increasing the resistance of the exercises by altering the body position or using weight. (Hans Selye 1956)

The manner in which these guidelines are applied depends on the goal of the circuit. If CVE is the goal, progress will be achieved by, for example, decreasing the time off between exercises and reducing the recovery time between circuits. Increasing the degree of difficulty and the resistance of each exercise or the number of repetitions is appropriate.

Guidelines for the application of these methods of progression are as follows: Change only one variable at a time, increase the time on before adding resistance, decrease the

repetitions of each exercise or the time on when adding another circuit. To avoid overtraining and the exhaustion phase of Selye's GAS model, incorporate weeks where the level of intensity of the stressor is reduced (these weeks are often termed down weeks). (Hanes Sely 19560)

For anaerobic circuits, the above methods of progression and the guidelines for the application of these methods would not apply. Quality and speed of movement is central to the effectiveness of an anaerobic circuit, so more is not necessarily better. The progression guidelines for an anaerobic circuit are the opposite of the above guidelines. You progress by ensuring that the exercises are performed at maximum intensity and that the speed and quality of the exercises are increased. (Selye's, 1956).

2.5.2 Instruction and Delivery of Circuit Training Session

To ensure that circuit training sessions are well planned and implemented in a safe environment, the following guidelines should be followed. Screens athletes at the start of the session for illnesses and injuries, include a warm-up at the start of the session and a cool-down at the end, and ensure that the room is properly ventilated. Check that the equipment is safe, e.g. collars tight on dumbbells. Ensure that the exercises selected and the progressions are not only appropriate to the experience and fitness levels of the athletes but also safe. Check the athletes' clothing; avoid wearing long tracksuits, heavy cotton clothing and jeweler, check to ensure that shoelaces are tied. Ensure that the floor surface is safe; if the surface is hard, use gym mats for any exercise where the body is in contact with the floor. Know where the nearest First Aid kit is and who is qualified to provide first aid, if required. Monitor the athletes throughout the session. Ensure that the athletes' technique is correct at all times. (Morgan. 1961)

Monitor athletes: this has to be done throughout the session to ensure that the athletes are gaining the training benefit while not getting into difficulty, it can be done by monitoring athletes' heart rates, breathing rates, appearance and exercise technique; you can simply ask them how they feel and/or use the rate of perceived exertion scale.

Feedback/correction of faults: provide feedback and encouragement throughout and at the end of the session. Make sure you observe the athletes' technique when carrying out the

exercises, and if a fault occurs, correct it. Try to avoid just telling the athlete what the fault was. Give the correction rather than the fault. Always try to be positive before giving this correction; this is known as constructive criticism

The American College of Sports Medicine (ACSM) and the American Heart Association (AHA) recommend the following. Do moderately intense cardio 30 minutes a day, 5 days a week or do vigorously intense cardio 20 minutes a day, 3 days a week and do 8-10 strength training exercises, eight to 12 repetitions of each exercise, 2 days a week

While these well-intentioned guidelines may seem unattainable to some, circuit training is an efficient, effective way to achieve them – and to reap results. Cardio and strength combined Developed in 1953 at the University of Leeds in England, traditional circuit training is comprised of 8-12 stations where individuals perform strength-training exercises using a resistance of about 40% to 60% of one-repetition maximum (1RM) for a specific duration (30 seconds to two minutes), with either rest or cardio intervals of 15 seconds to three minutes (or longer) between stations. Research continually shows that circuit training confers numerous benefits, given that it simultaneously develops cardiovascular fitness and strength. In fact, according to the prestigious Cooper Institute in Dallas, Texas, circuit training “is the most scientifically proven exercise system. It’s time efficient and incorporates strength, flexibility and cardio in the same workout.” Circuit training maximizes the advantages of individual cardio and strength workouts for greater conditioning and valuable psychological benefits. One new, convenient way to circuit train is which is available on Octane Fitness standing elliptical cross trainers. Physiological responses to circuit training, greater cardiovascular endurance, and numerous studies report that when performed consistently over 8-12 weeks, circuit training can increase aerobic oxygen consumption and VO2 max, resulting in greater stamina and overall fitness. Increased muscular endurance and strength Resistance training overloads muscles for improved endurance and strength. Studies indicate that strength gains of 7% to 32% are evident with circuit training. Strength training is particularly important for women, who lose muscle mass of 1 percent per year in their 30s and 40s, along with people over age 65 to help minimize bone loss. Significant caloric expenditure the amount of calories burned per workout depends on its intensity

and duration, the exercises selected and the exerciser's body weight. Circuit training has been reported to burn approximately 5-9 kcal/minute; however, this number increases significantly when exercisers also perform aerobic intervals. For example, heart rates fluctuate between aerobic and anaerobic zones, demanding more calories than either a traditional steady-state cardio or strength session alone. Improved body composition and higher metabolism Research demonstrates that circuit training decreases fat mass, and strength training increases lean body mass, which is more metabolically active than fat. Routine strength training builds muscles that burn more calories both during exercise and at rest (basal metabolic rate) for a higher metabolism, which helps with weight control. In today's 24/7/365 eternally plugged-in world, people feel busier and more stressed than ever, and lack of time is most commonly cited as a barrier to exercise. Circuit training provides an effective option that breaks this barrier and yields significant advantages. According to the Specific Adaptation to Imposed Demand (S.A.I.D.) principle, the body adapts over time to stressors such as exercise. Circuit training delivers continually varied cardio and strength training challenges that work the body in new ways and stimulate additional progress and better results. (ACSM & AHC)

Psychological and practical advantages; maximum efficiency Combining cardiovascular and strength-training sessions yields a greater return on the time investment, with more total work completed in a shorter amount of time. In fact, research shows that circuit training recruits the major muscle groups up to twice more than cycling, and five times more than walking. Renewed motivation the inherent variety in circuit training breaks up workouts which engages exercisers and keeps them working at a higher overall intensity versus going through the motions or skipping workouts altogether. Greater enjoyment positively impacts exercise performance and overall adherence. Valuable variety Circuit training is an excellent way to cross train, as it complements all other workouts by adding change and interest. (Scolich, M, 1990)

2.5.3 Benefit of Circuit Training on Physical fitness Variable

There have been numerous studies on circuit training and its effects on the body. Studies showed that circuit training met the qualifications for an effective muscular workout,

cardiovascular workout and this exercise method is the most effective method for increasing muscular endurance. Studies have also shown that circuit training for women is the most effective method of exercise that, when combined with diet, was helping them lose weight and keep it off long term. Today, circuit training is completed by individuals and groups, men and women alike. The exercise method is trained as being the most effective way to build explosive power for sports of all types, including fighting styles. It is also considered the best way to improve muscle strength and endurance which is important for today's athlete. (Adeniji, B. A 2007)

There were many benefits to using circuit training in your exercise program. These benefits stem from the fact that you were moving continuously throughout your workout. You were enjoying the benefits of strength training as well as the benefits of cardiovascular fitness. One of the major benefits of circuit training was that it was versatile. You can include whatever exercises you want in your circuit training. This means that you can work with what you have instead of forcing the need for exercise machines and expensive weight sets. You can use your own body weight, dumbbells, medicine balls or simple tools like jump ropes. Circuit training can include from 6 to 15 stations, depending on your personal work out goals and your level of fitness prior to starting this type of training. Variability also allows for the individual to keep from becoming bored with their fitness training. This keeps people interested in their work out routines and makes them less likely to stop before reaching their fitness goals. Additionally, variability means that you can easily choose exercises based on your fitness level. This makes circuit training ideal for beginners and expert strength trainers alike. Circuit training serves athletes as a way to keep their body fit and generally conditioned without the stress of in season sports. This way you can keep yourself conditioned and in good physical shape even on the off season. (Williams, 1995)

Additionally, if you do suffer an injury you can simply remove that type of exercise from your circuit and replace it with something you are physically capable of doing. For example, if you sprain an ankle, you can take jumping rope out of the circuit and add in some bench presses until your injury is healed. This way you can continue to get a work out and nurse your injury at the same time. Scholich(1990).

2.6 Calisthenics Exercises

Calisthenics (American English) are exercise consists of variety of gross motor movements, running, standing grasping, pushing etc., often performed rhythmically and with minimal equipment, so essentially, body weight exercise. They are intended to increase body strength, body fitness, and flexibility, through movements such as pulling or pushing oneself up, bending, jumping or swinging, using only one's body height for resistance; usually conducted in concert with stretches. When performed vigorously and with Varsity, calisthenics can provide the benefits of muscular and aerobic conditioning, in addition to improving psychomotor skills such as balance, agility and coordination. Many consider calisthenics as movement through space meaning you can move freely without any restriction blocking your full strength.

Urban calisthenics are form of street work out: calisthenics groups perform exercises routines in areas. Individuals and groups train to be able to Reformed calisthenics Skips such as muscle-ups brass's and both front and back levers.

Sports teams and military units often perform leader directed group calisthenics as form of synchronized physical training (often including customized call and response routine) for increase group cohesion and discipline calisthenics are also popular as components of physical education Premiere and secondary schools over much of globe. In addition to the general fitness, calisthenics exercises are often used as baseline physician evaluation for many military organizations, such us the test and U.S Army physical fitness test and U.S.M.C physical fitness test. (Wikipedia)

Pushup; - performed face down on the floor palms against floor under the shoulder toes curled up words against the floor. The arms are used to lift the body while maintaining a right line from head to have to heal. The arm of the subject should go from fully external in the high position to nearly fully flex in the low position while the subjects marks sure to allowed resting on the floor. Resting is only done in the high position of the exercise. Chest, shoulders, and triceps are trained with these exercises. By furthering the rage of motion, what is often called a push up, by pushing the shoulders down wards at the top the stratus anterior comes further in to play.

Squats; standing with feet shoulder width apart, the subject squats down as far as possible, bringing the arms, bringing the arms forward parallel to the floor. The subjects then returns to the standing position.

Dips; done between parallel bars or facing either a direction of trapezoid bars found in some gyms Feet are crossed with either foot in front and the body is lowered until the elbow are in line with shoulders.

Planks: this name for holding the top position a push up for extended period of time. The primary muscle involved in this exercise in the rectus abdominals. Calisthenics parks (2016).

2.7 Age-Appropriate Activities

As educators and parents consider how to help children develop the five health-related fitness components it is important to consider the age-appropriateness of activities. Obviously, one would not expect a young child in the first or second grade to participate in the same type of muscular strength and endurance training as a senior in high school. It is necessary to develop exercise prescriptions for both the elementary, middle grades, and secondary levels. The goal of the prescriptions is to increase the activity level of all students to at least 60 minutes per day by suggesting activities which students can engage in outside of the classroom. Within this prescription, detailed instructions must be given for activities that are age appropriate for the development of each health-related fitness component; students can chart the time spent engaged in the various activities for their math classes and write about their exercise in their language arts classes. (Kurz, 1994)

It is important to consider that fitness activities need to be made fun for children or they will not want to participate. For most individuals, giving a direct command to go out and run two laps will not be an interesting activity in which to participate in the area of cardiovascular endurance some fun activities for elementary age and middle school students might include: flag tag, a 15-minute fun circuit, or a family fun walk. In a game of flag tag, each student puts a flag in their back pocket. On the signal the students begin chasing others around the designated area, attempting to grab as many flags as they can. At the end of 1 minute, stop the game; the person with the most scarves is declared the

winner for that round. The 15-minute fun circuit includes stations for jump rope, jumping over a hoop, jumping jacks, and mountain climbers. Adding music to the fun circuit makes the activity even more appealing (Grice, T. 2003)).

The family fun walk is an activity that can take place at home. With the family, students are encouraged to take a brisk 20- minute walk throughout the neighborhood. A list of items to be found along the walk can be compiled to make the walk into a scavenger hunt type of activity. For middle grade or secondary age students, flag tag can be modified into rollerblade flag tag. The same directions would apply with the exception that the students are rollerblading instead of jogging. Jumping rope is another cardiovascular activity that older students can enjoy. Creating task cards and routines as well as setting the activity to music is an excellent way to engage students in a cardiovascular workout. It is also important to consider that basic activities such as jogging, walking, swimming, and aerobic dance are also considered excellent activities for people of all ages that promote cardiovascular endurance. When most people think of muscular strength and endurance training, they immediately think of weight training in the weight room. However, educators should be aware that weight training is not a feasible activity for younger children.

There are many activities that students of all ages can engage in without ever entering a weight room facility. For elementary age children, activities like tug-of-war, push-up routines, and the use of a stability ball can all assist in the development of muscular strength and endurance. Middle school and secondary level students can also use the stability balls, yet they may also safely begin workouts within the weight room environment. It is crucial for educators and parents to understand that teaching proper technique as well as having proper supervision are key elements in a successful weight lifting program. Body composition can be developed through a variety of activities. The stability ball can be used to perform sit-ups and crunches for students of all age levels. Each activity can be modified to fit the ability level of all students. For example, level one would consist of sitting on top of the ball, lying back and performing a certain number of sit-ups. In level two, there is a slight increase in the difficulty of the task. At this level, the student slides down the ball with their back at a slight angle. The student

then attempts to perform the set number of sit-ups. Level three would be the most difficult. The student would lie down with their back on the ground, and their legs on top of the ball while performing the sit-ups. Older students can also use weight training as a method of developing body composition. Educators and parents need to also consider the importance of proper diet along with these methods of exercise when attempting to develop body composition. The development of flexibility is mainly acquired through stretching programs. Stretches can be categorized on a continuum from static (no motion) to ballistic (rapid motion). Static stretching involves stretching a muscle to the farthest point and holding the stretch. Isometric stretching is a type of static stretching which involves resistance of muscle groups through the tensing of the muscles. This type of stretching is considered one of the best ways to increase flexibility. Passive stretching is sometimes referred to as relaxed stretching. (Matvienko, O & A.Iradge, 2009)

During a passive stretch, an individual would assume a position and hold it using another part of the body, a partner, or an apparatus of some type. This type of stretching is good for cooling down after a workout because it helps to reduce muscle fatigue and soreness. Active stretching includes assuming a position and holding it there with no assistance other than using the strength of your agonist muscles. Dynamic stretching involves moving parts of one's body and gradually increasing reach, speed of movement, or both. Dynamic stretching can be useful as part of a warm-up for an aerobic workout. Ballistic stretching uses the momentum of a moving body part or limb in an attempt to force it beyond its normal range of motion. This type of stretching is not considered useful and it has also been known to lead to injury. (Eric Swanson 2020)

As mentioned earlier, any physical activity designed for young children needs to be made fun. Although stretching routines can be very monotonous, they can be made more exciting for young children by simply adding music and giving each stretch a unique name. (Kurz, 1994)

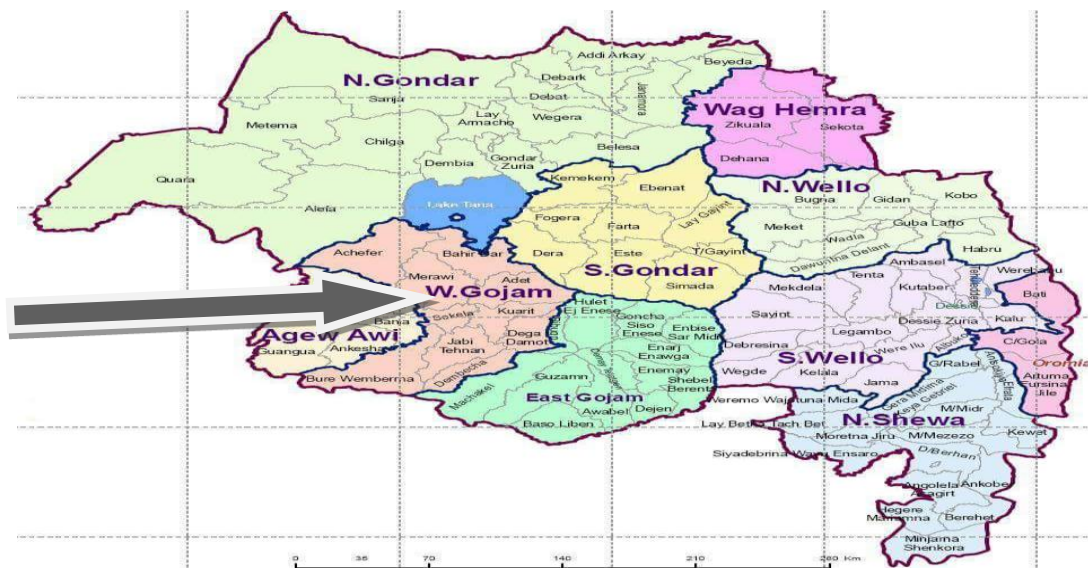
CHAPTER THREE

RESEARCH METHOD

In this part of the study describes of necessary materials and methods for this study, there are descriptions of the study area, research design, population and sampling technique, inclusion and exclusion criteria, source of data, data collection instrument and methods of data analysis.

3.1 Research Area

The study was conducted in Amahara region West Gojjam zone zone, North Mecha Wore da Merawi secondary schools. It is 34 kilometers far from the capital city of Amhara region which is Bahir Dar and 530 kilometers far from Addis Ababa. The North Mecha bordered on the south by South Mecha, on the north Bahir Dar zuriya , on the west South Achefer and on the eastern Yilmana Densa Woreda.



([www Google.com/search](http://www.Google.com/search))

Figure 1 Map of the study area

3.1 Research Design

The focus of this study was to investigate the effect of twelve weeks circuit training on selected physical fitness variables in the case of Merawi secondary school students. Depending on the nature and appropriateness of the pre and posttest data the research approach designed in this study was employed experimental design, since it helps to measure, assess, evaluate and analyze the effect of circuit training the independent variable on the dependent variables; these are cardio vascular fitness, flexibility and speed. The layout for this study was as follows.

Table1.The study Design Layout:

No	Items	Duration
1	Frequency	2 days/week
2	Repetition	2
3	Intensity	60%-90%MHR
4	Duration of whole training	12 weeks
5	Duration of training/session	40 minutes/session
6	Duration for each exercise	60 seconds
7	Active rest among stations	30 seconds
8	Days of training	Tuesday and Thursday

In this study exercise training was done in circuit with instructions and supervisions of researcher and assistants. The training was given in 60% - 90% intensity by the investigator for 12-weeks 2 days per week for 40 minutes. Training session was started with warm up exercises for 8 minutes, workout for 18 minutes; Cool down activities for 5 minutes and total active rest among each station for 9 minutes. Pre post tests were given on selected physical fitness parameters such as cardio respiratory endurance, flexibility, and speed.

3.2 Population and Sampling Technique

The study was conducted at Merawi secondary school grade nine students, since the research is experimental to monitor in training as well as manage in test administrations and data analysis only 30 male sample students had been taken from a population of 108 male student's age ranged 15 to 16 years by the means of available sampling technique. Simple random sampling technique was used to assign control and experimental group. 15 subjects were randomized to control group. The other 15 subjects were randomized to experimental group. Finally, Experimental group (n=15) were took 12-week circuit training and other group assigned as a control group (n=15). Both the EG and the CG participated in the typical 1 sessions of 40-minute physical education (PE) per session per week, except that the EG participated in additional 2 days per week of 40 minutes per session of exercise training for 12 weeks. Both groups were subjected to similar PE programmers aligned with the Ministry of Education (MOE) school curriculum. Subjects were specifically requested to avoid any activities that differed from their usual routine.

3.3 Inclusion and Exclusion Criteria

Individuals with cardiac conditions such as hypertension or uncontrolled diabetes or other conditions that would be contraindicated for exercise testing and training were not admitted to the study. Individuals having bone and joint problem, diabetes mellitus, bad habits and those taking medications were not included into the study. Also, students with a symptom of COVID 19 and who participated in a sport club were not included in the study.

3.4 Source of Data

The data for the study were collected from the results of test given from pre to post test of both experimental and control group. Quantitative data were collected through the appropriate Physical fitness test measures such as, cooper test for cardio respiratory fitness, sit & reach for flexibility and 60 meters speed for speed. Before the experimental groups were going to circuit training, the pretest was taken from both control and

experimental groups. Posttest was also taken from both groups after 12 weeks circuits training programs for experimental groups completed.

3.5 Data collection Instruments

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

3.5.1 Test for Cardio Respiratory Fitness

3.5.1.1 Cooper's 12 minutes run test

Cooper's 12 minutes run test (Cooper, 1968) is a popular field test used for measuring aerobic fitness. This fitness test was initially used to estimate the VO₂ max. Dr. Cooper found that there is a very high correlation between the distance someone can run (or walk) in 12 minutes and their VO₂ max value, which measure the efficiency with which someone can use oxygen while exercising. Students were familiar with the 12 minutes run/walk test protocol prior to the pre-testing date. This is measuring the distance covered in twelve minutes, involves running for twelve minutes around the 400 meters track marked out area and register how far covered in that time with the nearest 50 meters. The purpose of the distance runs is to measure maximal functional capacity and endurance of the cardio respiratory system. Subjects were instructed to run as far as possible in twelve minutes. The students were conducted a warm up for five minutes. The students began on the signal, "Ready, start." Participants were continued to run until a whistle was blown at twelve minutes. Walking was permitted, but the objective was to cover as much distance as possible during the twelve minutes. After completing the test the distance covered was registered near to 50m. Required equipment includes stopwatch or wrist watch, 400m track_ marked every 50m, assistance and data recording forms.

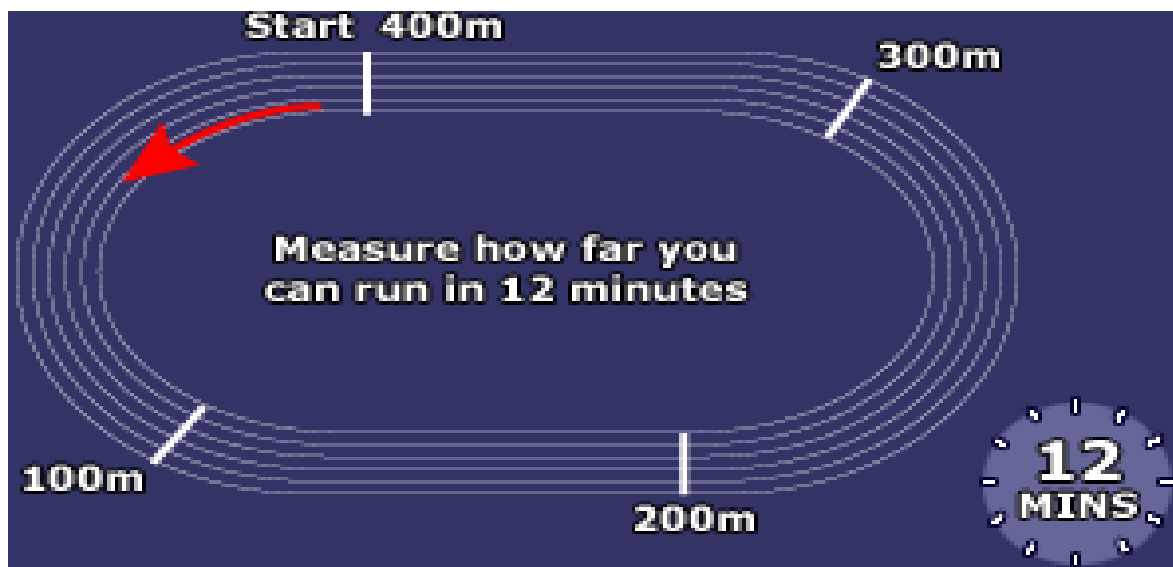


Figure 2 Twelve minutes run test Adopted from Mackenzie, B. (1997) Adopted from Mackenzie, 2005 101 performance evaluation tests

3.5.2 Measurement of flexibility

3.5.2.1 Sit and Reach

The sit and reach test conducted as follows:

- This test is best completed after a substantial amount of warm up is completed in order to ensure the best results as well as being a safety precaution. When a warm up is involved it is critical that the same warm up is completed each time the test is conducted.
- To begin this test, have the client sit on the floor with both feet straight out against a box for them to press their feet against.
- Make sure their feet are bare, both knees are pressed down to the floor, and their palms are facing downward.
- Have them reach as far as they can towards their toes, or if they are really flexible, over the box.
- With a ruler, or some sort, record the length of which the client can reach measuring from their toes to their fingertips.
- Make sure that both hands are even and one is not reaching further than the other.

- The client is allowed some practice reaches before you record their final hold.
- The client should not be making any jerky or quick movements while recording.

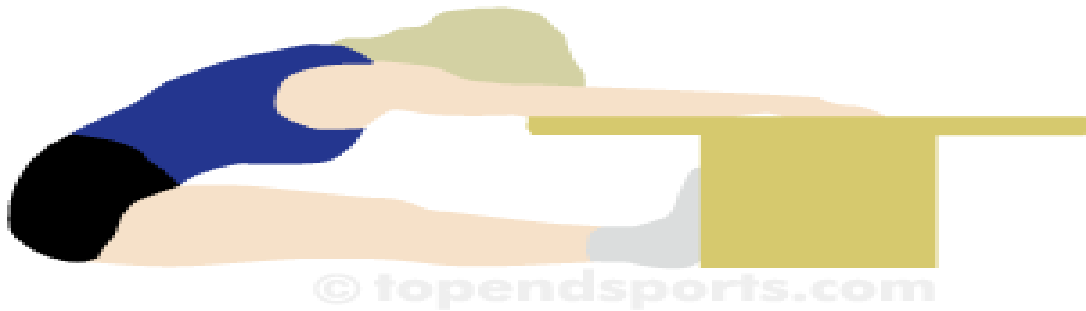


Figure 3 sit and reach

3.5.3 Measurement of speed

3.5.3.1 Sixty meters speed

The test comprises of 3 x 60m runs from a standing start and with a full recovery between each run. The athlete uses the first 30m to build up to maximum speed and then maintains the speed through to 60m. The coach should record the time for the athlete to complete 30m and 60m.

3.6 Methods of Data Analysis

The data collected through fitness tests like 12 minutes run/walk test for cardio respiratory fitness, sit and reach for flexibility and 60 meters for speed the collected data were analyzed and interpreted in to a meaningful idea using manually and in computer in order to compare selected physical fitness variable changes observed among groups. Data was analyzed using computerized statistical package software SPSS version 21. The paired t-test was used to compare the pre training and post training data. The level of significance was set at 0.05.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

This chapter deals with the analysis of pre, and post test data collected from randomly selected experimental (n=15) and control (n=15) groups under this study. The purpose of this study was to investigate the effect of 12weekscircuit training program on selected physical fitness variables of grade nine students at Merawi secondary school. Circuit training program was given for 12 consecutive weeks and attendance was taken for experimental throughout the training. The physical fitness components selected for this study were cardio vascular endurance, flexibility and speed. Pre-test and post-tests data were taken from both experimental and control groups. The collected data were analyzed using paired t test using SPSS version 21 2015.

4.1 Results of the Study

4.1.1 Characteristics of study participants and physical fitness variables

Based on the data taken prior to circuit training, the mean age, height and weight were almost similar for experimental and control group. The overall mean values of age, height and weight were 15.5, 1.56 and 48.233 respectively. In all parameters the simple randomization process resulted with insignificant slightly higher values in control group than values in the experimental group.

Table2 Characteristics of the study participants

Group	N	Age		Height		Weight	
		Mean	S.D	Mean	S.D	Mean	S.D
Experimental Group	15	15.533	0.516	1.568	0.039	48.233	1.5796
Control Group	15	15.466	0.513	1.547	0.0355	47.94	1.5300

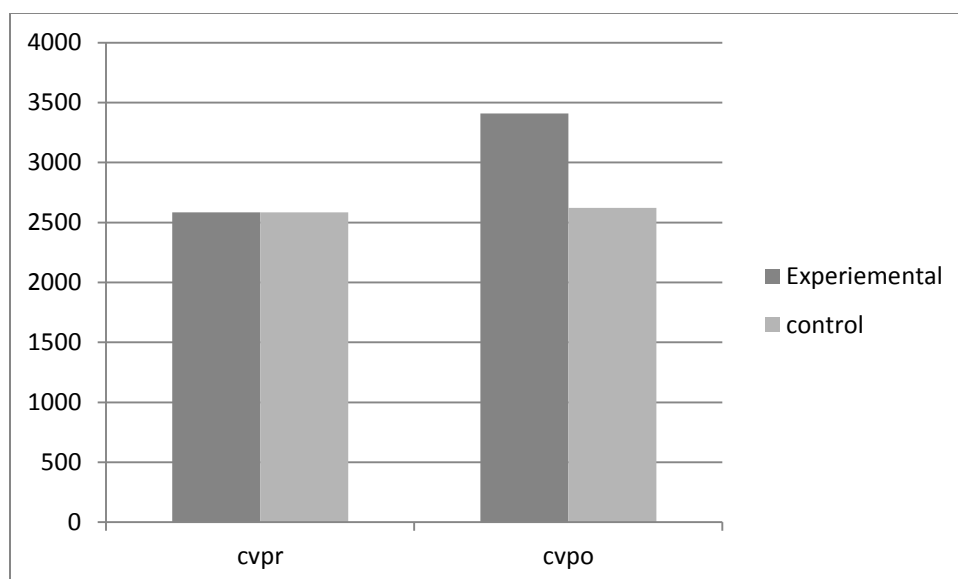
4.1.2 Effect of circuit training on cardiovascular performance

Table 3 comparison of results between pre and posttest of 12 minutes run test

Test	Subject							
	Experimental Group				Control Group			
	Mean		Std. Deviation		Mean		Std. Deviation	
	PT	POT	PT	POT	PT	POT	PT	POT
12 min run test	2583.33	3410.00	669.93	177.48	2584	2621.33	159.499	148.606

PT= pretest, POT= post test

The simple randomization process resulted with 2583.33 and 2584 prior to calisthenics circuit training for experimental and control group on cardio vascular endurance. Table 3 shows the pre and posttest results of 12 minutes run for both experimental and control groups. As shown in the table the pretest means of experimental group were found to be 2583.33meter with a standard deviation of 669.93 and the control group pretest mean found to be 2584 with a standard deviation of 159.49. But after circuit training given to experimental group, the mean score of 12 minutes run test of experimental group has a great change from pre to post test. But the mean value of control group 12 minutes run test remained very close from pre to post test. As the above table reveals, 12 minutes run test score of experimental groups found 3410 meters with a standard deviation of 177.48whereas control group found 2621.33 meter with a standard deviation of 148.606 after training. This result shows different results from pre to post test in experimental group.



Cvpr = pretest cardio vascular, cvpo = post cardio vascular

Graph 1 the pre and post cardio vascular endurance of high school students

4.1.3 Effect of Circuit Training on Flexibility of High School Students

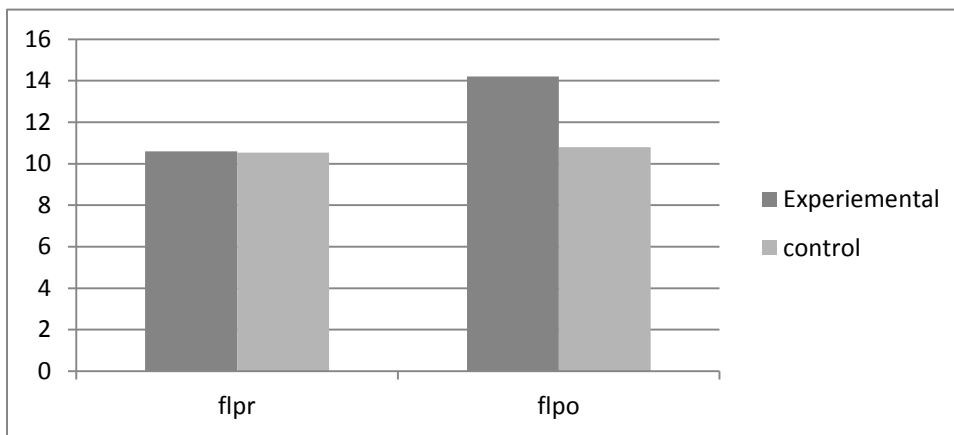
The Pretest means of experimental group was found to be 10.60 with a standard deviation of 1.68 whereas control group found to be 10.53 with a standard deviation of 2.61 (table 4). But after circuit training change was observed in sit and reach results among groups who did participate in the training unlike that of CG who's sit and reach post test result remains almost the same. The Posttest means of sit and reach for EG found 14.20 with a standard deviation of 2.144 whereas CG were found to be 10.8 with a standard deviation of 2.83.

Table 4. Comparison of results between pre and posttest of sit and reach test

Test	Subject							
	Experimental Group				Control Group			
	Mean		Std. Deviation		Mean		Std. Deviation	
	PT	POT	PT	POT	PT	POT	PT	POT
Sit and reach	10.60	14.2	1.68	2.14	10.53	10.8	2.61	2.83

PT= pre t test, POT= posttest.

The above table shows analyzed data of sit and reach test. The Pretest means of EG was found to be 10.60 with a standard deviation of 1.68 whereas CG found to be 10.53 with a standard deviation of 2.61. But after circuit training change was observed in sit and reach results among groups who did participate in the training unlike that of CG who's sit and reach post test result remains almost the same. The Posttest means of sit and reach for EG found 14.20 with a standard deviation of 2.144 whereas CG were found to be 10.8 with a standard deviation of 2.83.



flpr = pretest flexibility, flpo = posttest flexibility

Graph2. The pre and posttest flexibility of high school students

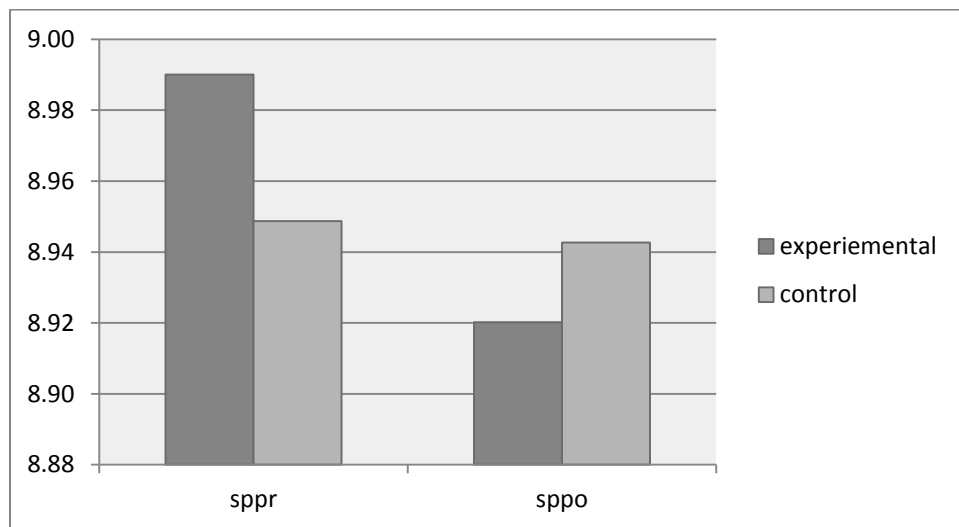
4.1.4 Effect of Circuit Training on Speed Test

Table5. Comparison of results between pre and posttest of 60 meters speed test

Test	Subject							
	Experimental Group				Control Group			
	Mean		Std. Deviation		Mean		Std. Deviation	
	PT	POT	PT	POT	PT	POT	PT	POT
60 meters speed	8.99	8.92	0.2258	0.2249	8.9487	8.9427	0.3932	0.3959

PT= pretest, POT= posttest

The above table indicates that the mean value of 60 meters speed test showed that there was reduction from pre to post test in EG. But in CG it was almost the same from pre to post test. EG has reduced from previous average of 8.99 of with a standard deviation of 0.2258 to 8.92 with a standard deviation of 0.2249 pre and posttest respectively following the 12 weeks circuit trainings. Whereas CG has increased 60 meters speed from 8.9487(pretest) to 8.9427 (posttest) with a standard deviation of 0.3932 and 0.3959 pre and posttest respectively.



sppr = pretest speed, sppo = posttest speed

Graph3.The pre and posttest speed of high school students

4.1.5 General Means Comparison of Cardio Respiratory Fitness

During the 12 weeks of circuit training, the improvement of subject performance was greatly increased from pre training to post training in experimental groups. This improvement shows that circuit training had effect on the improvement of cardio respiratory fitness, flexibility and speed. Mean value difference between pre and posttests of the groups were discussed as follows. Thus, paired t-test was computed to examine whether the result had statistically significant at the pre and posttest. According to the data presented in the table 3, the pre and posttest result of cardio respiratory fitness performance levels in 12minute run test showed a statistically significant difference in experimental group. The result suggests that experimental group significantly improved

cardio respiratory fitness (MD = 826.66, SD = 743.99 $p = 0.001$) when exposed to 12 weeks circuit training than CG (MD = 37.333 SD = 103.473, $p=0.184$). Hence, ($P < 0.05$). Post-training cardio respiratory fitness was significantly improved in 12 minutes run test than pre-test values for the experimental group. But there were no significant differences in 12 minutes run test between pre- and post-testing for the control group. In the table3 it was indicated that the mean score of 12 minutes run test after giving circuit training was higher than that of before giving circuit training. The mean value of experimental group 12 minutes run test before training was 2583.3and it increased to 3410 after circuit training and the pre training mean value of control group was 2584 and it increment to 2621.333 after circuit training. Between each, the mean value difference was 826.66 for experimental group and 37.33 for control group. This value showed that the performance of experimental group was significantly increased from pre-posttests but not significant control group. This indicates that twelve weeks circuit training could have a great effect on the improvement of Cardio respiratory fitness.

Table6. The summary results of circuit training on cardio vascular endurance

Test	Group	MD	Std. dev.	95 % interval difference		T	Sig . (2-tail ed)
				Lower	Upper		
12 minutes run test	EG(PT-POT)	-826.66	743.99	-1238.67	-414.65	-4.303	.001
	CG (PT-POT)	37.33	103.473	-19.968	94.634	1.397	0.184

CG = control group, EG = Experimental group, MD = mean difference, PT = pretest and PO = post test

4.1.6 General Means Comparison of Flexibility

According to the data presented in the table4, significant differences were found in experimental group sit and reach test. The result suggests that experimental group significantly increased sit and reach test (MD = 3.6, SD = 0.82808, $p = 0.000$) when exposed to 12 weeks circuit training than control group (MD = 0.26667, SD = 0.70373, $p=0.164$). Hence, ($P < 0.05$) Post-training sit and reach test was significantly increased than pre-test values for the experimental group. But there were no significant differences in sit and reach test between pre- and post-testing for the control group. It was indicated that the mean score of set and reach test after giving circuit training was higher than that of before giving circuit training. The mean score of experimental groups set and reach test before training was 10.6 and it increased to 14.2 after circuit training and the pre training mean score of control group was 10.533 and it a few increments to 10.800 after circuit training. Between each, the mean value difference was 3.6 for experimental group and 0.267 for control group. This value showed that the performance of experimental group was significantly increased from pre-posttests but not significant in control group. This reveals that twelve weeks circuit training can result in the improvement of flexibility.

Table7. The summary results of circuit training on flexibility

Test	Group	MD	Std. dev.	95 % interval difference		T	Sig. (2-tailed)
				Lower	Upper		
Sit and reach test	EG(PT-POT)	-3.600	0.828	-4.058	-3.1414	-16837	0.000
	CG (PT-POT)	0.266	0.7037	-0.12305	0.6563	1.468	0.164

CG = control group, EG = Experimental group, MD = mean difference, PT = pretest and PO = post test

4.1.7 General Means Comparison of Speed

According to the data presented in table, the pre and posttest result of 60 meters speed result there is evidence to suggest that EG significantly reduced 60 meters speed (MD = 0.0700, SD= 0.00378, $p= 0.000$) when exposed to circuit training than control group (MD = 0.00600, SD =0.04085, $p=0.578$) of the experimental group showed a statistically significant difference. Thus, ($P < 0.05$) Post-test circuit training was significantly reduced than pre-test values for the experimental group. But there was no significant difference in 60 meter speed pre- and post-testing for the control group. In the table it was indicated that the mean score of experimental groups 60 meters speed after giving circuit training was reduced than that of before giving circuit training.

The mean value of experimental group was 8.9900 before calisthenics circuit training and it reduced to 8.9200 after circuit training and the pre training mean value of control group was 8.9487 and it a few declines to 8.9427 after circuit training. Between each, the mean value difference was 0.0700 Reductions for experimental group and 0.006 increments for control group. These values showed that 60 meters speed of experimental group were significantly improved from pre-posttests but not significant in control group. From this we can understand that the more frequent calisthenics circuit training a person involves the better improvement of speed.

Table8. The summary results of circuit training on speed

Test	Group	MD	Std. dev.	95 % interval difference		T	Sig. (2-tailed)
				Lower	Upper		
60 meters speed	EG(PT-POT)	0.0700	0.00378	0.06791	0.07209	71.729	.000
	CG (PT-POT)	0.0060	0.04085	-0.01662	0.02862	0.569	0.578

CG = control group, EG = Experimental group, MD = mean difference, PT = pretest and PO = post test

4.2 Discussion of the Study

This study was conducted to investigate effects of twelve weeks circuit training program on selected physical fitness variable like cardio respiratory endurance, flexibility, and speed of Merawi Secondary School students.

The major findings that depend on the research hypothesis for this investigation were the increment or the improvement of selected physical fitness variables such as: cardio respiratory endurance, flexibility, and speed. There are a lot of exercises that develop physical fitness of participants. For this study 12 minutes run was used to measure cardio respiratory endurance; sit and reach was used to measures flexibility; 60 meters speed test was used to measure speed of two groups, which means both experimental and control groups. The analysis of data was done through paired t-test to see the difference. The level of significance was set at 0.05. As, the tests result indicated that there was progressive improvement in performance from pre-test to post test on experimental groups due to the calisthenics circuit training program in 12 weeks. But there was no change in the second group or in control groups.

4.2.1 Cardio Respiratory Endurance

The tests results showed that statistically significance enhancement observed in the participants' fitness level. The finding of this study was in agreement with Kaikkonen, (2000) who conducted the study on the effects of 12 weeks low resistance training on cardio respiratory endurance and muscular fitness on ninety health sedentary adults and found the training group significantly improved cardio respiratory endurance Sonchaan (2017) who dealt with the effects of circuit training program intervention on muscle ,strength ,agility, anaerobic performance and cardiovascular endurance observed that significantly more improvements in the above variables. The finding of this study was in agreement with Kinet (2013) who mentioned that 8 weeks progressive circuit training of program has significant improvement on all the physical fitness components in case of boys.

This result was supported by the study of Newport and Laliberte (2001). They concluded that appropriate physical activity could build cardiovascular fitness in all types of people. Adaption to exercise include increased heart rate, deep respiration, improved ventilation ratios in the lungs; increase in heart size and rate which lead to cover the given distance in minimum time. These factors combined with metabolic muscular changes improve the effectiveness of responses to exercise which in turn increases performance (ACSM, 1995).

Inselet *al.* (2001) concluded in their study that cardio-respiratory endurance depends on the ability of the lungs to deliver oxygen from the environment to the bloodstream; the hearts capacity to pump blood; an ability of the nervous system and blood vessels to regulate blood flow; the muscles capacity to generate power and capability of the body's chemical systems to use oxygen and process fuels for exercise.

4.2.2 Speed

The findings on speed revealed that there was significantly improvement in performance. The improvement in speed performance level was due to the calisthenics circuit training program in which they were engaged in for twelve weeks. The lower time spent in covering distance, the greater effects of training on direction change and acceleration were indicating improvement of speed, because there was decline in time throughout 12 weeks training.

The finding of this study was in agreement with Kumar(2016) who mentioned that eight weeks progressive training of physical fitness program has significant improvement on speed, leg power arum power agility of the subjects components in case 60 boys. The practice of progressive training program improved the speed, explosive power, endurance strength and forearm muscles of boys.

The results of this study was also in agreement with the result of Adeniji(2007) who conducted study to examine the comparative effects of calisthenics circuit training program on Speed and Power of Pre- and Post-Monarchial girls. Pre- to posttest control group experimental design was used to carry out the study. A total of eighty secondary school girls from St. Peter's College, Olomore, Abeokuta, in Ogun State of Nigeria, ages

10-17 years took part in the study. The findings of Adeniji indicated that the circuit training on speed and power were significantly better for experimental group. Therefore, they must do training in order to improve their performance capacity and health level.

4.2.3 Flexibility

The tests results showed that statistically significance enhancement observed in the participants flexibility. Circuit training provides strenuous work entirely suited to an individual's specific needs, existing capacity and rate of adjustment to progressive vigorous exercises. The finding of this study was in agreement with Ahmad Hurrah and Rvpatil. (2018) who conducted the study on the effects of weight training and circuit training on health related physical fitness components on adults and found the training group significantly improved flexibility. .kurz (1994) who dealt with the static stretching exercise intervention on flexibility and observed that exercise group had significantly improvements in tensing of muscle. While these well-intentioned guidelines may seem unattainable to some, calisthenics circuit training is an efficient, effective way to achieve them – and to reap results.

Cardio and strength combined Developed in 1953 at the University of Leeds in England, traditional circuit training is comprised of 8-12 stations where individuals perform strength-training exercises using a resistance of about 40% to 60% of one-repetition maximum (1RM) for a specific duration (30 seconds to two minutes), with either rest or cardio intervals of 15 seconds to three minutes (or longer) between stations.

Research continually shows that calisthenics circuit training confers numerous benefits, given that it simultaneously develops cardiovascular fitness and strength. In fact, according to the prestigious Cooper Institute in Dallas, Texas, circuit training “is the most scientifically proven exercise system. It’s time efficient and incorporates strength, flexibility and cardio in the same workout.”

Circuit training maximizes the advantages of individual cardio and strength workouts for greater conditioning and valuable psychological benefits. One new, convenient way to circuit train is which is available on Octane Fitness standing elliptical cross trainers

4.3 Discussions on Hypotheses

1. It was hypothesized that experimental and control group would have significant differences on cardiorespiratory fitness due to circuit training. The finding of the study revealed that experimental group showed significant improvement due to circuit training than control group between Merawi secondary school male students. Hence, the first hypothesis was accepted at 0.05 level of confidence.

2. It was hypothesized that experimental and control group would have no significant differences on cardiovascular endurance due to circuit training. But the finding of the study showed that experimental group showed significant improvement due to circuit training than control groups between Merawi secondary school male students. Hence, the second hypothesis was rejected at 0.05 level of confidence.

3. It was hypothesized that experimental and control group would have significant differences on flexibility due to circuit training. The finding of the study showed that there was significant improvement due to circuit training between groups of Merawi secondary school male students. Hence, the third hypothesis was accepted at 0.05 level of confidence.

4. It was hypothesized that experimental and control group would have no significant differences on flexibility due to circuit training. But the finding of the study showed that experimental group showed significant increment due to circuit training than control groups between Merawi secondary school male students. Hence, the fourth hypothesis was rejected at 0.05 level of confidence

5. It was hypothesized that experimental and control group would have significant differences on speed due to circuit training. The finding of the study revealed that experimental group had significant reduction of speed due to circuit training than control group between Merawi secondary school male students. Hence, the fifth hypothesis was accepted at 0.05 level of confidence

6. It was hypothesized that experimental and control group would have no significant differences on speed due to circuit training. But the finding of the study showed that

experimental group showed significant reduction due to circuit training than control groups between Merawi secondary school male students. Hence, the sixth hypothesis was rejected at 0.05 level of confidence.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary

The purpose of this study was to evaluate the effect of twelve weeks circuit training on cardio respiratory fitness flexibility and speed of Merawi secondary school grade nine male students. For this purpose, the researcher reviewed the available literatures in order to decide the focus of the study and methodologies. In order to attain the general objective of the study, the following specific research objectives were formulated.

1. To evaluate the effect of twelve weeks circuit training cardio respiratory fitness.
2. To assess the effect of twelve weeks circuit training on flexibility.
3. To determine the effect of twelve weeks circuit training on speed.

Based on the above specific objectives, the hypotheses were formulated. In dealing with these basic objectives, the study conducted on grade nine students at secondary school. Among a population of 108 grade nine male students using available sampling system ,and 15 students were experimental of circuit training for three months and 2 days per week, and 15 students serve as control group were attended one practical academic physical education lesson per week with experimental groups. A pretest and posttest of selected physical fitness tests were taken to gain the necessary information required. Through paired t-test the data was analyzed. Hence, the following findings were investigated.

- High Improvement in cardio respiratory fitness was observed. Experimental groups had shown improvement as a result of the circuit training, Cardio respiratory fitness were improved better in EG than CG.
- Flexibility was significantly increase in EG than CG as a result of circuit training.
- After 12 weeks of circuit training speed was significantly reduction in EG than CG.

5.2 Conclusions

Based on the major findings of the study, these points were stated as conclusion

- Selected circuit training exercises contribute to the improvement of physical fitness variables on selected physical fitness
- This study found that there was progressive improvement in the selected physical fitness variables during training periods in experimental groups, while not in control groups.
- Regular participation in circuit training improves physical fitness of male students.
- Circuit training was found better in improving the cardio respiratory fitness, flexibility and speed significant to improve the performance of the participants on physical fitness.
- This implies to get more improvement it requires more time.
- Rather than two days per a week it needs four days per a week.

5.3 Recommendations

The finding of this research proved that twelve weeks of circuit training significantly improved most of the selected physical variables of the participants. Based on results, discussions and findings of the study, the following would be recommended:

- Students who want to improve their physical fitness should engage in circuit training at least 3 days per week 40 minutes each day. Thus, physical education class per week should be increased and contents should emphasis on circuit training program.
- Physical education teachers as a means to improve the physical fitness status of all students should encourage circuit training among various classes and grade levels.

- Ministry of education should be incorporated and encourage circuit training programs in physical education lessons at school. This will help to improve the physical fitness of students' particularly cardio respiratory fitness flexibility and speed.
- Efforts through physical education educators should be made in advocating the importance of circuit training since it has enormous benefits.
- Studies should be conducted in the same area on different samples of age and sex. Further study should be conducted to understand how circuit training affects cardio respiratory fitness flexibility and speed.

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APPENDICES

Appendix1. Physical Activity Readiness Questionnaire

Physical activity readiness questionnaire is the first step to take in to consideration if one planned to involve in regular exercise. The Physical activity readiness questionnaire is designed to identify the small number of students for whom circuit training might be inappropriate or those who should seek medical advice concerning the type of activity most suitable for them. The following questions are prepared and distributed to students regarding to their health status for the participation of the designed circuit training.

For Students; please read the following questions carefully and indicate your correct responses to each question by encircle “YES” or “NO” options.

Students full Name: _____

Students Signature: _____

Date: _____

NO	Questions	Yes	No
1	Do you currently participate in regular exercise at least 2 times per week?		
2	Do you currently smoke?		
3	Do you have coronary heart disease?		
4	Have you currently take medications?		
5	Do you have diabetes mellitus or any other metabolic disorder?		
6	Have you ever suffered from shortness of breath at rest or with physical exercise?		
7	Have you ever felt pain in your chest when you do physical exercise?		
8	Do you have high blood pressure?		
9	Do you have bone or joint problem which has been aggravated by exercise?		
10	Do you have upper or lower back pain which has been aggravated by exercise?		

Appendix 2: Characteristics of the study participants

Group	N	Age		Height		Weight	
		Mean	S.D	Mean	S.D	Mean	S.D
Experimental	15	15.33	0.516	1.568	0.039	48.233	1.5796
Control Group	15	15.466	0.513	1.547	0.0355	47.94	1.5300

Appendix 3 -Data of Experimental group

No.	Section	Group	Age	Height	weigh t	cvpr	Cvpo	flpr	flpo	Sppr	Sppo
1	9C	Experimental	16.00	1.59	48.70	2800	3750	11	15	9.0400	8.9705
2	9F	Experimental	15.00	1.58	50.50	2750	3400	12	16	8.9600	8.8935
3	9H	Experimental	15.00	1.56	48.00	300	3700	10	14	9.1200	9.0475
4	9G	Experimental	16.00	1.61	50.00	2950	3550	11	14	9.0400	8.9705
5	9G	Experimental	16.00	1.50	46.00	3100	3500	10	14	9.1600	9.0860
6	9H	Experimental	15.00	1.59	47.00	2800	3550	8	12	9.2700	9.2015
7	9K	Experimental	16.00	1.48	45.30	2600	3300	7	10	9.3100	9.2400
8	9J	Experimental	15.00	1.53	47.60	2900	3350	9	11	9.2000	9.1245
9	9D	Experimental	16.00	1.55	46.40	2750	3400	13	17	8.9200	8.8550
10	9D	Experimental	15.00	1.62	50.50	2350	3250	10	13	8.9600	8.8935
11	9A	Experimental	16.00	1.56	49.00	3000	3400	11	15	8.8500	8.7780
12	9B	Experimental	15.00	1.59	48.00	2450	3300	13	17	8.5400	8.4700
13	9I	Experimental	16.00	1.61	48.50	2950	3100	11	15	8.6900	8.6240
14	9A	Experimental	15.00	1.58	49.50	2650	3400	12	17	8.6700	8.6009
15	9C	Experimental	16.00	1.59	48.70	2800	3750	11	15	9.0400	8.9705

Appendix 4 -Data of control group

No.	Section	Group	Age	Height	weight	Cvpr	cvpo	Flpr	Flop	Sppr	Sppo
1	9 C	Control	15.00	1.55	50.50	2720	2790	14.00	15	9.0500	9.0300
2	9 K	Control	16.00	1.57	48.00	2530	2600	11.00	11	8.8200	8.8100
3	9 K	Control	15.00	1.49	46.50	2510	2550	10.00	11	8.5500	8.5000
4	9 H	Control	16.00	1.55	47.50	2760	2780	9.00	7	8.7000	8.6800
5	9 I	Control	15.00	1.60	49.50	2570	2500	13.00	15	9.1200	9.1000
6	9 F	Control	16.00	1.58	48.40	2220	2500	10.00	10	8.6300	8.6100
7	9 A	Control	16.00	1.56	50.00	2670	2800	11.00	10	8.9600	8.9400
8	9A	Control	15.00	1.57	49.30	2430	2450	10.00	11	9.2000	9.1800
9	9 F	Control	15.00	1.50	45.70	2570	2600	10.00	10	10.0100	9.9600
10	9 I	Control	16.00	1.55	47.00	2820	2750	10.00	12	8.4700	8.4500
11	9 D	Control	15.00	1.57	48.00	2390	2500	14.00	15	9.2300	9.2100
12	9 D	Control	16.00	1.50	46.00	2660	2600	9.00	8	8.4300	8.4000
13	9 E	Control	15.00	1.58	49.20	2760	2900	6.00	5	9.0500	9.1200
14	9 G	Control	15.00	1.55	47.50	2530	2400	11.00	11	8.9700	9.0400
15	9 J	Control	16.00	1.49	46.00	2620	2600	10.00	11	9.0400	9.1100

Appendix 5 -Experimental

[Experimental paired t test]

Paired Samples Statistics					
		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	cardio vascular pre	2583.3333	15	669.93248	172.97582
	cardio vascular post	3410.0000	15	177.48239	45.82576
Pair 2	flexibility pre	10.6000	15	1.68184	.43425
	flexibility post	14.2000	15	2.14476	.55377
Pair 3	speed pre	8.9900	15	.22580	.05830
	Spo	8.9200	15	.22494	.05808

Experimental mean difference

Paired Samples Test								
	Paired Differences					T	Df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
cardio vascular pre - cardio vascular post	-826.66667	743.99181	192.09786	-1238.67560	-414.65774	-4.303	14	.001
flexibility pre - flexibility post	-3.60000	.82808	.21381	-4.05857	-3.14143	-16.837	14	.000
speed pre –spo	.07000	.00378	.00098	.06791	.07209	71.729	14	.000

Descriptive

[Descriptive experimental]

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Age	15	15.00	16.00	15.5333	.51640
Weight	15	1.48	1.62	1.5687	.03998
Height	15	45.30	50.50	48.2333	1.57963
Valid N (listwise)	15				

[control paired t test]

Paired Samples Statistics					
		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	cardio vascular pre	2584.0000	15	148.60622	38.36996
	cardio vascular post	2621.3333	15	159.49922	41.18252
Pair 2	flexibility pre	10.5333	15	2.83347	.73160
	flexibility post	10.8000	15	2.61498	.67518
Pair 3	speed pre	8.9487	15	.39321	.10153
	Spo	8.9427	15	.39592	.10223

Control mean difference

Paired Samples Test

	Paired Differences					T	Df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
cardio vascular pre - cardio vascular post	37.33 333	103.47302	26.71662	-19.96812	94.63478	1.397	14	.184
flexibility pre - flexibility post	.2666 7	.70373	.18170	-.12305	.65638	1.468	14	.164
speed pre –spo	.0060 0	.04085	.01055	-.01662	.02862	.569	14	.578

Descriptive control

[DataSet0]

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Age	15	15.00	16.00	15.4667	.51640
Weight	15	45.70	50.50	47.9400	1.53008
Height	15	1.49	1.60	1.5473	.03555
Valid N (listwise)	15				

Appendix 6-Three months circuit training program

Day	Week	Contents of exercise	Cycles	Exercise duration (s)	Rest period between stations (s)	Rest period between cycles (s)	Total duration (m)
Tuesday and Thursday	1	Warming up exercise (jogging, movements of hands and leg, stretch)					8
		Main part (Squat,pushup,jumpingjack,lung,plank,sidelifts)	2	60	30	2	18
		Coolingdown (Cooling lower and upper body, starching ,breathing mediation)					5
Tuesday and Thursday	2	Warming up exercise (jogging, movements of hands and leg, stretch)					8
		Main part Jumping rope, wall sit, abdominal crunch, side plank, step up, triceps dips	2	60	30	2	18
		Cooling down (Cooling lower and upper body, starching ,breathing mediation)					5
Tuesday and Thursday	3	Warming up exercise (jogging, movements of hands and leg, stretch)					8
		Main part (Squat, push up, jumping jack, lung ,plank, side lifts)	2	60	30	2	18
		Cooling down (Cooling lower and upper body, starching ,breathing mediation)					5
Tuesday and Thursday	4	Warming up exercise (jogging, movements of hands and leg, stretch)					8
		Main part Jumping rope, wall sit, abdominal crunch, side plank, step up, triceps dips	2	60	30	2	18

		Cooling down (Cooling lower and upper body, stretching, breathing mediation)					5
Tuesday and Thursday	5	Warming up exercise (jogging, movements of hands and leg, stretch)					8
		Main part (Squat, push up, jumping jack, lung ,plank, side lifts)	2	60	30	2	18
		Cooling down (Cooling lower and upper body, stretching, breathing mediation)					5
Tuesday and Thursday	6	Warming up exercise (jogging, movements of hands and leg, stretch)					8
		Main part Jumping rope, wall sit, abdominal crunch, side plank, step up, triceps dips	2	60	30	2	18
		Cooling down (Cooling lower and upper body, stretching, breathing mediation)					5
Tuesday and Thursday	7	Warming up exercise (jogging, movements of hands and leg, stretch)					8
		Main part (Squat, push up, jumping jack, lung ,plank, side lifts)	2	60	30	2	18
		Cooling down (Cooling lower and upper body, stretching, breathing mediation)					5
Tuesday and Thursday	8	Warming up exercise (jogging, movements of hands and leg, stretch)					8
		Main part Jumping rope, wall sit, abdominal crunch, side plank, step up, triceps dips	2	60	30	2	18
		Cooling down (Cooling lower and upper body, stretching, breathing mediation)					5

Tuesday and Thursday	9	Warming up exercise (jogging, movements of hands and leg, stretch)					8
		Main part (Squat, push up, jumping jack, lung ,plank, side lifts)	2	60	30	2	18
		Cooling down (Cooling lower and upper body, starching ,breathing mediation)					5
Tuesday and Thursday	10	Warming up exercise (jogging, movements of hands and leg, stretch)					8
		Main part Jumping rope, wall sit, abdominal crunch, side plank, step up, triceps dips	2	60	30	2	18
		Cooling down (Cooling lower and upper body, starching ,breathing mediation)					5
Tuesday and Thursday	11	Warming up exercise (jogging, movements of hands and leg, stretch)					8
		Main part (Squat, push up, jumping jack, lung ,plank, side lifts)	2	60	30	2	18
		Cooling down (Cooling lower and upper body, starching ,breathing mediation)					5
Tuesday and Thursday	12	Warming up exercise (jogging, movements of hands and leg, stretch)					8
		Main part Jumping rope, wall sit, abdominal crunch, side plank, step up, triceps dips	2	60	30	2	18
		Cooling down (Cooling lower and upper body, starching ,breathing mediation)					5