JIMMA UNIVERSITY

COLLEGE OF NATURAL SCIENCE

DEPARTMENT OF SPORT SCIENCE

EFFECTS OF MIXED INTERVALTRAINING RECOVERY SHORT TERM AND LONG TERM ON MIDDLE DISTANCEENDURANCE RUNNING PERFORMANCE BEKOJII ATHLETIC TRAINING CENTER

BY

AWEKE HABTEGIYORGIS

A THESIS SUBMITTED TO THE COLLEGE OF NATURAL SCIENCE OF JIMMA UNVERSITY DEPARTMENT OF SPORT SCIENCE IN PARTIAL FULFILLEMENT OF THE REQUIREMENTS FOR MASTER OF SCIENCE IN SPORT SCEINCE

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ACRONYM

HII:-high-intensity interval training

ATP-CP:-Adenosine triphosphate creatine phosphate

ATP:-Adenosine triphosphate

BMI:-Body mass index

GAS:-General Adaptation Syndrome

HRmax:-Maximal Heart Rate

IAAF:-International Association of Athletics Federation

IOC:-International Olympic Committee

MAS- :- Maximal Aerobic Speed

RHR:-Resting Heart Rate

SPSS:-statistical package for social science software

Vo2max-Maximal amount of oxygen inhale during exercise

ABSTRACT

This study was intended to investigate the effect of mixed interval training recovery short term and long term on middle distance endurance running performance of athletes. Specific objective of this study were: - to assess short and long interval training recovery result of pre-test and post-test athletes' endurance running performance, to identify short and long interval training recovery ;. Before and after 8-weektraining through Circuit training, Repetition training,Explosive Exercise Training, Interval training, Lunge/Sprint Combination Interval training significant difference between pre-test and post-test on athlete endurance running performance and to examine the effect of mixed interval training on athlete endurance running performance . To achieve the intended objective basic research question formulated and purposive sampling technique was used to select participant and the subjects were allowed to participate in this training was 20 athletes were selected. 12 (60%), of them were male athletes and 8 (40%), were female athletes from Bekoji athletics training center during the year of 2018/19. The selected subject was under the quasi-experimental design of before training (pre-test) and post-test after short and long interval training period. The training periods of these groups were eight-weeks, three, (3) days per week with duration of 60 minutes in one session. The data were collectedthrough endurance performance assessment which includes;-cooper-test, vo2max, 2.4kmrun and anthropometry assessment;-weight, height, Body mass index. The endurance running performance variables were statistically analyzed by using spss 21 version .Pre and post test of athlete' endurance performance analyzed by mean, and Std .Deviation, significance difference of during pre and post test analyzed by Paired-Samples t-test whereas effect of mixed interval training recovery on athlete endurance running performance analyze through multiple regression model. The finding of this study results showed there were significant difference between pre and post test endurance running performance improvement of athlete after training. There was significant change in pre-test and post-test results of short interval training recovery than long interval training recovery, mixed interval training recovery had vital effect to improve athletes 'endurance running performance significantly.

***Keywords**: Interval, Training, performance, pre-test and post-test, endurance, recovery*

CHAPTER ONE

1. INTRODUCTION

1.1 Background of the Study

Historically, athletics is started during Olympic game in Athens in 776 B.C. and most modern events are conducted by the member clubs of the international Association of Athletics Federations. Furthermore, the first modern Olympic Games took place in 1896 and athletics were part of the games with the competition being divided in to track and field event (IOC, 2011).

The word athletics is derived from the Greek word "Athlos" meaning "contest" or "task" initially. The term was used to describe Athletics contests in general i.e. sporting competition based primarily on human physical fit. In the 19th century in Europe, the term Athletics acquired a more narrow definition and come do describe sport involving competitive running, walking, jumping and throwing. Furthermore, foreign words in many Germanic and Romance languages which are related to the term Athletics also have a similar meaning. (www.olympic org /studies)

Athletics is one of the purest of all sports, relying solely on the strength of human body rather than their technological implements to improve performance.In the same vein, African countries such as Ethiopia, Kenya, Algeria, Morocco, South Africa, Uganda, and Eritrea, many others have been and still are the icons of running events, particularly in the middle and long distances. Typically, the rationale behind their achievement lays on that, the practice of this event requires remarkably little facilities, having a door -openers' "a role models"", an engagement with manual work at the early age, for instance, long distance round-trip to school, fetching water and gathering fire wood …etc, could be mentioned as some of the main factors (Tsehaynew,2010).

When we mention sport and Ethiopia, the large number of first- class distance runners' immediately comes to our mind. In fact, at this stage on could safely and justifiably come to an agreement that Ethiopia has some of the best middle and long distance runners in the world. Accordingly, the New York Times called Ethiopia "running Mecca" due to its historical successes I the athletes program, in which it also took 5th place in the world ranking during the Olympic champion at Beijing (International Olympic committee, 2010).

Ethiopian first participated at the Olympic Games in1956, and has sent athletes to compete in every summer Olympic Games since then, except for the 1976, 1984, and 1988 Games.

Ethiopian Athletes have won a total of 38 medals, all in Athletics. National Olympic committee of Ethiopia was founded in 1948. (Judah, 2008; IOC, 2010)

Fitness training for most people comprises a workout of continuous exercise at a constant intensity. This type of training is very effective but, to propel yourself to the next level of fitness, you need to incorporate interval training into your fitness training regimen. You will burn more calories, increase your speed, strength, endurance, motivation and overall athletic performance. The concept of interval training has been around for years as the basis for athletic fitness training routines. Originally called Fartlek, it combined alternating short and fast bursts of intensive exercise with the slower, easier activity of continuous work. Fartlek training was a deliberate attempt to complete more work than continuous training by increasing the intensity of workouts.

Regular endurance training improves performance during tasks that rely mainly on aerobic energy metabolism, in large part by increasing the body's ability to transport and utilize oxygen, and enhancing the capacity for the oxidative metabolism of substrates by working skeletal muscle (Saltin&Gollnick, 1983). While less widely appreciated, high-intensity interval training (HIIT) is a potent stimulus to induce physiological adaptations that resemble, and indeed may be superior to, changes typically associated with traditional endurance training (Kubukeli et al., 2002; Ross &Leveritt, 2001). Indeed, highly-trained endurance athletes have long incorporated HIIT as an integral component of training programs designed. to maximize performance (Laursen& Jenkins, 2002). Recently, short-term studies lasting up to several weeks in healthy persons of average fitness have established that HIIT per se is a potent stimulus to induce physiological adaptations that resemble changes typically associated with traditional endurance training, despite a lower total exercise volume and reduced training time commitment (Burgomaster et al., 2005; Gibala et al., 2006; Little et al., 2010).

This brief review highlights recent work that sheds new light on the potency of low-volume HIIT to induce rapid physiological remodeling and enhance the capacity for performance during tasks that rely mainly on aerobic energy metabolism. For a more comprehensive analysis, as well as the potential application of HIIT to different populations, the reader is referred to other recent reviews by the present author (Gibalaet al., 2012, 2014) and others, including work that has specifically focused on those at risk for, or afflicted by, cardio metabolic disorders (Kessler et al., 2012; Weston et al., 2014).

With regard to practical applications and training prescription, two other recent reviews (Buchheit&Laursen, 2013ab).consider in detail various aspects of HIIT programming, with a particular focus on athletic performance.

From this notion, the researcher argument privates on the fact that Ethiopia track and field event athletes; the Methodological approach of short and long interval training to improve endurance performance; would repeat what has been achieved by track event athletes; provided that the journey of trainee athletes preparation is conducted under well organized and equipped Bekojiathletics Training Center, worked together in harmony with all stakeholders

1.2 Statement of the Problem

Now, a day's athletics is the most popular game that is practiced in all nations of the world. It's simplicity of the competition and cheaper equipment's make athletics popular all over the world. And also, it is a dynamic sport that needs understanding and solving problems of training to create performance improvement to compete in a frequent changing environment.

Fitness training for most people comprises a workout of continuous exercise at a constant intensity. This type of training is very effective but, to propel yourself to the next level of fitness, you need to incorporate interval training into your fitness training regimen. You will burn more calories, increase your speed, strength, endurance, motivation and overall athletic performance. (BradWalker, 2018).

The various types of interval training can be divided into two categories: short interval training and long interval training. That are so short that oxygen uptake and the pulse (in the rest) does not decrease appreciably before the start of the next work period.

Long interval involves work period from two minutes and up to 10 - 15 minutes, and rest lengths such that work intensity can be maintained approximately constant during each work period. The short interval is very important during the regatta season to keep a good quantity of training in the right area of race velocity, and use of stroke rate valid for competition. Training after the Interval principle will increase or maintain the heart's stroke volume (Increased aerobic capacity).Basic Training Methodology (Thor S. Nilsen, NOR)

Short interval involves work periods up to two minutes and rests Short and long interval training improves performance during tasks that rely mainly on aerobic energy metabolism, in large part by increasing the body's ability to transport and utilize oxygen, and enhancing the capacity for the oxidative metabolism of substrates by working skeletal muscle(Saltin&Gollnick, 1983). While less widely appreciated, high-intensity interval training (HIIT) is a potent stimulus to induce physiological adaptations that resemble, and indeed may be superior to, changes typically associated with traditional endurance training Kubukeli et al., (2002; Ross &Leveritt,(2001). Indeed, highly-trained endurance athletes have long incorporated HIIT as an integral component of training programs designed to maximize performance (Laursen& Jenkins, 2002).

Coaches and trainers often use interval work, during which periods of highintensity effort are alternated with periods of lowintensity effort, to prolong the duration of work at supramaximal intensities and to maximize the biochemical and genetic adaptations that favor performance. Because of this, recovery, in terms of duration and the method used (active or passive), must be managed carefully, given that it can directly influence the metabolic response to the exercise and the chronic physiological adaptations induced by the training. In energy terms, anaerobic performance appears to rely on the muscle's capacity to break down phosphor creatine (PCr) (Hirvonen et al. 1987) and glycogen stocks as rapidly (or for as long) as possible, depending on the intensity and duration of the effort to be produced (Gastin 2001; Glaister 2008; Ward-Smith and Radford 2000).

Numerous scientific studies have investigated methods to promote and maintain a high fraction of VO2max (Billat 2001a, b; Laursen and Jenkins 2002). Their results indicate that intermittent exercises involving >90% VO2max improve aerobic performance levels in previously trained athletes. Interval training consists of alternating high intensity exercises with passive or active recovery periods. Introducing recovery periods between the phases of intense exercise allows athletes to maintain the intensity for longer than when exercise is performed continuously until exhaustion. Thus, the duration and method of recovery (active or passive) significantly affects the bio energetic response during interval training sessions. Many trainers and researchers recommend active recovery between repeated brief, intense efforts to maintain a high VO2max, to promote the return to homeostasis (elimination of lactate ions and protons), and thus to maintain the exercise for longer.(Billat 2001a,b; Laursen and Jenkins 2002).

But the case of Bekoji athletics Training CenterMethodological of short and long interval recovery training which to improve endurance performance of the team failed to show the expected level of the performance progress for some years. To understand the problem of the team the result that the athlete has registered in oromiya athletics championship competition most of the time shows that the team of athletics is not fit for the competition organized at oromiya level. Even though, there are numerous factor affecting performances of the athlete.

The researcher will try to see some effects contributing to the decline of the Bekoji athletics Training Center aerobic performance. These are especially Methodological knowledge of the coach, athletes, oromiyaathletics federation and sport commission relationship, facilities and equipment, motivation and selection criteria of the athlete etc…

Moreover, the purpose of this study is to deal with those problems that exist at Bekoji athletics Training Center in focus is the Methodological of short and long interval training recovery which to improve endurance performance forward possible solutions.

1.3 Research Questions

1. What are athletes' pre-test and post- tests selected variables performance?
2. Is there significant difference between pre-test an post-test performance
3. Do mixed interval training effect on athletes' selected performance

1.4 Objective of the Study

1.4.1 General Objective

The main objective of the study was to investigate the effects of short and long interval training recovery aspects on middle distance endurance running performance Bekojii Athletic training center

1.4.2 Specific Objectives

The specific objective of the study was to:-

1. To assess the athletes selected pre-test and pos-test variables performance
2. To identify the significant difference between pre-test and post-test performance
3. To examine the effect of mixed interval raining recovery on selected variable performance

1.5 Significance of the Study

The significance of the study was stated as follows:

Create understanding and awareness on effect of short and long interval training recovery aspect on endurance performance, It stimulates the interest of individuals to conduct research on the assessment relate issue. Used as reference for further investigations concerning effect of short and long interval recovery training aspect on endurance performance, It provide a hint to the athletics training center community and other concerned bodies, as to find possible solution concerning short and long interval recoverytraining effect on endurance performance and Based on research findings, the study will be expected to give possible recommendation to the training centre manager and technical director

1.6 Delimitation of the study

The scope of the study was delimited more specifically to the Bekoji athletics Training CenterArsi Zone, Oromia Regional state .Even though different type of training has effect on endurance performance to make the study specific and manageable the researcher delimited the area of study on investigate on the effect of short and long interval trainingrecovery aspects onmiddle distance endurance performance.Because of few number endurance athlete trainees, resource, time and other constraints.

1.7. Limitation of the Study

The most serious limitations were lack of reference materials, and other resources, including related researches in our context, lack of facility and equipment. Additionally on this experimental research, the investigator was faced complexity in recording the athlete performance through test.To mention some constraints of time and money were contributed to the inadequacy of the research. However, the investigator was tried all his best to maintain the excellence of this study by putting utmost effort.

1.8 Operational Definition of Terms

The following key terms were used throughout this document and ensure clarity of meanings and usages the terms are defined below:

Athletics: - is a competitive physical activity made up of several separate events, based on the natural movement of running, jumping and throwing. (Webster new world college, 4th Edition)

Interval:-Training with periodic changes between exertion and rest, or between high and low work load.(Thor S. Nilsen (NOR), Ted Daigneault (CAN), Matt Smith (USA)

Performance: - is observable behavior of athletes in playground. (www.world sport .com)

Pre-test: Pre-test is a preliminary test administered to determine performance of students' before training (Brian Mac, 2000).

Post-test: Post-test is an achievement test administered after training (Davis, 2000).

Training: Training is methodological process of upgrading or improving performance (Gerry Carr, 1992).

1.9 Organization of the Study

The study will consist five chapters. The first chapter deals with introduction, background of the study, Statement of the problem, basic research questions, objectives of the study, significance of the study, delimitation of the study, operational definition of terms and organization of the Study. The second chapter contains review of related literature relevant to the research. The third chapter is comprises of research design and methodology and chapter four discussion analysis and interpretation. The last chapter five includes summary, conclusion and recommendation.

CHAPTER TWO

2. Review Literature

2.1 Performance

Athletics performance is the manner in which sport participation is measured. Sport performance is a complex mixture of biomechanical function, emotional factors, and training techniques. Performance in an athletic context has a popular connotation of representing the pursuit of excellence, where an athlete measures his or her performance as a progression toward excellence or achievement. There is an understanding in sport that athletes interested in performance tend to the competitive or elite level; athletes interested in simple participation, for broader purposes such as fitness or weight control, are most often recreational athletes who do not set specific performance goals .(www.world sport .com)

2.2 Training theories and methodologies

The human body is structured in such a way that it maintains relatively stable internal physiological conditions, or homeostasis. Blood volume, hematocrit, arterial pressure and core temperature are among the most important physiological indicators of homeostasis. When this balance is disturbed, the body reacts acutely in an attempt to preserve homeostasis and, if the 'disturbance' continues, it adapts its functions to a higher level. Physical training aims to cause such an imbalance in the body over a period of time, while training theory and methodology deals with the understanding of the cause and optimization of training results. The theoretical background of training originally comes from the work of Dr. Hans Seyle, who first introduced the General Adaptation Syndrome (GAS) theory in 1956. (Tudor Bompa, 1999)

In his model, Seyle suggested that the body responds to stress in three different stages. The first stage, or 'shock stage', is when the source of biological stress is identified by the body, which responds to this change and tries to overcome the imbalance caused by the stressor. As the stressor persists, physical and mental performance is reduced below baseline levels.

In terms of training, this stage refers to the introduction of a training program where the individual experiences soreness, stiffness and tiredness due to the initial 'shock' caused by the exercise. The second stage of the GAS is termed the 'resistance stage' which starts as soon as the stressor is removed. During this stage, the human body recovers from the temporary imbalance and adapts at a higher level of performance to compensate for the increased demands. These two stages are natural responses to the stressor and have positive effects on the body. The third stage is referred to as the ‘exhaustion’ or ‘fatigue’ stage, and can be reached when the stressor is of great longitude or magnitude, and the body does not have sufficient time to adapt. Performance optimization is the result of long term, demanding and well- structured exercise training. (Harre 1982)

For the athlete to gain maximum benefits from exercise, several factors involved in the adaptation mechanism have to be considered. These factors include overload, specificity, individual differences and reversibility. Overload refers to the intensity and duration of the training stimuli. Exercise training has to be sufficient in its intensity and duration to activate the adaptation mechanism and bring about changes in structural, physiological, neural, psycho- logical and endocrine functions. If the training exercise does not stress the body sufficiently, no adaptation occurs. On the other hand a very high stress can lead to injury or over-training; hence, any new increase should be followed by an unloading phase during training theory and methodology (Charles Clinton USA Track and Field Clinician)

Which the body relaxes, adapts and prepares for a new increase in load (Harre 1982). Not every type of exercise is appropriate for all sports. The performed exercise has to be sport-specific and focus on the muscles and organs stressed during the actual competition. Low-intensity strength training, for example, does not prepare the muscle for the demands of competition in which high muscle forces are required, while speed increases should be possible only if training loads are low but with high-velocity muscular actions.

A training program has also to be planned according to the training principle of individuality in order to meet the needs of each athlete. Inter-individual variation in responses to exercise and adaptation rate are partially because of genetic differences. The relative predominance of fast- or slow-twitch motor units in muscles and endocrine factors determine to a great extent the level of adaptation. The com- petition level can also affect individual training programs, particularly in relation to overall length, which may extend from 8 to more than 30 hours per weekly. (Harre 1982)

2.3 Training for Endurance Performance

Training intensity over the years different sports have adopted different definitions and terminology to categorize the various types of training employed within a training program. Much discussion has occurred, and debate still continues, regarding the definition and number of training zones, the terminology used, the physiological markers that should be assessed while monitoring training intensity and the appropriate per iodization of training zones. Wide-reaching review articles (Pate & Branch 1992)

Broadly categorize training associated with endurance performance into three distinct zones: Long slow distance, Moderate-duration, high-intensity training, Short-duration and very high-intensity training.

In addition to the basic training zones, a proportion of an endurance athlete's time will be devoted to strength training and flexibility. The most effective training mode is the intermittent interval training, which results in increased accumulation of lactic acid. Short rest intervals of up to 2 minutes are provided between the activities. This type of training allows the athlete to perform exercise of an increased total duration at an intensity that could not be tolerated for a prolonged period. Anaerobic endurance training (short- duration).(Pate & Branch 1992)

The repetition of short- duration maximal intensity exercise bouts (≤ 15 seconds) with a work: rest ratio in the region of 1:10. This type of training increases the capacity of the ATP-CP energy pathway and enhances muscular power. Anaerobic endurance training (long-duration): The repetition of maximal intensity exercise of 1–3 minutes duration with a work: rest ratio in the region of 1:4. This type of training places significant demands on the anaerobic glycolysis energy system.the endurance program of a trainer must be intense, brief, and generate the type of endurance gains that most functional in performing the training(Hoff and Helgerud, 2002).

2.4 Planned Performance Training

John Amneusetal (1995) describes that, the primary purpose of training is to improve and plan the performance of the athlete. The systematic application of skill instruction, biomechanics, and the principles of training to the development of track and field athletes is planned performance training.

Planned performance training seeks to achieve maximum improvement in performance and structured so that peak performance occurs at predetermined moments within the competitive season. That, after all, is the point of competition. Without such planning, the training of the athletes becomes haphazard and good results become a matter of happenstance rather than planning and prediction. John Amneusetal (1995)

The first requirement of successful planned training is assessment. A coach must evaluate the athletes and their abilities, the level of competition and the time available for training and competition. From this evolution, the objectives and goals for individuals and the team are defined. A set of expectations for the athletes establishes direction and purpose for their efforts. Expectations frame the goals the coach and the athletes will have for the season. At the same time though, goals must be realistic and open ended. Goals that are too grandiose only serve to discourage performance. Goals that do not evolve inhibit the unseen abilities of the athlete. Goals are most often achieved when accompanied by the true expectation of success.

The second element of planned performance training is planning. The coach needs to create an overall plan for training the team and individuals. This plan should apply the fundamental principles of training to the expectations and goals that have been defined. If anything, this basic plan constitutes the foundation upon with the coach creates the structure of competitive success. Coaching without a plan for the season or phase of training is like navigating unfamiliar territory without a map. Too often athletes are kept ignorant of the course of their training. How can they possibly prepare mentally to train with commitment if their coaches do not demonstrate such preparation?

Of course, training must be adapted to circumstance, but without a strategy athletes are unlikely to experience success. Once a plan is made, the construction and execution of the daily, weekly, and cyclic training component becomes the third element of planned performance Principles and methods of Training. This constitutes the body of the training design. The fourth step in the process of planned performance training is evaluation. (John Amneusetal ,1995)

Evaluation is not a final step, but an ongoing process that allows the coach's strategy to adapt to the changing demands of any training situation. Evaluation provides measurement and feedback that allows the coach and athlete to evolve over the course of the season. Sharkey (1986) even stated that sport consisted of about 99% preparation and 1% performance. However, as clarified by Vernacchia, McGuire, and Cook (1992), practice does not necessarily make perfect; because only perfect, planned, purposeful practice makes perfect. Peak performances and lifetime bests seldom occur by chance. Very often, they are the results of careful preparation. Furthermore, training programs must be tailored to fit individual athletes, with their positions (as in team games) or events be taken into consideration. Thus, how to determine the proper training workout for each athlete has become an important concern in this matter. Not surprisingly, many guidelines for conducting training programs have been provided by exercise physiologists (e.g., Astrand & Rodahl, 1986; Fox et al., 1993) who study the acute and long-term effects of training and sport participation on physical responses. The principles of running training are not much different from the more general sport training principles, and several of the more important sport training principles are summarized as below:-

2.5 Principles of training:

Training should be matched to an individual's needs. By using the principles of training as a framework we can plan a personal training program that uses scientific principles to improve performance, skill, game ability and physical fitness.that training program effects on increments of performance efficiency in interval training due to the exercise training.(Edgerton, 1976)

A successful training program will meet individual needs which are personal fitness needs based on age, gender, fitness level and the sport for which we are training. A successful training program will also include exercise in the correct heart-rate target zone. The key principles when planning a program are:

- **Specificity**: Training must be matched to the needs of the sporting activity to improve fitness in the body parts the sport uses.
- **Overload**: Fitness can only be improved by training more than you normally do. You must work hard.
- **Progression**: Start slowly and gradually increase the amount of exercise and keep overloading.
- **Reversibility**: Any adaptation that takes place as a result of training will be reversed when you stop training. If you take a break or don’t train often enough you will lose fitness (L mood Musker Rink. 12th edition).

In planning a program, use the **FITT** principles to add the detail:

- ✓ **Frequency**: Decide how often to train or the number of training sessions either daily or weekly.
- ✓ **Intensity**: Choose how hard to train, or the level of work, energy expenditure or physiological response in relation to the maximum.
- ✓ **Time**: Decide for how long to train or the amount of times spent training per session or per day.
- ✓ **Type**: Decide which methods of training to use.

You should also consider the principle of moderation. It is important to have rest periods which allow the body to adapt. Too much training (overtraining) can lead to injury (Kaye, 1978).

2.6 Sport Specific Combinations of Strength, Speed, and Endurance

Strength, speed, and endurance are the important abilities for successful athletic performance. The dominant ability is the one from which the sport requires a higher contribution; for instance, endurance is the dominant ability in long-distance running. Most sports, however, require peak performance in at least two abilities. In addition, the relationships between strength, speed, and endurance create crucial physical athletic qualities. When athletes and coaches understand these relationships, they can plan effective sport-specific programs for strength training. Here are a few examples. As illustrated in the combination of strength and endurance creates muscular endurance the ability to perform many repetitions against a given resistance for a prolonged period. A different combination, that of maximum strength and maximum speed, results in power the ability to perform an explosive movement Strength Endurance ,Speed Coordination , flexibility ,Muscular endurance ,Speed endurance .Agility ,Mobility ,Power ,Maximum strength ,Anaerobic endurance, Aerobic endurance, Maximum speed, Perfect coordination, Full range of flexibility. Per iodization training for sports in the shortest possible time. Yet another combination that of endurance and speed is called speed endurance the ability to move at speed for an extended time. In a more complex example, the combination of speed, coordination, flexibility, and power produces agility, which is demonstrated, for instance, in gymnastics, wrestling, American football, soccer, volleyball, baseball, boxing, diving, and figure skating. It has to be noted that agility is particularly improved through increases in maximum strength (Schmidtbleicher et al. 2014).

In turn, flexibility the range of motion of a joint is important to training in its own right. Various sports require varying degrees of flexibility to prevent injury and promote optimal performance. The sport-specific phase of specialized training that occurs following the initial years of training, characterized by multilateral training, is crucial for all national-level and elite athletes who aim for precise training effects. Specific exercises during this period allow athletes to adapt to their specializations. For elite athletes, the relationships between strength, speed, and endurance depend on both the sport and the individual athlete’s needs. In each case, when one biomotor ability dominates, the other two do not participate to a similar extent. The general notion of one ability dominating so totally, however, is pure theory and applies to few sports. In the vast majority of sports each ability has a given input. Coaches and athletes can use the figure to determine the dominant biomotor abilities in their sports. Each sport has its own specific physiological profile and characteristics. All coaches who design and implement sport-specific training programs must understand the body's energy systems and how they apply to sport training. Although the purpose of this book is to discuss in specific terms the science, methodology, and objectives of strength training for sports, the physiological complexity of each sport also requires strong understanding of the energy systems dominant in that sport and how they relate to training. The body produces the energy required for neural (strength, power, speed) and metabolic training by breaking down food and converting it into a usable form of fuel known as adenosine triphosphate (ATP). Because ATP has to be constantly replenished and reused, the body relies on three main systems of energy replenishment to facilitate ongoing training: the anaerobic alactic (ATP-CP) system, the anaerobic lactic system, and the aerobic system. The three systems are not independent of each other but collaborate based on the physiological requirements of the sport. Sport-specific program development should always be focused on training the dominant energy system(s) for the chosen sport. Specific development of a biomotor ability must be methodical. In addition, a developed dominant ability directly or indirectly affects the other abilities; the extent to which it does so depends strictly on the resemblance between the methods employed and the specifics of the sport. Therefore, development of a dominant biomotor ability may produce either a positive or (rarely) a negative transfer. For example, when an athlete develops strength, he or she may experience a positive transfer to speed and endurance. On the other hand, a strength training program designed only to develop maximum strength may negatively affect the development of aerobic endurance. Similarly, a training program aimed exclusively at developing aerobic endurance may produce a negative transfer to strength and speed. Because strength is a crucial athletic ability, it always has to be trained with the other abilities. Unfounded and misleading theories have suggested that strength training slows athletes and negatively affects their development of endurance and flexibility. Such theories have been discredited by research (Atha 1984; Dudley and Fleck 1987; Hickson et al. 1988; Micheli 1988; Nelson et al. 1990; Sale et al. 1990). For example, one recent study of cross-country skiers found that maximum strength training alone not only improved the skiers' maximum strength and rate of force development but also produced positive transfer to work economy by increasing the time to exhaustion (Hoff, Gran, and Helgerud 2002).

2.7 Per iodization Training for Sports

Through the combination of endurance training and heavy resistance training (Ronnestad and Mujika2013).Combined strength and endurance training with sport-specific loading parameters does not affect improvement of aerobic power or muscular strength; that is, it produces no negative transfer. Similarly, strength programs pose no risk to flexibility, if stretching routines are integrated into the overall training program. Thus, endurance athletes in sports such as cycling, rowing, cross-country skiing, and canoeing can safely use strength and endurance training concurrently with their other training. For speed sports, in fact, power represents a great source of speed improvement. A fast sprinter is also strong. Muscles that are strong and contract quickly and powerfully enable high acceleration, fast limb movement, and high frequency. In extreme situations, however, maximum loads can affect speed for example, when speed training is scheduled after an exhausting training session with maximum loads. In this case, fatigue both in the nervous system and at the muscular level impedes neural drive and performance. For this reason, macro cycles aimed at developing maximum strength should include acceleration development and sub maximal speed, whereas maximum speed is better developed in conjunction with power. At the training unit level, speed training should always be performed before strength training. Most actions and movements are more complex than previously discussed in this chapter. Thus, strength in sports should be viewed as the mechanism required performing skills and athletic actions. Athletes do not develop strength just for the sake of being strong. The goal of strength development is to meet the specific needs of a given sport to develop specific strength or combinations of strength in order to increase athletic performance to the highest possible level. Combining strength and endurance results in muscular endurance . Sports may require muscular endurance of long, medium, or short duration. Before discussing this topic further, we must briefly clarify two terms: cyclic and acyclic. Cyclic movements are repeated continuously; examples include running, walking, swimming, rowing, skating, cross-country skiing, cycling, and canoeing. For such activities, as soon as one cycle of the motor act is learned, it can be repeated with the same succession, over and over. Acyclic movements, on the other hand, represent a combination of different motor patterns. Examples of acyclic activities include throwing events, gymnastics, wrestling, fencing, and many technical movements in team sports. With the exception of sprinting, cyclic sports are endurance sports, which mean that endurance either is dominant or makes an important contribution to performance in the sport. Acyclic sports, on the other hand, are often power sports. Many sports, however, are more complex and require speed, power, and endurance The elements are discussed here in a clockwise direction, starting with the (strength–endurance) axis. Each strength combination features an arrow pointing to a certain part of the axis between two biomotor abilities.

2.8 Training Methods for the Long Distance Running Events

Long distance running training aims at improving both the anaerobic and aerobic capacities of athletes. The longer the running distance, the more important aerobic capacity with related to performance, and vice versa. Most long distance running training programs include both anaerobic and aerobic running training. Running training that raises the heart rate to about 80% of the athlete's maximal heart rate (HRmax)7 is mainly for the development of aerobic capacity. Running training that raises the athlete's heart rate to 90% of her HRmax or higher aims at anaerobic development. The proportion of anaerobic and aerobic training depends on the athlete's major event. The longer the race distance, the more aerobic running training should be emphasized, and vice versa. Long distance runners usually employ two main types of running training: continuous running training, and interval running training. Besides, repetition running training and fartlek training are also utilized by many long distance runners in their training programs.Continuous Running Training Continuous running training involves running continuously for relatively long distances. Wilt (1968) also classified continuous running training into two categories: continuous slow-running training and continuous fast-running training. (1) Continuous Slow-running Training Continuous slow-running means running for long distances at a slow pace. This type of running is also referred to as LSD (long, slow distance some runners. Generally, athletes should cover from 2 to 5 times of their race distance at a pace that can bring their heart rate to 80 to 85% of the HRmax (Fox, Bowers, & Foss, 1993).

2.9 Developing a Coaching Philosophy

The two most important considerations in developing a personal coaching philosophy are determining coaching objectives and coaching style. Coaching objectives could include improving the program's win/loss record, winning a league title, placing among the top five teams in the section or state championships, showing significant individual and team improvement, making the program fun for all the athletes, or teaching the athletes to compete well (Johan Amneusetal, 1995).

High school coaches often believe their first responsibility is to produce winning teams; however, winning should not be the single measure of success for the coach or the athletes.

An overemphasis on wining can produce such negative responses in young athletes as anxiety, fear of failure, reduced self-esteem and a loss of motivation.

Coaching success should be measured in a variety of ways other than a state ranking, win/loss record, or a high place in the league meet. The number of athletes attracted to the program, the athlete's enthusiasm for track and field, the improvement the team shows through the course of the season and the amount of parental/community/ school interest and support generated for the program are equally important measures of success. (Introduction to coaching, peter J L Thompson)

Winning the majority of the meets during the season does not necessarily make any coach a good leader or positive role model for young athletes. A coach's actions speak louder than words, especially during competition. Coaches must teach respect for the rules, the opponents and the Judgment and integrity of officials by example through their behavior (Johan Amneusetal, 1995).

2.10 Interval Training

Interval training is the ultimate cardiovascular workout. Just by practicing interval training once a week, you will be able to take advantage of a number of benefits, from more effective oxygen intake to a slower heart rate Gray, S. (2011). One of the greatest benefits to interval training is the similarity to regular activities that the average person performs on a daily basis. Most people are not focusing on working at a moderate to high level of intensity for long periods of time through the day. It is natural to take breaks and rest between activities, especially when such activities are so intense. Interval training is an excellent way to prepare your body for the sudden bursts of stress or activity that everyone experienced from time to time.

The body's ability to make use of oxygen can be greatly improved through the practice of interval training. Oxidative capacity is how much oxygen muscles can use during aerobic exercise. If your muscles are not able to pull the oxygen from the blood stream, then it makes no difference if your lungs are working sufficiently.(Gray, S. 2011)

The measure of oxidative capacity is known as VO2 max, which is the maximum amount of oxygen the muscles are able to take from the blood and use. Studies indicate that interval training significantly increases the ability to use oxygen by as much as 100%.The muscle carbohydrate reserves, glycogen, is almost exhausted thorough interval training.

It may seem a little backwards to think that improved fat burning is one of the many benefits of interval training because carbohydrates are used as the main source for fuel. On the contrary, once the glycogen reserves have been exhausted replacement is necessary through the fuel source fat. Hours after you have completed your workout, you will continue to reap the benefits of interval training because your body will use up fat replacing the depleted glycogen. The amount of blood that is pumped throughout the body can be improved in two different ways. First of all, there is the amount of

Blood expelled by the heart. Secondly, heart rate, which is the rate that the heart pumps blood. Research shows that fit individuals have a lower than average resting pulse. Interval training makes the heart stronger, making it possible for more blood to be expelled with each pump. This means that your heart will not have to pump as often, thus reducing your resting heart rate.

2.11 Methods of Conducting Interval Running Training Programs

Classical interval running training was developed in Germany in the 1930s, and the complete workout is fairly tightly structured and monitored by stopwatches (Reilly, 1981). The original form of interval running as conceived by the German coach Gerschler and physiologist Reindall was to repeat a set distance in a set time with a fixed recovery jog between (Watts & Wilson, n.d.). A typical session for a 1500-meter runner with a personal best of 3:40 could be 8 repetitions of 400 meters in 57 to 58 seconds, with a recovery jog of 300 meters covered in 3 minutes (Alford, Holmes, Hill & Wilson, 1985). Based on Fox et al. (1993), when conducting an interval training program, one must decide which energy system or systems is/are to be improved. Then the appropriate type of exercise (e.g., running, in the case of improving running performance) is selected and used during the work interval (i.e., the portion of the interval training program that consists of the high intensity work). The intensity and length of the work interval should be based upon the primary energy system being used in the sport event. For example, sprinters should have short but high-intensity intervals, whereas Marathon runners may run intervals of 3 miles at race pace or slower (Jensen & Fisher, 1979). To determine the proper intensity of the work interval, Fox et al. suggested that the training heart rate should be between 85 and 95% of the HRmax for high-school and college athletes and students. Previous research such as that conducted by Sharkey and Holleman (1967) also supported that there was a need for exertion prompting the heart rates above 150 beats per minute in order to obtain significant training effects. When the relationship between training and recovery becomes imbalanced, symptoms of fatigue develop, followed by decreased performance. This condition is known as overreaching (Meeusen et al. 2006). Overreaching can be classified as either functional or nonfunctional, depending on the duration of the decrease in performance and the severity of the symptoms. In functional overreaching, a rebound and improvement in performance occurs after a few days of full recovery. this is knon as super compensation, and it is sometimes used as a strategy to boost performances in anticipation of an important competitive event (Halson and Jeukendrup 2004).

the super compensation principle may be described as a planned breakdown as a result of sustained training, followed by recovery and enhanced performances (Kentta and Hassmen 1998).

Sharkey (1986), based on previous studies, stated that approximately equal work and rest intervals between 2 to 5 minutes seemed to produce the greatest aerobic improvements. In addition, shorter work intervals (e.g., 15 seconds) with a work-rest ratio of 1:1 are also effective in developing the aerobic system. For anaerobic training, the maximum duration for any work interval should not exceed 90 seconds, or the body might switch to the aerobic system to support the ongoing activity. Moreover, investigation conducted by Gaiga and Docherty (1995) indicated that aerobic interval training program might even enhance performance in repeated high intensity, short duration work. For most interval training sessions, Fox et al. (1993) recommended that the number of repetitions of the work interval should provide a total working distance of between 1.5 and 2 miles to achieve maximum improvement. With longer work intervals (e.g., 800 yards and over), usually a 1:1 or 1:1.5 work-rest ratio is prescribed; with moderate duration intervals (e.g., 400 to 600 yards), a 1:2 work-rest ratio is used; and with shorter work intervals, a 1:3 work-rest ratio is prescribed. More recently, Babineau and Leger (1997) also showed that aerobic interval running using either 400, 800, or 1600 meters as the working distance with a work-rest ratio of 5:1 was also a good simulator and indicator of endurance performance (at least true for the 5000-meter time trial in their study). Besides, the 5:1 work-rest ratio made the training more intense and reduced the total training time when compared to the traditional intermittent training ratio of 1:1 or 1:1.5 finally, active recovery rather than passive recovery. Recovery during the rest intervals is preferred because most studies indicated that subsequent performance was enhanced when low-intensity exercise instead of complete rest was performed during the rest intervals (Bogdanis, Nevill, Lakomy, Graham & Louis 1996; Signorile, Ingalls & Tremblay, 1993).

2.12 High Intensity Interval Training

The role of high intensity interval training as opposed to, or in conjunction with more traditional methods of developing endurance is an area of interest for many researchers in individual as well as team sports (Billat, 2001, Franch, Madsen, Djurhuus& Pedersen, 1998). This interest may be due to the limitation in simply increasing training volume, such as distance covered, on athletes who already have a high training load. Taking account the overabundance of training needs to athletics. High Intensity Interval Training (HIIT) warrants investigation for improving aerobic power in a time efficient manner. (Billat, 2001) . Performance in many athletic activities depends on the athlete’s capacity to reconstitute the energy required for the organic functions used during the exercise, in the form of a molecule known as adenosine triphosphate (ATP) Depending on the duration of the exercise, its intensity, and its continuous or intermittent nature, performance depends on the contribution of the athlete's anaerobic and aerobic pathways(Knicker et al. 2011).

2.13 Active Recovery

Active recovery consists of maintaining sub maximal work after fatiguing exercise with the aim of preserving performance level between events. This is supposed to enhance the recovery mechanisms at the energetic, muscular, and psychological levels. Active recovery can be planned at different times, either as part of a training session or during the cool-down phase. In this case, it generally precedes other recovery methods, such as stretching or massage. It is also possible to include active recovery during the days following an intense training session or competition. This chapter addresses active recovery through this temporal prism, examining its efficacy and how it is applied in relation to the available scientific data. Thus, the duration and method of recovery (active or passive) significantly affects the bioenergetics response during interval training sessions. Many trainers and researchers recommend active recovery between repeated brief, intense efforts to maintain a high VO2max, to promote the returnto homeostasis (elimination of lactate ions and protons), and thus to maintain the exercise for longer. This hypothesis was validated with a recovery period of at least 30 s (Dorado, Sanchis-Moysi, and Calbet 2004; Thevenet et al. 2007). Babineau and Leger (1997) also showed that aerobic interval running using either 400, 800, or 1600 meters as the working distance with a work-rest ratio of 5:1 was also a good simulator and indicator of endurance performance (at least true for the 5000-meter time trial in their study). Besides, the 5:1 work-rest ratio made the training more intense and reduced the total training time when compared to the traditional intermittent training ratio of 1:1 or 1:1.5. Finally, active recovery rather than passive recovery. Recovery during the rest intervals is preferred because most studies indicated that subsequent performance was enhanced when low-intensity exercise instead of complete rest was performed during the rest intervals (Bogdanis, Nevill, Lakomy, Graham & Louis 1996; Signorile, Ingalls & Tremblay, 1993

2.14 Recovery Methods and Interval Work

Performance in many athletic activities depends on the athlete's capacity to reconstitute the energy required for the organic functions used during the exercise, in the form of a molecule known as adenosine triphosphate (ATP) (Knicker et al. 2011). Depending on the duration of the exercise, its intensity, and its continuous or intermittent nature, performance depends on the contribution of the athlete's anaerobic and aerobic pathways (Gastin 2001). For example, brief, high-intensity activities, such as sprinting, mainly involve anaerobic metabolism, while long-distance races rely more on aerobic contribution. Depending on the pace variations imposed by the activity, many disciplines involve mixed energy sources, which activate both the anaerobic and aerobic resynthesis pathways to significant levels (Gastin 2001). An example is in team sports where decisive, repeated sprints are separated by periods of less-intense activity (Carling et al. 2008; Gray and Jenkins 2010). Improvements in anaerobic and aerobic resynthesis capacities are closely linked to the development of some physical athletic qualities, such as speed, endurance, or the capacity to repeat high intensity efforts. Many methods are used to do this, often relying on the overload principle. According to this principle, the athlete must repeatedly perform at almost maximal level to induce the appropriate physiological adaptations that promote improved physical performance levels (Issurin 2010; Laursen 2010). Coaches and trainers often use interval work, during which periods of high intensity effort are alternated with periods of low intensity effort, to prolong the duration of work at supra maximal intensities and to maximize the biochemical and genetic adaptations that favour performance. Because of this, recovery, in terms of duration and the method used (active or passive), must be managed carefully, given that it can directly influence the metabolic response to the exercise and the chronic physiological adaptations induced by the training. In energy terms, anaerobic performance appears to rely on the muscle's capacity to break down phosphor creatine (PCr) (Hirvonen et al. 1987) and glycogen stocks as rapidly (or for as long) as possible, depending on the intensity and duration of the effort to be produced (Christophe hausswirth, 1995,Gastin 2001; Glaister 2008; Ward-Smith and Radford 2000). These metabolic adaptations are linked to increases in the activity of key enzymes involved in energy-resynthesis mechanisms, increases in endogenous stores of intramuscular substrates, and increases in the muscle's ability to prevent the accumulation of metabolites linked to fatigue (Ross and Leveritt 2001). The training methods used to induce these adaptive mechanisms are heterogeneous, but they generally consist of repeating short or long sprints while manipulating the type and duration of recovery between repetitions (Ross and Leveritt 2001). This type of protocol has been used successfully to improve performance levels and to induce positive adaptations of anaerobic metabolism (Cadefau et al. 1990; Dawson et al. 1998; Harridge et al. 1998; Linossier et al. 1993; McKenna et al. 1993; Nevill et al. 1989; Ortenblad et al. 2000), although some studies found no significant effect (Allemeier et al. 1994; Jacobs et al. 1987).

2.15 Training and Recovery

When the relationship between training and recovery becomes imbalanced, symptoms of fatigue develop, followed by decreased performance. This condition is known as overreaching (Meeusen et al. 2006). Overreaching can be classified as either functional or nonfunctional, depending on the duration of the decrease in performance and the severity of the symptoms. In functional overreaching, a rebound and improvement in performance occurs after a few days of full recovery (see chapter 2). this is known as super compensation, and it is sometimes used as a strategy to boost performances in anticipation of an important competitive event (Halson and Jeukendrup 2004). the super compensation principle may be described as a planned breakdown as a result of sustained training, followed by recovery and enhanced performances (Kentta and Hassmen 1998). Nonfunctional overreaching is a more severe condition, with decreased performance lasting for weeks or months (Meeusen et al. 2006). as shown in figure 1.1, the disturbance in homeostasis is reduced after athletes stop the exercise. Various biological systems require different time periods for recovery. this seemingly passive period is important for the subsequent

adaptations. Consider, for example, that the mrNa expression of several oxidative enzymes is upregulated 24 h after the bout of exercise (Leick et al. 2010). this suggests that an important action associated with training-induced adaptations occurs long after the acute effects of the bout of exercise have subsided. Inadequate recovery between training sessions will result in adaptations, with the accompanying symptoms of fatigue and impaired muscle function. Insufficient recovery prevents athletes from training at the required intensity or completing the required load at the next training session. to enhance the recovery process, athletes often undertake proactive recovery strategies after training, such as massage, cryotherapy, immersion in water of contrasting temperatures, compression, and stretching (Barnett 2006). these sessions shift the stress–recovery balance in favor of the recovery processes. a purported consequence of this is that athletes can tolerate higher training volumes. the positive effects of the training load may also be enhanced (see part III).

2.16 Maximal Aerobic Speed Training

Maximal Aerobic Speed (MAS) training should be considered as a method of increasing or maintaining aerobic performance for athletics. Specifically, MAS training involves training at intensity near to, equivalent to, or higher than the speed attained when the participant reached VO2max Midgley& McNaughton, (2006). A number of different methods exist to determine

VO2max which can be used to determine MAS. These may include both field & laboratory tests. Although laboratory tests using gas analysis is generally considered a gold standard for determining VO2max, certain field tests have been shown to be effective at estimating VO2max indirectly. MAS can be estimated as the last complete speed achieved in an indirect VO2max test. Berthoin et al (1996).

The intensity of MAS generally approaches volitional fatigue. It has been suggested that training at intensities greater than 90% of VO2max can elicit the greatest gains in aerobic power .Wenger & Bell (1986).

The greater the time spent training at or around VO2max, the greater the adaptation and improvement in aerobic power (Tabata, Nishimura, Kouzaki, Hirai, Ogita, Miyachi& Yamamoto, 1996) of the research on MAS training has varying results. A supra-maximal interval training session was compared with regular endurance training methods to ascertain the effect on anaerobic capacity and aerobic power. Both training regimens resulted in significant and similar increases in VO2max. The intensity of the regimen required athletes to perform at an intensity that equated to their VO2max, which, in turn, elicited a training effect and increased VO2max significantly.

Earlier research showed that 120% of MAS in short intervals elicited the longest performance a VO2max. Dupont et al,(2003). This protocol lead to improvements in the velocity achieved at VO2max. Interestingly, this study was conducted during the season. Improvement in team performances were observed during the course of the study. In addition, other physiological needs, such as speed and leg power were maintained during the study. This shows that physical characteristics such as aerobic power and MAS can be improved during the season without any decreased in performance or other physiological areas of importance.

In partial contrast, a study compared long interval training and shorter high intensity interval training (16.5 km/h, 4 to 6 x 4 minutes with 2 minutes recovery) and shorter intervals (20.4 km/h, 30 to 40 x 15 seconds with 15 seconds of recovery) .Franch et al ,(1998). All two regimens lead to improved aerobic power. However, long interval training groups improved significantly more than the shorter higher intensity training group.

2.17 Performance Evaluation Tests

Performance is an assessment of how well a task is executed and the success of a training program is largely dependent upon satisfying the performance aims associated with it. (http://www.brianmac.co.uk/eval.htm)

2.17.1How can performance be monitored

Testing and measurement are the means of collecting information upon which subsequent performance evaluations and decisions are made.

2.17.2 What is the evaluation process

The whole measurement/evaluation process is a six stage, cyclic affair, involving:

The selection of characteristics to be measured, the selection of a suitable method of measuring, the collection of that data, The analysis of the collected data

The making of decisions and The implementation of those decisions All of the above stages should be completed with the athlete - especially the analysis of the collected data and making decision of an appropriate way forward.

2.17.3 What are the requirements of a test

In constructing tests it is important to make sure that they really measure the factors required to be tested, and are thus objective rather than subjective.

In doing so all tests should therefore be specific (designed to assess an athlete's fitness for the activity in question), valid (the degree to which the test actually measures what it claims to measure), reliable (capable of consistent repetition) and objective (produce a consistent result irrespective of the tester).

In conducting tests the following points should be considered:

Each test should measure ONE factor only, The test should not require any technical competence on the part of the athlete (unless it is being used to assess technique) ,Care should be taken to make sure that the athlete understands exactly what is required of him/her, what is being measured and why and The test procedure should be strictly standardized in terms of administration, organization and environmental conditions

2.17.4 What are the benefits of testing

The results from tests can be used to:

Predict future performance, indicate weaknesses, measure improvement, enable the coach to assess the success of his training program, place the athlete in appropriate training group

And motivate the athlete

Tests additionally break up and add variety to the training program. They can be used to satisfy the athlete's competitive urge out of season. Maximal test demand maximum effort of the athlete so they are useful at times as a training unit in their own right.

2.17.5 What factors may influence test results

The following factors may have an impact on the results of a test (test reliability):

The ambient temperature, noise level and humidity ,The amount of sleep the athlete had prior to testing, The athlete's emotional state ,Medication the athlete may be taking ,The time of day ,The athlete's caffeine intake, The time since the athlete's last meal ,The test environment - surface (track, grass, road, gym) ,The athlete's prior test knowledge/experience ,Accuracy of measurements (times, distances etc.) ,Is the athlete actually applying maximum effort in maximal tests ,Inappropriate warm up ,People present ,The personality, knowledge and skill of the tester ,Athlete's clothing/shoes ,Surface on which the test is conducted and Environmental conditions - wind, rain, etc.

2.17.6 What should be recorded

The information to be recorded falls into two broad categories: -

- The day-to-day information from training

State of the athlete (health, composure) ,Physiological data (body weight, resting heart rate, etc.) ,The training unit (speed, speed endurance, strength, technique) ,The training load (the number of miles, the number of sets and repetitions, the number of attempts) ,The training intensity (kilograms, percentage of maximum, percentage of VO_2) ,The prevailing conditions (wet, windy, hot etc.)

And the response to training the assignments completed, the resultant heart rate recovery, felt tired, etc.Information that measures status this can take the form of a test. If the test is repeated throughout the program, it can then be used as a measure of progress within the training discipline. Examples of such tests are:

Time trials - speed, speed endurance, endurance Explosive strength - power bounding, vertical jump, overhead shot put and Event specific

2.17.7 How can we make tests more reliable and valid

Use competent and well trained testers ,Equipment should be standardized and calibrated regularly ,Each test should measure only one factor ,Care should be taken to make sure the athlete understands exactly what is required of them ,The test procedure should be standardized in terms of administration, organization and environmental conditions ,The test should be designed so that it can easily be repeated by another trained tester and The test should be fully documented so that it can be administered in exactly the same way the next time it is conducted

2.18 VO_2 max

Fitness can be measured by the volume of oxygen you can consume while exercising at your maximum capacity. VO_2 max is the maximum amount of oxygen in milliliters, one can use in one minute per kilogram of body weight. Those who are fit have higher VO_2 max values and can exercise more intensely than those who are not as well conditioned. Numerous studies show that you can increase your VO_2 max by working out at an intensity that raises your heart rate to between 65 and 85% of its maximum for at least 20 minutes three to five times a week. A mean value of VO_2 max for male athletes is about 3.5 liters/minute and for female athletes it is about 2.7 liters/minute.(http://www.brianmac.co.uk/VO2max.htm) Recovery Methods and Development of Aerobic V O2max represents the highest level of oxygen consumption that someone can achieve when exercising at sea level. This parameter is identified as a determinant for performance in endurance activities. Thus, a high VO2max is required to reach a higher level of performance in aerobic sports (Joyner and Coyle 2008). Numerous scientific studies have investigated methods to promote and maintain a high fraction of VO2max (Billat 2001a, b; Laursen and Jenkins 2002). Their results indicate that intermittent exercises involving >90% VO2max improve aerobic performance levels in previously trained athletes. Interval training consists of alternating high intensity exercises with passive or active recovery periods.).

2.18.1Factors affecting VO_2 max

The physical limitations that restrict the rate at which energy can be released aerobically are dependent upon: The chemical ability of the muscular cellular tissue system to use oxygen in breaking down fuels and the combined ability of cardiovascular and pulmonary systems to transport the oxygen to the muscular tissue system

There are various physiological factors that combine to determine VO_2 max for which there are two theories: Utilization Theory and Presentation Theory.

Utilization theory maintains that VO_2 max is determined by the body's ability to utilize the available oxygen whereas Presentation Theory maintains it is the ability of the body's cardiovascular system to deliver oxygen to active tissues.

A study by Saltin and Rowell (1980) concluded that it is the delivery of oxygen to active tissues that is the major limiting factor to VO_2 max. A study by Gollnick et al. (1972) showed a weak relationship between the body's ability to utilize the available oxygen and VO_2 max.

2.18.2 VO_2 max and age

As we get older our VO_2 max decreases. A study by Jackson et al. (1995) found the average decrease was 0.46 ml/kg/min per year for men (1.2%) and 0.54 ml/kg/min for women (1.7%). The decline is due to a number of factors including a reduction in maximum heart rate and maximum stoke volume.

2.18.3 VO_2 max and performance

VO_2 max on its own is a poor predictor of performance but using the velocity (vVO_2 max) and duration ($tlimvVO_2$ max) that an athlete can operate at their VO_2 max will provide a better indication of performance.

- Cooper VO_2 max test - suitable for endurance sports

2.18.4 VO_2 max - using HR_{max} and HR_{rest}

Research by Uth et al. (2004) found that VO_2 max can be estimated indirectly from an individual's maximum heart rate (HR_{max}) and resting heart rate (HR_{rest}) with an accuracy that compares favorably with other common VO_2 max tests. It is given by:

- VO_2 max = 15 x ($HR_{max} \div HR_{rest}$)

2.18.5 The effect of altitude

VO_2max decreases as altitude increases above 1600m and for every 1000m above 1600m maximal oxygen uptake decreases by approximately 8-11%. The decrease is mainly due to a decrease in maximal cardiac output (product of heart rate and stroke volume). Stoke volume decreases due to the immediate decrease in blood plasma volume.

2.18.6 VO_2max Assessment

Table 1, normative data (Heywood 1998) for Female (values in ml/kg/min)

Age	Very Poor	Poor	Fair	Good	Excellent	Superior
13-19	<25	25 – 30	31 – 34	35 – 38	39 – 41	>41

Table 2, normative data (Heywood 1998)for Male (values in ml/kg/min)

Age	Very Poor	Poor	Fair	Good	Excellent	Superior
13-19	<35	35 – 37	38 – 44	45 – 50	51 – 55	>55

2.18.7% HR_{max} and %VO_2 max

It is possible to estimate your exercise intensity as a percentage of VO_2 max from your training heart rate. A study by David Swain et al. (1994) using statistical procedures examined the relationship between % HR_{max} and %VO_2 max. Their results led to the following regression equation:

- $\%HR_{max} = 0.64 \times \%VO_2\ max + 37$

The relationship has been shown to hold true across sex, age and activity.

2.19 Normative data and Evaluation Tests

Testing and measurement are the means of collecting information upon which subsequent performance evaluations and decisions are made. Where normative data (average test results) is available, it is included on the appropriate evaluation test pages which are identified below.

2.19.1 Cooper VO_2 max Test

Objective of the Cooper Test (Cooper 1968) is used to monitor the development of the athlete's aerobic endurance and to obtain an estimate of their VO_2 max.

Assessment:-

The following normative data, Cooper (1968), is available for this test:

Table 3, Male Athletes normative data Cooper test

Age	Excellent	Above Average	Average	Below Average	Poor
13-14	>2700m	2400-2700m	2200-2399m	2100-2199m	<2100m
15-16	>2800m	2500-2800m	2300-2499m	2200-2299m	<2200m
17-19	>3000m	2700-3000m	2500-2699m	2300-2499m	<2300m

Table 4, Female Athletes normative data Cooper test

Age	Excellent	Above Average	Average	Below Average	Poor
13-14	>2000m	1900-2000m	1600-1899m	1500-1599m	<1500m
15-16	>2100m	2000-2100m	1700-1999m	1600-1699m	<1600m
17-20	>2300m	2100-2300m	1800-2099m	1700-1799m	<1700m

VO_2max-An estimate of your VO_2 max can be calculated as follows:

- (Distance covered in meters - 504.9) ÷ 44

2.19.2The 2.4km Run Test

The objective of this test is to monitor the development of the athlete's aerobic endurance.

Required resources

To undertake this test you will require: 400metre track, Stop watch and Assistant.

How to conduct the test the test is conducted as follows: Athlete to complete a 10 minute warm up , Athlete to run 2.4 km (6 laps of a 400m track) as fast as possible ,Assistant to keep athlete informed of the number of laps remaining to complete the test and Assistant to record the time taken for the athlete to run 2.4km.

Analysis

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

2.19.3BMI and normative data

Body Mass Index (BMI) is a simple index of weight-for-height that is commonly used to classify underweight, overweight and obesity in adults. It is defined as the weight in kilograms divided by the square of the height in meters (kg/m^2). For example, an adult who weighs 70kg and whose height is 1.75m will have a BMI of 20.

BMI = 70 kg / ($1.75\ m^2$) = 70 / 3.5= 20

Table 7: The International Classification of adult underweight, overweight and obesity according to BMI

Classification	BMI(kg/m^2)	
	Principal cut-off points	Additional cut-off points
Underweight	<18.50	<18.50
Severe thinness	<16.00	<16.00
Moderate thinness	16.00 - 16.99	16.00 - 16.99
Mild thinness	17.00 - 18.49	17.00 - 18.49
Normal range	18.50 - 24.99	18.50 - 22.99
		23.00 - 24.99
Overweight	≥25.00	≥25.00
Pre-obese	25.00 - 29.99	25.00 - 27.49
		27.50 - 29.99

Obese	≥30.00	≥30.00
Obese class I	30.00 - 34.99	30.00 - 32.49
		32.50 - 34.99
Obese class II	35.00 - 39.99	35.00 - 37.49
		37.50 - 39.99
Obese class III	≥40.00	≥40.00

Source: Adapted from WHO, 2004.

CHAPTER THREE

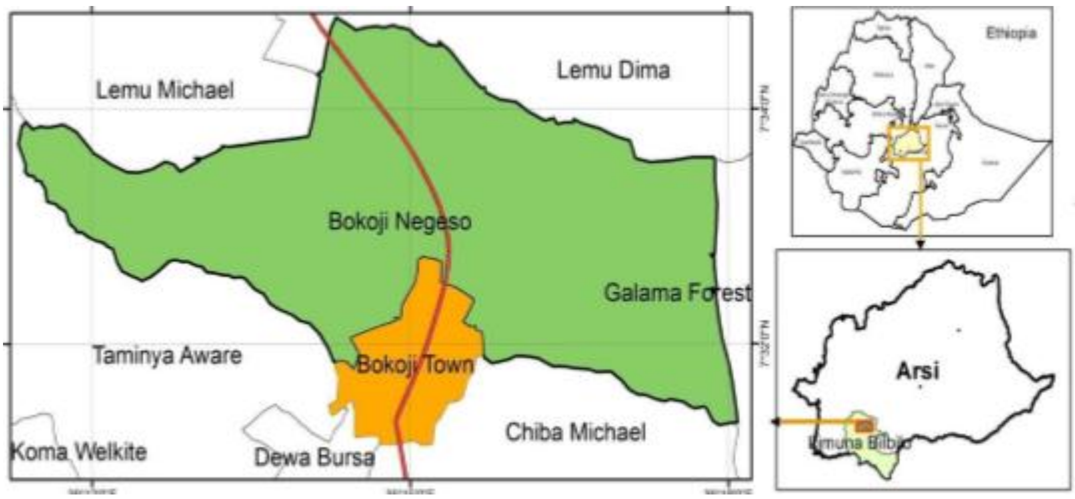
3. RESEARCH METHODOLOGY

3.1 Research Design

Longitudinal Quasi experimental method would be used since the aim of the research is up to describing over several time-periods on the existing condition of the issues under investigation. I.e. Effects of short interval training recovery and long interval training recovery aspect on middle distance endurance running performanceBokeji athletics training center**.**

3.2 Description of the study area

The survey was conducted in Bekoji Athletics training center district located in Arsi zone, Oromia Regional State of Ethiopia. Bekoji Athletics training center district was located about 224 km South-East of the capital Addis Ababa on the highway towards Bale zone. The altitude of the area was 2800 m above sea level.



BokojiNegesoKebele

Surrounding Kebele

Bokoji Town

Map of the study area. Source: GIS source of Ethiopian Institute of Agricultural Research (EIAR)

3. 3 Sources of Data

The primary information was obtained from athletetraining result athletes, where as secondary source obtained from relevant source such as internet, books and journals.

3.4 Study population

The intended populations in the proposed research were Athlete who were currently trained in Bekoji Athletics training center and The sampling method to be employed for selecting Athlete would be census because all the population are selected for the proposed study .The sample size would be 20 Athlete. It was sampling to select athletes and to collect the necessary data

3.5 Sample size and Sampling Techniques

For the specific research the total population of the study 20 athlete. Whereas the following sample would be select. It is non-probabilitysampling.Purposive sampling techniques would be employ because of directly concerned with the issues under discussion and also because of they are few in number all of them are included in the study. In its totality 20 subjects was participate to conduct the assessment.

3.6 Data collecting instrument

The data collection instruments would be Endurance Performance assessment method CooperTest, Vo2max, The 2.4km run test and Anthropometric assessment method, Weight, Height, BodyMass Index. Which are selected as data collection instrument by the researcher because it would be preferable to show the extent of identifying the middle distance endurance performance in the target study.

3.7 Method of data collection

Data collections in conducting the current study, the following relevant procedures were used. Prior contacts were made with respondent to ensure willingness to participate in the study.Before giving training for middle distance athlete endurance performance assessment the purpose of the Cooper Test,Vo2max, 2.4km and Anthropometric Height , Weight, Body Mass Index would be told to the Athlete after setting into class safely. After informing the purpose of the study the researchers would start the training and after giving training for athlete data were collected using the appropriate physical fitness Variables.

3.8 Method of Data Analysis

Longitudinalquasi-experimental study, quantitative data analysis was used. Athletes' selected pre-test and post –test performance was analyzed by mean and standard deviation, athletes' significance difference during pre-test and post-test was analyzed by paired t-test .Level of significance was < 0.05%.T-test was employed to check whether there exists any significant difference between the mean scores of the study with respect to their post-test results and effect of mixed training interval was done using multiple regression model.

3.9. Ethical Consideration

Regrind ethical consideration the researcher was governed by the researcher code of ethical in maintaining prefacing and confidential and or other related values and the researching promise to the study that the information which was collected from the respondent shall not be transferred to third part in candid or it would not be exploited for under taking other than the research studyBesides this the proceeding of data collection was done anonymously without writing their name identification number, telephone number .so that the threat of beings disclosed was very much minimized.

CHAPTER FOUR

4. DISCUSSION, ANALYSIS AND INTERPRETATION OF THE DATA

This part of the study deals with the discussion, analysis and interpretation of data gathered on athletes' performance through the mixed interval training recovery short term and long term has been analyzed and presented in this chapter. The purpose of the study was to examine effect of short and long interval training recovery endurance running performance of athletes. The variables selected for the study were endurance assessment (i.e. cooper test, Vo2 max, 2.4km run) and anthropometric assessment (i.e. height, weight, body mass index) performance of selected athletes was from Bekoji athletics training canter athletes. The participation rate was 100%, i.e. there was no dropout due to physical or some healthy related problem.

4.1 Demographic characteristics of the sample of athlete

Table: 4.1. Frequency graph age of athlete.

Age	Frequency	Percent	Valid Percent	Cumulative Percent
14-15	13	65.0	65.0	65.0
16-17	7	35.0	35.0	100.0
Total	20	100.0	100.0	

The age of shortand long interval training recovery athlete group 13(65%) was found between 14-15where as 7 (35%) found between16-17.so we can conclude easily majority of athlete were young they can perform activity effectively.

Table: 4.2 Frequency graph for sex profile of athlete

Sex	Frequency	Percent	Valid Percent	Cumulative Percent
Male	12	60.0	60.0	60.0
Female	8	40.0	40.0	100.0
Total	20	100.0	100.0	

The shortand long interval training recovery group was included 12(60%) male athletes and 8 (40%)female athletes so as the above table indicated the number of male participated greater than the female participation.

Table.4.3 Frequency table for training age profile athlete.

Training Age	Frequency	Percent	Valid Percent	Cumulative Percent
1-2	14	70.0	70.0	70.0
3-4	6	30.0	30.0	100.0
Total	20	100.0	100.0	

Concerning the training age of athlete14 (70%) of athlete found betwen1-2year, 6(30%) of athlete training age found between 3-4year.so from the above table the researcher can summarize the training year majority of athlete were found between 1-2year.

Table.4.4Descriptive Statistics

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Sex	20	1.00	2.00	1.40	.50
Age	20	1.00	2.00	1.35	.48
Training Age	20	1.00	2.00	1.30	.47
Grade Of Athlete	20	1.00	3.00	2.10	.78

4.2 To Assess the Athletes Selected Pre-Test and Pos-Test Variables Performance

Table4.5 Athlete'sendurance status of cooper test performance for short and long interval training recovery.

No	Endurance assessment Item	Mean	Std. Deviation
1	Pre Cooper Test for short Interval training recovery	3035.60m	478.71m
	Post Cooper Test for Short Interval training recovery	3072.40m	488.01m
	Difference	37m	9.3m
2	Pre Cooper Test for Long Interval training recovery	3200.70m	410.24m
	Post Cooper Test for Long Interval training recovery	3204.00m	409.89m
	Difference	3.3m	0.35m

As can be seen from table 4.5, above item 1,Pre Cooper Test for short Interval training recovery endurance running performance of athletes had showed with total mean value of 3035.60 and Std. Deviation Value 478.71 relative to their performance observed after the short interval training recovery were givenwith total mean score 3072.40m and Std. Deviation Value 488.01m as the above table analysed data indicated.Therefore, the mean and Std. Deviation post-test performance of ten athletes was significantly different from that of pre-test. In the light this (Cooper 1968) Objective of the Cooper Test is used to monitor the development of the athlete's aerobic endurance and to obtain an estimate of their VO_2 max Thus, the value of post mean and standard deviation show probability of statistical significant differences.After Short interval recovery training was given the investigator was observed that, athletes' were good improved endurance running performance. The rationale behind the improvement in Short interval training recovery was due to the exercise, which they took in the training schedule.This test result indicated that giving appropriate training for the trainers was highly important to improve or develop their performance in endurances. Physical training aims to cause such an imbalance in the body over a period of time, while training theory and methodology deals with the understanding of the cause and optimization of training results.

The theoretical background of training originally comes from the work of Dr. Hans Seyle, who first introduced the General Adaptation Syndrome (GAS) theory in 1956. (Tudor Bompa, 1999)

In table 4.5 items 2Pre Cooper Test for Long Interval training recovery the total mean result of all athletes' during pre-test was 3200.70 and 3204.00 at post-test. The total Std. Deviation result of all athletes' during pre-test was 410.24 and 409.89 at post-test.After longinterval training recovery was given lessimprovementendurance running performance.Additionally the result of post short interval training recovery and long interval training recovery revealed that short interval training recover has high effect than long interval training recover to improve athlete endurance running performance as the value indicated.In partial contrast, a study compared long interval training and shorter high intensity interval training.Franch et al, (1998). All two regimens lead to improved aerobic power. However, long interval training groups improved significantly more than the shorter higher intensity training group.

Table 4.6Athletes' Short and long t Interval Recovery endurance status of VO2max test performance

No	Endurance assessment Item	Mean	Std. Deviation
1	Pre-Test Vo2max For Short Interval Recovery	56.58ml/kg/min	10.67ml/kg/min
	Post Test Vo2max For Short Interval Recovery	57.39ml/kg/min	10.91ml/kg/min
	Difference	0.81ml/kg/min	0.24ml/kg/min
2	Pre-Test Vo2max For Long	60.22ml/kg/min	9.13ml/kg/min
	Post Test Vo2max For Long	60.34ml/kg/min	9.16ml/kg/min
	Difference	0.02ml/kg/min	0.03ml/kg/min

As seen from table 4.6 above item 1 Pre-test Vo2 max for short interval training recovery the total mean result of all athletes' during pre-test was 56.58 and 57.39 at post-test. The total Std. Deviation result of all athletes' during pre-test was 10.67 and 10.91 at post-test, which revealed that there was very good performance improvement Vo2max endurance. Therefore, the mean and Sts. Deviation (average) post-test performance of ten athletes was significantly different from that of pre-test. Numerous studies show that you can increase your VO_2 max by working out at an intensity that raises your heart rate to between 65 and 85% of its maximumfor at least 20 minutes three to five times week.(http://www.brianmac.co.uk/VO2max.htm).After 8week short interval recovery training was given the investigator was continuously observed that, athletes were improved and developed progression of their endurance running performance. From this result it was possible to concluded, that training program had positive effects on increments performance efficiency in Vo2max endurance performance due to the exercise training.

As depicted above in table4.6 item 2 pre-test Vo2max for long interval training recovery the total mean result of all athletes during pre-test were 60.22and 60.34 at post-test. The total Std. Deviation result of all athletes ‘during pre-test were 9.13 and 9.16at post-test, which revealed that there was improvement Vo2max endurance running performance.After 8 week long interval training recovery was given the investigator was continuously observed that, athletes were less improvement of their endurance running performance when compared with value reveal on short interval training recovery to improve athlete endurance running performance. In partial contrast, a study compared long interval training and short interval training recovery all two regimens lead to improved athlete endurance running performance. However, short interval training groups improved significantly more than the long interval training recovery group.

So one can easily understand from the above table short interval training more effective for athlete endurance running performance development than long interval training recovery Intensity exercises with passive or active recovery periods. Introducing recovery periods between the phases of intense exercise allows athletes to maintain the intensity for longer than when exercise is performed continuously until exhaustion. Thus, the duration and method of recovery (active or passive) significantly affects the bioenergetics response during interval training sessions. Many trainers and researchers recommend active recovery between repeated brief, intense efforts to maintain a high VO2max, to promote the returnto homeostasis (elimination of lactate ions and protons), and thus to maintain the exercise for longer. (Dorado, Sanchis-Moysi, and Calbet 2004; Thevenet et al. 2007).

Table 4.7: Sampled athletes' Short and long Interval Recovery endurance status of 2.4km run test performance

No	Endurance assessment Item	Mean	Std. Deviation
1	Pre-test 2.4km Run for short Interval Recovery	00:08':94"	00:01':18"
	Post test 2.4km run for short interval recovery	00:08':78"	00:01':20"
2	Pre-Test 2.4km Run For Long Interval training Recovery	00:08':64"	00:00':88"
	Post Test 2.4km Run For Long interval training recovery	00:08':57"	00:00':80"

As we can see from the above table 4.7 item 1 Pre-test 2.4km run for short interval training recovery performance results of individual athletes.The total means value of 00:08.94 during pre-test and with mean value 00:08.78 after the post-test. The total Std. Deviation result of all athletes' during pre-test was 00:01.18 and 00:01.20 after the post-test.Therefore mean and standard deviation result indicates that there was statistically significant difference between the pre and post. . After short interval recovery training exercises were given the investigator was continuously observed that, athletes were show significant endurance running performance development. The test results were clearly showing that short interval recovery training would have great effect on their endurance performance development

As shown above in table 4.7 item 2 long interval training recovery 2.4km run pre-test and post-test performance results of athletes. The total means value of 00:08.64 during pre-test and with mean value 00:08.57 after the post-test. The total Std. Deviation result of all athletes' during pre-test was 00:00.88 and 00:00.80 after the post-test in the light of this:- In addition, shorter work intervals (e.g., 15 seconds) with a work-rest ratio of 1:1 are also effective in developing the aerobic system. For anaerobic training, the maximum duration for any work interval should not exceed 90 seconds, or the body might switch to the aerobic system to support the ongoing activity. Moreover, investigation conducted by Gaiga and Docherty (1995) indicated that aerobic interval training program might even enhance performance in repeated high intensity, short duration work. For most interval training sessions,

Therefore, the finding reveal that long interval training no effective as short interval training recovery in order to encourage the endurance performance of athlete to make success and competitive in competition. Therefore the researcher can concluded short interval training recovery more vital during training to become success in middle distance running. So the test results were clearly showing that long interval training recovery would have less effect on their endurance performance when compare with short interval training recovery.

Table 4.8: Athletes Short and long Interval Recovery endurance status of Weight test

No	Endurance assessment Item	Mean	Std. Deviation
1	Pre-Test Weight For Short Interval Training Recovery	57.37m	5.59m
	Post Test Weight For Short Interval Training Recovery	54.83m	5.20m
2	Pre-Test Weight For Long Interval Training Recovery	56.69m	6.16m
	Post Test Weight For Long Interval Training Recovery	56.20m	6.12m

As depicted above in table 4.8 item1pre-test weights for short interval training recoveryduring pre-test weight of athletes were repeatedly tested and their mean and Std. deviation result were taken. Similarly, during post-test i.e. after 8 weeks training the same procedure was taken. However, the total mean result of all athletes during pre-test was 57.37and 54.83at post-test. The total Std. deviation result of all athletes during pre-test 5.59 and 5.20 at post-test. Therefore, the average post-test weight test of ten, (10) athletes was significantly different from that of pre-test.

In the above table 4.8 item 2pre-test weights for long interval training recoverythe total mean result of all athletes during pre-test was 56.6900and 56.2000 at post-test. The total Std. deviation result of all athletes during pre-test 6.16 and 6.12 at post-test. Therefore, the average long interval training recovery post-test weight test of ten, (10) athletes was very less significantly different from that of pre-test which implies it very less effect on weight change as short interval training recovery.

Table 4.9: Sampled athletes' Short and long Interval Recovery endurance status of body mass index test performance

No	Endurance assessment Item	Mean	Std. Deviation
1	Pre-test Body Mass Index For short interval Recovery	16.88	1.20
	Post test Body Mass Index for Short Interval Recovery	16.00	.93
2	Pre-Test Body Mass Index For Long Interval Recovery	16.75	1.41
	Post Test Body Mass Index For Long Interval Recovery	16.60	1.40

As shown above in table 4.9 item 1 pre-test body mass index for short interval recovery the total mean result of all athletes during pre-test was 16.8 and 16.00 at post-test. The total Std. deviation result of all athletes during pre-test 1.20 and 0.93 at post-test. It also showed the 2 month short interval recovery training program had positive effects on endurance performance this implies athlete improve lean tissue and decrease fat tissue. In the light of thisAdapted from *WHO (2004)* Body Mass Index (BMI) is a simple index of weight-for-height that is commonly used to classify underweight, overweight and obesity in adults.

As indicated the above table 4.9 item 2 sample athletes' pre-test and post-test result of long interval training recoverythe total mean result of all athletes' during pre-test was 16.75and 16.60at post-test. The total Std. Deviation result of all athletes' during pre-test was 1.41and 1.40 at post-test, Additionally the result of post short interval training recovery and long interval training recovery revealed that short interval training recover has high effect than long interval training recover to increase lean tissue and decrease fat tissue which used to make athlete more muscular and perform middle distance running efficiently.

4.2 Is there significance difference between pre and post test

4.10 Paired Samples Statistics for short and long interval training recovery

		Mean	Std. Deviation	Correlation	sig.
Pair 1	Pre Cooper Test For Short	3035.60m	478.71	.998	.000
	Post Cooper Test For Short	3072.40m	488.01		
Pair2	Pre- Cooper Test for Long Interval	3200.70m	410.24	.697	.003
	Post Cooper Test for Long	3204.00m	409.89		
Pair 3	Pre-Test Vo2max For Short	56.58ml/kg/min	10.67	.998	.000
	Post Test Vo2max For Short	57.39ml/kg/min	10.91		
Pair4	Pre-Test Vo2max For Long	60.22ml/kg/min	9.13	.792	.002
	Post Test Vo2max For Long	60.34ml/kg/min	9.16		
Pair 5	Pre-Test 2.4km Run For Short	00:08':94"	00:01.18	.989	.000
	Post Test 2.4km Run For Short	00:08':78"	00:01.20		
Pair6	Pre-Test 2.4km Run For Long	00:08':64"	00:00.88	.598	.004
	Post Test 2.4km Run For Long	00:08':57"	00:00.80		
Pair 7	Pre-Test Weight For Short	57.37m	5.59	.973	.000
	Post Test Weight For Short	54.83m	5.20		
Pair8	Pre-Test Weight For Long	56.69m	6.16	.597	.004
	Post Test Weight For Long	56.20m	6.12		
Pair 9	Pre-Test Body Mass Index For Short	16.88	1.20	.890	.001
	Post Test Body Mass Index For Short	16.00	.93		
Pair10	Pre-Test Body Mass Index For Long	16.75	1.41	.697	.003
	Post Test Body Mass Index For Long	16.60	1.40		

From above table 4.10 pair1 short interval training recovery pre-test and post-test performance result of distance cover to cooper test. The total mean result of all athletes during pre-test was 3035.60m and 3072.40m at post-test. Therefore the total Std Deviation result all athletes during pre- test was 478.71 and post- test was 488.01. When we compare the mean value after 8-week Circuit training, Repetition training, Explosive Exercise Training, In Interval training was given the investigator was observed that, athlete were good improved endurance running performance and increased their progression with mean difference in short interval training recovery. After short interval training recovery the mean and Std Deviation result of athletes distance cover was improve.

In conformity to this Paired-Sample T-test, the p-value .000 was less than 0.05 confidence level. Therefore, the mean (average) post-test performance of ten, (10) athlete was significantly different from that of pre-test and also as the above table indicated the correlation coefficient value .998 show as pre test and post test result has very high relationship which indicate short interval training has positive effect on athlete middle distance endurance running performance. In supporting this, it is generally accepted that "Practice makes perfect." Sharkey (1986) even stated that sport consisted of about 99% preparation and 1% performance. However, as clarified by Vernacchia, McGuire, and Cook (1992), practice does not necessarily make perfect; because only perfect, planned, purposeful practice makes perfect. Peak performances and lifetime bests seldom occur by chance. Very often, they are the results of careful preparation. Furthermore, training programs must be tailored to fit individual athletes, with their positions (as in team games) or events be taken into consideration. Thus, how to determine the proper training workout for each athlete has become an important concern in this matter. Not surprisingly, many guidelines for conducting training programs have been provided by exercise physiologists (e.g., Astrand & Rodahl, 1986; Fox et al., 1993) who study the acute and long-term effects of training and sport participation on physical responses. The principles of running training are not much different from the more general sport training principles, and several of the more important sport training principles.

In the table 4.10 above pair 2 Paired samples statistics of long interval training recovery pre-test and post-test performance result of distance cover to cooper test. However, the total mean result of all athletes during pre-test was 3200.70m and 3204.00m at post-test. Therefore the total Std Deviation result all athletes during pre- test was 410.24and post- test was 409.89. Which revealed that there was good performance improvement as the study was conducted (norms found on table4.2.1).In conformity to this Paired-Sample T-test, the p-value 0.03 was less than 0.05 confidence level. Therefore, the mean (average) post-test performance of ten, (10) athlete was significantly different from that of pre-test and also as the above table indicated the correlation coefficient result .697 show as pre test and post test result has moderate relationship.When we compare the mean value of after long interval training recovery the mean and Std Deviation result of athletes distance cover was less improvement on middle distance endurance performance.

As the above paired 3 sample t-tests for Vo2max pre-test and post-test performance results of individual athletes'. The total means result all athletes during pre-test was 56.58 and 57.39 at post-test. Total Std Deviation result all athletes during pre- test was 10.67 and 10.91 at post-test. Paired sample t-test for Vo2max pre-test and post-test performance results of individual athletes' and then to in conformity to this Paired-Sample T-test, the p-value 0.00 was less than 0.05 confidence level. Therefore, the mean (average) post-test performance of ten, (10) athlete was significantly different from that of pre-test. Additionally the value of correlation coefficient reveal that short interval training recovery pre-test given and post test given show high relationship which implies they had positive relationship and had vital effect on athlete middle distance endurance improvement.

As the above table show about paired 4, total mean result of long interval training recovery of Vo2max all athletes during pre-test was 60.22 and 60.34at post-test. And then the total Std Deviation result all athletes during pre- test was 9.13 and 9.16 at post-test. Therefore the long interval training recovery the mean post-test performance of ten athletes' was show significantly different from that of pre-test to in conformity to this Paired-Sample T-test, the p-value 0.02 was less than 0.05 confidence level. Therefore, the mean (average) post-test performance of ten, (10) athlete was significantly different from that of pre-test. Additionally the value of correlation coefficient reveal that long interval training recovery pre-test given and post test given show moderate relationship which implies they had positive relationship and had effect on athlete middle distance running endurance improvement in supporting this,Vo2max represents the highest level of oxygen consumption that someone can achieve when exercising at sea level. This parameter is identified as a determinant for performance in endurance activities. Thus, a high Vo2max is required to reach a higher level of performance in aerobic sports (Joyner and Coyle 2008). Numerous scientific studies have investigated methods to promote and maintain a high fraction of Vo2max (Billat 2001a, b; Laursen and Jenkins 2002). Their results indicate that intermittent exercises involving >90% Vo2max improve aerobic performance levels in previously trained athletes. Interval training consists of alternating high intensity exercises with passive or active recovery periods. Introducing recovery periods between the phases of intense exercise allows athletes to maintain the intensity for longer than when exercise is performed continuously until exhaustion. Thus, the duration and method of recovery (active or passive) significantly affects the bioenergetic response during interval training sessions. Many trainers and researchers recommend active recovery between repeated brief, intense efforts to maintain a high Vo2max, to promote the return to homeostasis (elimination of lactate ions and protons), and thus to maintain the exercise for longer. This hypothesis was validated with a recovery period of at least 30 s (Dorado, Sanchis-Moysi, and Calbet 2004; Thevenet et al. 2007

As it was also indicated in the table 4.10 Paired5 Samples Statistics pre-test and post-test performance results of individual athletes in short interval recovery 2.4km running were given. The mean and Sts. Deviation result of each athletes showed that there is an improvement in their performance after the short interval recovery training were given. That is each athletes have showed lower performance before giving any training. The total mean value of 00:08.94during pre-test and with mean value 00:08.78 after the post-test.

The total Std. Deviation result of all athletes' during pre-test was 00:01.18 and 00:01.20 after the post-test.in addition to this the t value is greater than 0 and the p-value .000 was less than 0.05 confidence level. Therefore, the mean (average) post-test performance of ten, (10) athlete was significantly different from that of pre-test or the effect of post training happened mostly.

As it was also indicated in the table 4.10, Paired6 Samples Statistics pre-test and post-test performance results of individual athletes in long interval training recovery 2.4km running were given. The mean and Sts. Deviation result of each athletes showed that there is an less improvement in their performance after the long interval training recovery were given when compare with short interval training. The total mean value of 2.4km running 00:08.64during pre-test and with mean value 00:08.57 after the post-test. The total 2.4km running Std. Deviation result of all athletes' during pre-test was 00:00.88 and 00:00.80 after the post-test. In conformity to this Paired-Sample T-test, the p-value .004 was less than 0.05 confidence level. Therefore, the mean (average) post-test performance of ten, (10) athlete was significantly different from that of pre-test and also as the above table indicated the correlation coefficient result .597 show as pre test and post test result has low moderate relationship.When we compare the mean value of after long interval training recovery the mean and Std Deviation result of athletes distance cover was less improvement on middle distance endurance performance. Babineau and Leger (1997) also showed that aerobic interval running using either 400, 800, or 1600 meters as the working distance with a work-rest ratio of 5:1 was also a good simulator and indicator of endurance performance (at least true for the 5000-meter time trial in their study). Besides, the 5:1 work-rest ratio made the training more intense and reduced the total training time when compared to the traditional intermittent training ratio of 1:1 or 1:1.5 finally, active recovery rather than passive recovery. Recovery during the rest intervals is preferred because most studies indicated that subsequent performance was enhanced when low-intensity exercise instead of complete rest was performed during the rest intervals (Bogdanis, Nevill, Lakomy, Graham & Louis 1996; Signorile, Ingalls & Tremblay, 1993).

Based on the above table paired7 sample athlete's pre-test and post-test weight result of short interval recovery trainer weight test were given. During pre-test weight of athletes were repeatedly tested and their mean and Std. deviation result were taken. Similarly, during post-test i.e. after 8 weeks training the same procedure was taken. However, the total mean result of all athletes during pre-test was 57.37and 54.83at post-test. The total Std. deviation result of all athletes during pre-test 5.59 and 5.20 at post-test. Therefore, the average post-test weight test of ten, (10) athletes was significantly different from that of pre-test. And also the p-value .000 was less than 0.05 confidence level. Therefore, the mean (average) post-test performance of ten, (10) athlete was significantly different from that of pre-test which indicate the training has effect on athlete weight change. And also the value of correlation coefficient reveal .973 it implies as correlation coefficient standard the two training had very highrelationship and it had positive impact on athlete middle distance running endurance performance improvement.

Concerning the above table paired 8-sample athlete's pre-test and post-test weight result of long interval training recovery weight test were given. During pre-test weight of athletes were repeatedly tested and their mean and Std. deviation result were taken. Similarly, during post-test i.e. after 8 weeks training the same procedure was taken. However, the total mean result of all athletes during pre-test was 56.69 and 56.20 at post-test. The total Std. deviation result of all athletes during pre-test 6.16 and 6.12 at post-test. Therefore, the average post-test weight test of ten, (10) athletes was less significantly different from that of pre-test when we compare with short interval training in addition to this the p value revealed. .004 was less than 0.05cutpoint. Therefore, the mean (average) post-test performance of ten, (10) athlete was significantly different from that of pre-test in addition to this value of correlation coefficient reveal .597 implies as correlation coefficient standard the two training had low moderate relationship and it had positive impact on athlete middle distance running endurance performance improvement.

As shown above in table paired, 9. Sample of t-test BMI athletes' pre-test and post-test body mass index result of short interval recovery training were conducted. During pre-test Body Mass Index of athletes were tested and their mean result were taken. Similarly, during post-test i.e. after short interval recovery training the same procedure was taken. However, the total mean result of all athletes during pre-test was 16.8and 16.00 at post-test. The total Std. deviation result of all athletes during pre-test 1.20 and 0.93 at post-test. In generally It also showed the 2 months effects of short interval recovery training program had positive effect on endurance performance athlete. in light of this, When the relationship between training and recovery becomes imbalanced, symptoms of fatigue develop, followed by decreased performance. This condition is known as overreaching (Meeusen et al. 2006). Overreaching can be classified as either functional or nonfunctional, depending on the duration of the decrease in performance and the severity of the symptoms. In functional overreaching, a rebound and improvement in performance occurs after a few days of full recovery (see chapter 2). this is known as super compensation, and it is sometimes used as a strategy to boost performances in anticipation of an important competitive event (Halson and Jeukendrup 2004). The super compensation principle may be described as a planned breakdown as a result of sustained training, followed by recovery and enhanced performances (Kentta and Hassmen 1998). Beside to this the above table shows **sig < 0.05** & t value > 0, this indicated significantly higher /greater/ than the cutoff point--happened mostly or usually.

As shown above in table paired 10, sample of T. test BMI athletes' pre-test and post-test result of long interval training recovery was given. During pre-test Body Mass Index of athletes were tested and their mean result were taken. Similarly, during post-test i.e. after short interval recovery training the same procedure was taken. However, the total mean result of all athletes during pre-test was 16.75 and 16.60 at post-test. The total Std. deviation result of all athletes during pre-test 1.41 and 1.40 at post-test. In generally, it also showed the 2 months effects of long interval training recovery program had less effect on endurance performance when compare with short interval training recovery. Earlier research showed that 120% of MAS in short intervals elicited the longest performance a VO2max. Dupont et al,(2003). This protocol lead to improvements in the velocity achieved at VO2max. Interestingly, this study was conducted during the season. Improvement in team performances were observed during the course of the study. In addition, other physiological needs, such as speed and leg power were maintained during the study. This shows that physical characteristics such as aerobic power and MAS can be improved during the season without any decreased in performance or other physiological areas of importance. In partial contrast, a study compared long interval training and shorter high intensity interval training .Franch et al, (1998). All two regimens lead to improved aerobic power. However, long interval training groups improved significantly more than the shorter higher intensity training group. Beside to this the above table shows **sig < 0.05** & t value > 0, this indicated significantly higher /greater/ than the cutoff point--happened mostly or usually.

4.3 Effect of mixed interval training on athletes' endurance running performance

Endurance Performance assessment

Cooper test for short and long intervaltraining Recovery group

No	**Cooper test short interval recovery** **Vo2max =distance covered in meter -504.9)/44.73**				**Cooper test for long interval Recovery**			
	Pretest		Post test		Pretest		Post test	
	Distance	VO2max	Distance	VO2max	Distance	VO2max	Distance	VO2max
1	3598m	69.15	3669m	70.73	3590m	68.97	3596m	69.10
2	3585m	68.85	3616m	69.55	3588m	68.92	3591m	68.99
3	3520m	67.40	3536m	67.76	2400m	42.36	2405m	42.47
4	2869m	52.85	2889m	53.29	2800m	51.31	2802m	51.35
5	2702m	49.11	2725m	49.63	2875m	52.98	2879m	53.07
6	2900m	53.54	3000m	55.78	3543m	67.52	3544m	67.94
7	3515m	67.29	3565m	68.41	3435m	65.50	3439m	65.59
8	2600m	46.83	2630m	47.50	3000m	55.78	3003m	55.84
9	2787m	51.01	2799m	51.28	3495m	66.84	3496m	66.87
10	2280m	39.86	2295m	40.02	3281m	62.06	3285m	62.18

2.4km run for short long interval recovery group

	2.4 km running test for short interval Recovery		2.4 km running test for Long interval Recovery	
	Pre test	Post test	Pre test	Post test
	Minute and second	Minute and second	Minute and second	Minute and second
1	0:7:50	0:7:42	0:7:51	0:7:49
2	0:7:55	0:7:48	0:7:52	0:7:51
3	0:8:01	0:7:55	0:8:5	0:8:47
4	0:9:51	0:9:46	0:9:45	0:9:42
5	0:9:58	0:9:45	0:10	0:9:56
6	0:11:12	0:11:01	0:8:19	0:8.19
7	0:8:37	0:8:32	0:9:24	0:9:2
8	0:8:49	0:8:45	0:8:13	0:8:11
9	0:9:1	0:8:57	0:9:59	0:9:54
10	0:10:21	0:10:09	0:8:28	0:8:25

Linear regression model is a statistical model that used to identify factors which can possibly affect the dependent variable if there is linear relationship between the dependent and independent variables. Linear regression model can be simple, if only one independent variable is used and multiple, if there are two or more than two independent variables or factors are used.

Table 4.11 Multiple Linear Regression Model Result for short and long interval training recovery cooper test

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	-17.262	62.124		-.278	.788
	Pre cooper test for Short Interval training	1.018	.020	.998	50.287	.000
a. Dependent Variable: post Test Distance Cover Cooper Test for Short Interval						
2	(Constant)	6.083	4.438		1.371	.208
	Pre Cooper Test for Long Interval training	.999	.001	1.000	725.935	.000
a. Dependent Variable: post Test Distance Cover Cooper Test for Long Interval						

As can be seen from table 4.11, above item 1 and 2,. The linear sample regression was calculated two predict the pre cooper test of short interval training recovery athletes from their post cooper test of short interval recovery. these variable statistically predict pre cooper test of short interval Df= (1, 8) F value = 2528.776, p value <000R^2 = .997and post cooperof long interval training recovery df = (1, 8) F= 526981.712 P = 000R^2= 1.000therefore , the predict that has positive significant of athletes endurance running performance of post cooper test short and long interval training recovery . As the result of analysis showed the factors such as cooper per test, were significantly affect post cooper test of short and long interval training recovery is the ultimate cardiovascular workout. Just by practicing interval training once a week, you will be able to take advantage of a number of benefits, from more effective oxygen intake to a slower heart rate Gray, S. (2011). One of the greatest benefits to interval training is the similarity to regular activities that the average person performs on a daily basis. Most people are not focusing on working at a moderate to high level of intensity for long periods of time through the day. It is natural to take breaks and rest between activities, especially when such activities are so intense. Interval training is an excellent way to prepare your body for the sudden bursts of stress or activity that everyone experienced from time to time.

Studies indicate that interval training significantly increases the ability to use oxygen by as much as 100%.The muscle carbohydrate reserves, glycogen, is almost exhausted thorough interval training. Since the p-values were less than alpha (α) value at 5% level of and the t-value is greater than zero they had significance difference. From the above analysis someone can easily understand dependent variable had positive effect on in dependent variable which implies there is significant difference pre test value and post test value of cooper test.

Table 4.12 Multiple Linear Regression Model Result for short and long interval training recovery Vo2 max test

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.366	1.182		-.309	.765
	pre-Test Vo2max For Short	1.021	.021	.998	49.662	.000
a. Dependent Variable: 1post Test Vo2max For Short						
1	(Constant)	-.082	.254		-.321	.756
	pre-Test Vo2max For Long	1.003	.004	1.000	240.744	.000
a. Dependent Variable: post Test Vo2max For Long						

As the table 4.12 above item, The linear sample regression was calculated two predict the pre test Vo2 max of short and long interval training recovery athletes from their post cooper test of short interval recovery. these variable statistically predict pre test Vo2 max of short interval df = (1, 8) F= 2466.315P = 000R^2= .997and pre test Vo2 max of long interval training recovery df = (1, 8) F= 57957.830P = 000R^2= 1.000therefore , the predict that has positive significant of athletes endurance running performance of post cooper test short and long interval training recovery.

The regression model result in the above table 4:12 showed the result of model output of different factors on post-test Vo2 max of short and long interval recovery case. As the result of analysis showed the factors post test VO2 max, had significantly effect on short and long interval training recovery pre-test Vo2 max since the p-values were less than alpha (α) value at 5% level of significance and the t –value is greater than zero. And also the coefficient standard show that independent and dependent variable had high relationship which means dependent variable had positives effect on independent variable. Performance in many athletic activities depends on the athlete's capacity to reconstitute the energy required for the organic functions used during the exercise, in the form of a molecule known as adenosine triphosphate (ATP) Depending on the duration of the exercise, its intensity, and its continuous or intermittent nature, performance depends on the contribution of the athlete's anaerobic and aerobic pathways (Knicker et al. 2011).

Table 4.13 Multiple Linear Regression Model Result for short and long interval training recovery 2.4km running test

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.239	.480		-.498	.632
	pre-Test 2.4km Run For Short	1.008	.053	.989	18.940	.000
a. Dependent Variable: post Test 2.4km Run For Short						
1	(Constant)	.726	.366		1.986	.082
	pre-Test 2.4km Run For Long	.908	.042	.992	21.555	.000
a. Dependent Variable: post Test 2.4km Run For Long						

As can be seen from table 4.13items, the linear sample regression was calculated two predict the pretest 2.4km run of short and long interval training recovery athletes from their post 2.4km run of short and long intervaltraining recovery. these variable statistically predict pre test 2.4km run of short interval df = (1, 8) F= 358.732 P = 000 R^2= .978 and pre test 2.4km run of long interval training recovery df = (1, 8) F= 464.619 P = 000 R^2= .983therefore , the predict that has positive significant of athletes endurance running performance of post 2.4km run short and long interval training recovery.

The regression model result in the above table 4:13 showed the result of model output of different factors on post-test 2.4km run of short and long interval training recovery cases. The greater the time spent training at or around VO2max, the greater the adaptation and improvement in aerobic power (Tabata, Nishimura, Kouzaki, Hirai, Ogita, Miyachi& Yamamoto, 1996) of the research on interval training has varying results. As the result of analysis showed the factors such as pre test 2.4km, were significantly effect post-test 2.4km of short and long interval recovery since the p-values were less than alpha (α) value at 5% level of significance and t value greater than zero and also the coefficient value indicated as they had high relationship this imply short and long interval training had positive effect on athlete endurance running performance development as statically as linear regression data analysis indicated.

Table 4.14 Multiple Linear Regression Model Result for short and long interval training recovery Weight test

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.876	4.388		.655	.531
	pre-Test Weight For Short Interval Recovery	.906	.076	.973	11.889	.000
a. Dependent Variable: 1post Test Weight For Short Interval Recovery						
1	(Constant)	-.021	1.156		-.018	.986
	pre-Test Weight For Long Interval Recovery	.992	.020	.998	48.896	.000
a. Dependent Variable: 2post Test Weight For Long Interval Recovery						

As shown above in table 4.14 The linear sample regression was calculated two predict the pre testWeightof short and long interval training recovery athletes from their post Weight test of short interval recovery. these variable statistically predict pre Weighttest of short interval training recovery df = (1, 8) F= 141.358P = 000R^2= .946and pre Weighttest of long interval training recoverydf = (1, 8) F= 2390.861P = 000 R^2= .997therefore , the predict that has positive significant of athletes endurance running performance of post Weight test short and long interval training recoveryshowed the result of model output of different factors on post-test Weight of short and long interval recovery case. As the result of analysis showed the factors post test Weight, had significantly effect on short and long interval training recovery pre-test since the p-values were less than alpha (α) value at 5% level of significance and the t –value is greater than zero this indicated as dependent variable had positive significant effect on independent variable. And also the coefficient standard show that independent and dependent variable had high relationship.

Table 4.15 Multiple Linear Regression Model Result for short and long interval training recovery body mass index test

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	4.367	2.108		2.071	.072
	pre-Test Body Mass Index For Short Interval Recovery	.689	.125	.890	5.531	.001
a. Dependent Variable: post Test Body Mass Index For Short Interval Recovery						
1	(Constant)	-.048	.442		-.108	.917
	pre-Test Body Mass Index For Long Interval Recovery	.994	.026	.997	37.815	.000
a. Dependent Variable: post Test Body Mass Index For Long Interval Recovery						

As can be seen from table 4.15, above item the linear sample regression was calculated two predict the pre body mass indextest of short interval training recovery athletes from their post body mass index test of short interval recovery. these variable statistically predict pre body mass index test of short interval df = (1, 8) F= 30.587P = 000 R^2= .793 and post cooper of long interval training recoverydf = (1, 8) F= 1429.991P = 000 R^2= .994therefore , the predict that has positive significant of athletes endurance running performance of post body mass index test short and long interval training recovery. The regression model result in the above table showed the result of model output of different factors on post-test Body Mass Index of short and long interval training recovery cases. As the result of analysis showed the factors such as pre test Body Mass Index, were significantly affect post-test Body Mass Index of short and long interval recovery since the p-values were less than alpha (α) value at 5% level of significance and t value greater than zero and also the coefficient value indicated as they had high relationship this imply short and long interval training had positive effect on athlete endurance performance development as statically linear regression data analysis indicated.

Table 4.16 multiple linear regression models

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.879[a]	.772	.658	3.04622
a. Predictors: (Constant), Pre-Test Body Mass Index For Short Interval Recovery, Pre-Test 2.4km Run For Short, Pre-Test Distance Cover Cooper Test For Short Interval				

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	188.404	3	62.801	6.768	.024[b]
	Residual	55.677	6	9.279		
	Total	244.081	9			
A. Dependent Variable: Post Test Weight For Short Interval Recovery						
B. Predictors: (Constant), Pre-Test Body Mass Index For Short Interval Recovery, Pre-Test 2.4km Run For Short, Pre-Test Distance Cover Cooper Test for Short Interval						

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	.570	23.267		.024	.981
	Pre-Test Distance Cover Cooper Test for Short Interval	-.002	.003	-.199	-.689	.517
	Pre-Test 2.4km Run For Short	-.508	1.257	-.115	-.404	.700
	Pre-Test Body Mass Index For Short Interval Recovery	3.872	.871	.897	4.445	.004
a. Dependent Variable: Post Test Weight For Short Interval Recovery						

As can be seen from table 4.16, above item, the linear sample regression was calculated to predict the pre cooper test, pre- test of body mass index and pre- test 2.4km run of short interval training recovery. these variable statistically predict pre cooper test of short interval Df= (1, 8) F value = 6.768, R^2 = .772, p value =.517 cooper testof short interval training recovery, pre-test 2.4km run for shortp value =.700 andpre-test body mass index for short interval recoveryP value .004 therefore, In this study multiple linear regression models summery was used to identify the significant factors those effect pre test weight of short interval recovery by taking pre of cooper test, pre- test of body mass index and pre- test 2.4km run as an independent variables. The regression model result in the above table, the pre- test of body mass index F value was 6.768P value was .004. This indicated as dependent variable had positive significant effect on independent variable. P-values were less than alpha (α). And also the coefficient standard show that independent and dependent variable had high relationship. Whereas the factors such as cooper test in pre-test and 2.4km for short interval training recovery of the athletes, were not statistically significant. And also the coefficient values indicated as they had no significant relationship this imply the dependent variable had not positive effect on athlete endurance performance as statically linear regression data analysis indicated

4.4. DISCUSSION

This section deals with the finding of the present's investigation discussed in the light of the statements of the problems, research question and review of related literature in order toassess effects of mixed interval training recovery aspects on middle distance endurance performance running bekoji athletic training centre

The athletes selected pre-test and pos-test variables performance, to identify the significant difference between pre-test and post-test performance. The information collected in reference to this issue analyzed using, mean and standard deviation for first specific objective, paired sample t-teat for second specific objective and for the last objective multiple regression model to Obtained valid information. Based on the finding of mean and standard deviation the researcher forwarded the following suggestion: - After 8-week Circuit training, Repetition training,Explosive Exercise Training, Interval training, Lunge/Sprint Combination Interval Training was given the investigator was observed that, athlete were good improved performance and increased their progression with mean difference in short and long interval training recovery.

The rationale behind the improvement in running endurance performance was due to the exercise, which they took in the training schedule. The Paired-Sample T-test results were clearly showing that training would have great effect on their running endurance performance. From this result it was possible to concluded, that training program had positive effects on increments of performance efficiency in interval training due to the exercise training. This result was similar with the reports of (Edgerton, 1976)

This test result indicated that giving appropriate training for the trainer was highly important to improve or develop their endurance performance in running. The results of post mean and standard deviation were clearly showing that training would have great effect on their endurance performance of athletes. In the light of this, (Harre 1982) Performance optimization was the result of long term, demanding and well- structured exercise training. This test result indicated that giving appropriate training for the trainees was highly important to improve or develop their endurance running performance. From this result it was possible to concluded, that training program had positive effects on increments of athlete endurance running performance efficiency and also the result of analysis indicated that short interval training had more endurance improvement than long interval training group. after8-weekInterval training, had vital effect on athlete endurance running performance due to exercise training was given.. Earlier research showed that 120% of MAS in short intervals elicited the longest performance a VO2max. Dupont et al,(2003). This protocol lead to improvements in the velocity achieved at VO2max. Interestingly, this study was conducted during the season. Improvement in team performances were observed during the course of the study. In addition, other physiological needs, such as speed and leg power were maintained during the study. This shows that physical characteristics such as aerobic power and MAS can be improved during the season without any decreased in performance or other physiological areas of importance.

In partial contrast, a study compared long interval training and shorter high intensity interval training .Franch et al, (1998). All two regimens lead to improved aerobic power. However, long interval training groups improved significantly more than the shorter higher intensity training group. Concerning the finding of paired sample t-test to identify the significant difference between pre-test and post-test performance of athlete, The mean (average) show the value of post-test endurance running performance of athlete after 8week training though mixed interval training recovery was significantly different from that of pre-test or the effect of post training happened mostly. so the researcher concluded short and long interval training recovery had efficient effective on athlete middle distance running endurance performance development as the analyzed data reveal. in the light of this ,John Amneusetal (1995) describes that, the primary purpose of training is to improve and plan the performance of the athlete. The systematic application of skill instruction, biomechanics, and the principles of training to the development of track and field athletes is planned performance training.

Planned performance training seeks to achieve maximum improvement in endurance running performance and structured so that peak performance occurs at predetermined moments within the competitive season. The endurance running performance formula for a well-conditioned endurance running performance trainer is a simple one. There are no short cuts, no magic pills. Along term commitment is necessary to reach and maintain a trainer full endurance running performance potential. The two primary objectives of the endurance program are to enhance the abilities to perform the exercise. Also the endurance program of a trainer must be intense, brief, and generate the type of endurance gains that most functional in performing the training (Hoff and Helgerud, 2002).

Base on the finding of multiple regressions the following conclusion was forwarded:-

As the result of analysis showed the factors such as short interval training recovery, such as; Circuit training, Repetition training,Explosive Exercise Training, Interval training, Lunge/Sprint

Combination Interval Training were significantly effect on running endurance performance of post-test as the result of after 8 week training. And also the p-values were less than alpha (α) value at 5% level of and the t-value is greater than zero this imply there was significance difference between pre-test and post-test after appropriate endurance training program implemented properly.Numerous studies show that you can increase your VO_2 max by working out at an intensity that raises your heart rate to between 65 and 85% of its maximum for at least 20 minutes three to five times a week.(http://www.brianmac.co.uk/VO2max.htm From the above analysis someone can easily understand dependent variable had positive effect on in dependent variable which implies there is significant difference pre test value and post test value of training. A study by Saltin and Rowell (1980) concluded that it is the delivery of oxygen to active tissues that is the major limiting factor to VO_2 max. A study by Gollnick et al. (1972) showed a weak relationship between the body's ability to utilize the available oxygen and VO_2 max.

CHAPTER FIVE

SUMMARY, CONCLUSION, AND RECOMMENDATION

This chapter deals with the summary, conclusions and recommendations.

5.1. Summary

This study was intended to examine the effect of mixed interval training recovery short term and long term on middle distance endurance running performance of athletes. In order to test effect of interval training exercise, the subjects were allowed to participate in this training. Twenty athletes were selected. 12 (60%), of them were male athletes and 8 (40%), were female athletes from Bekoji athletics training center during the year of 2018.

The selected subject was under the quasi-experimental design of two groups before training (pre-test) and post-test after short and long interval training period.The training periods of these groups were eight-weeks, three, (3) days per week with duration of 60 minutes in one session.The data were collected on some selected endurance performance assessment:-cooper test ,Vo2 max ,2.4km run and anthropometry assessment:-height, weight, body max index. The endurance performancefitness variables were statistically analyzed by using mean, Std. Deviation, Paired-Samples T-test and multiple regression models.

The finding of this study results showed there were significant endurance performance improvement of athlete after training.There was significant change in pre-test and post-test results of short interval training recovery than long interval training recovery based on the value of mean, standard deviation, paired sample-test and regression model.In other hand the results of long interval training recovery indicated that there was slight improvement had been observed on their endurance running performance.

5.2. Conclusion

Based on the analysis result and the findings the following conclusions could be drawn

- As showed by the results of short interval training recovery in the post –test results had high effects of endurance running performance improvement.
- Comparison was made between short and long interval training recovery post-test results of long interval training recovery endurance running performance as indicates less improvement
- Concerning body mass index paired sample t-test short interval recovery training show training program had positive effects on endurance performance this implies athlete improve lean tissue and decrease fat tissue as we can seen from pre test and post test.
- As the result of analysis showed the factors post test VO2 max, had significantly effect on short and long interval training recovery pre-test VO2 max of endurance running performance. And also the coefficient standard show that independent and dependent variable had high relationship which means dependent variable had positives effect on independent variable
- The coefficient value indicated as they had high relationship this imply short and long interval training had positive effect on athlete endurance running performance development as statically as linear regression data analysis indicated. .
- From this we can understand that effective training had high effect on athlete endurance performance increments to make success in competition and to become competitive in middle distance running effectively.
- Based on the finding mean and standard deviation result of endurance assessment of short interval training recovery show improvement in post test as compared to pre-test in the case of short interval training on this indicate effectively implementing the training program brings athlete endurance performance development.

This study reports there was significance difference between pre-test and post-test of endurance running performance assessment test.

The study reveals that short and long interval training recovery enhances endurance running performance of athletes. The result of the study showed improvement by all test results increase the performance of athletes in two month training program of this study. It showed that. Short and long interval training program had effect on endurance running performance of the athletes. As it has been mentioned by the athletes result effect of mixed interval training recovery short term and long term on middle distance endurance running performance of Bekoji athletics training canter more use important for their endurance improvement short internal training recovery than long interval recovery.

5.3. Recommendation

The investigator was suggested the following recommendations in light of the summary and the conclusions made:

- Athlete has to perform their exercise in regular manner.
- Short interval training had high effect on athlete endurance performance development, so they should be train properly.
- Coach should have to give attention for short interval training recover while train athlete to maximize the endurance running performance of participant
- Trainee should be understand the effect of short and long interval training recovery on athlete endurance running performance improvement
- Concerned body should be prepared the one who have knowledge and skill concerning the effect of long and short interval training on middle distance athlete endurance running performance development.
- Athlete would have to participate in regular training program as training principle indicates in order to benefit from the training.
- Coach should be give more attention for short interval training recovery than long interval training recovery to improve endurance performance of middle distance runner athlete.
- Concerned body should be work jointly with the training centre to minimize the factors that hinder participation of athlete in training properly.
- Concerned bodyupgrade the coaches' quality through the specialization level of coaching certification system in order to bring progression of athletes' performance.
- Trainer should be understand number of session for the middle-distance runner engaged equivalent with that of the progressive adaptation principle, so that they can scale up their performance and get constant training.

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Appendix. I

Training program

The training will be performed three times per week for eight weeks Interval Training for short recovery. (Use roll on recovery)

	Mesocycle	Mesocycle 1												Mesocycle 2										
1	Micro cycle	1			2			3			4			5			6			7		8		
2	Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
3	Content																							
4	Circuit training									1								1						
5	Repetition training		1						1		1						1		1					
6	Explosive Exercise Training			1				1				1				1				1				
7	Interval training				1		1						1		1						1			1
8	Lunge/Sprint Combination Interval					1								1								1		
9	Test	1													1							1		
10	Volume		L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
11	Intensity		H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
12																								

Volume = Low

Intensity = HighSub Maximum = SM

The training will be performed three times per week for eight weeks Interval Training for Long recovery (Use 2min- 10min recovery)

	Mesocycle	Monocycle 1												Mesocycle 2										
1	Micro cycle	1			2			3			4			5			6			7		8		
2	Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
3	Content																							
4	Circuit training									1								1						
5	Repetition training		1						1		1						1		1					1
6	Explosive Exercise Training			1				1				1				1							1	
7	Interval training				1		1						1		1					1		1		
8	Lunge/Sprint Combination Interval					1								1							1			
9	Test	1											1											
10	Volume		L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
11	Intensity		H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H

Appendix. II

Second session for short interval training recovery (Use roll on recovery)

Unit	Content	Organization	Coaching point
Warm Up 15’	Warm up for 20’ away from track Mobilization exercises skipping -side steps	Carry out safety check on the area Check with athlete for any injury /activities	Run tall Use questioning Athlete to suggest other exercise
	Running drills over 30M High knees Butt kicks	Have athlete work in pairs and watch each other	Coordinate arm and lag Butt kicks ,toe up ,heel up,
Fitness	**<u>Repetition training</u>** 3x3x300m(F=60", M = 50" [35"and 3']	Introduce session and instruct and explain Recap and ask them what they are going to do Move athlete with position in the group for each repetition	Check for understand after explain the session Observe athlete for concentration and fatigue during the session See how react to running in front ,in the middle at the back of the group
Cool down 10’	5' - 10' easy run Static starching	Check athletes response to training Hydrate Review the session	Athletes relaxed and loose Provide feedback by questioning And telling Hold stretch for 6- 8 sec
Evaluation	**Session goals** :- To be completed after the session **Personal session goals** : To be completed after the session		

Second session Training for long interval training recovery (Use 2min- 10min recovery)

Unit	Content	Organization	Coaching point
Warm Up 15’	Warm up for 20’ away from track Mobilization exercises skipping -side steps	Carry out safety check on the area Check with athlete for any injury /activities	Run tall Use questioning Athlete to suggest other exercise
	Running drills over 30M High knees Butt kicks	Have athlete work in pairs and watch each other	Coordinate arm and lag Butt kicks ,toe up ,heel up,
Fitness	**<u>Repetition training</u>** 3x3x300m(F=60", M = 50" [2'and 8']	Introduce session and instruct and explain Recap and ask them what they are going to do Move athlete with position in the group for each repetition	Check for understand after explain the session Observe athlete for concentration and fatigue during the session See how react to running in front ,in the middle at the back of the group
Cool down 10’	5' - 10' easy run Static starching	Check athletes response to training Hydrate Review the session	Athletes relaxed and loose Provide feedback by questioning And telling Hold stretch for 6- 8 sec
Evaluation	**Session goals** :- To be completed after the session **Personal session goals** : To be completed after the session		

Appendix. III

Endurance Performance assessment Evaluation:-Cooper Test,Vo2 max and The 2.4km run test

Anthropometric assessment Evaluation:-Weight, Height andBody Mass Index

Intensity % of athlete's best performance

Maximum:95-100
Sub Maximum: 85-94
High:75-84
Medium:65-74
Light: 50-64
Low:30-49

Scale of intensity relative to best performance

(Foundation track and field coaching manual, 1995-2008)

(By Kristin Rooke, 2016, Medically Reviewed, 2016)

(Introduction to Coaching Theory, Peter J L Thompson, 2000)

(101Performance Evaluation Tests, Jonathan Pye, jonathan.pye@electricwordplc.com,200)

Appendix. IV

Conducted data to short and long interval training recovery

No	Number of Athlete		Training Age		Age of Athlete		Grade of Athlete	
							Grade	**Number**
1	**Sex**	**Number**	**Year**	**Number**	**Age**	**Number**	5-6	5
2	F	8	1-2	14	14-15	13	7-8	8
3	M	12	3-4	6	16-17	7	9-10	7
4	Total	20		20		20		20

Endurance Performance assessment

Group 1: Experiment Cooper test for short interval Recovery

	Cooper test short interval recovery **Vo2max =distance covered in meter -504.9)/44.73**			
	Pre test		Post test	
	Distance	VO2max	Distance	VO2max
1	3598m	69.15	3669m	70.73
2	3585m	68.85	3616m	69.55
3	3520m	67.40	3536m	67.76
4	2869m	52.85	2889m	53.29
5	2702m	49.11	2725m	49.63
6	2900m	53.54	3000m	55.78
7	3515m	67.29	3565m	68.41
8	2600m	46.83	2630m	47.50
9	2787m	51.01	2799m	51.28
10	2280m	39.86	2295m	40.02

Group 2: Experiment Cooper test for long interval Recovery

	Cooper test for long interval Recovery **Vo2max =distance covered in meter -504.9)/44.73**			
	Pre test		Post test	
	Distance	VO2max	Distance	VO2max
1	3590m	68.97	3596m	69.10
2	3588m	68.92	3591m	68.99
3	2400m	42.36	2405m	42.47
4	2800m	51.31	2802m	51.35
5	2875m	52.98	2879m	53.07
6	3543m	67.52	3544m	67.94
7	3435m	65.50	3439m	65.59
8	3000m	55.78	3003m	55.84
9	3495m	66.84	3496m	66.87
10	3281m	62.06	3285m	62.18

Group 1: Experiment2.4km for short interval recovery

	2.4 km running test for short interval Recovery	
	Pre test	Post test
	Minute and second	Minute and second
1	0:7:50	0:7:42
2	0:7:55	0:7:48
3	0:8:01	0:7:55
4	0:9:51	0:9:46
5	0:9:58	0:9:45
6	0:11:12	0:11:01
7	0:8:37	0:8:32
8	0:8:49	0:8:45
9	0:9:1	0:8:57
10	0:10:21	0:10:09

Group 2: Experiment 2.4km for long interval recovery

	2.4 km running test for Long interval Recovery	
	Pre test	Post test
	Minute and second	Minute and second
1	0:7:51	0:7:49
2	0:7:52	0:7:51
3	0:8:5	0:8:47
4	0:9:45	0:9:42
5	0:10	0:9:56
6	0:8:19	0:8.19
7	0:9:24	0:9:2
8	0:8:13	0:8:11
9	0:9:59	0:9:54
10	0:8:28	0:8:25

Anthropometric Assessment

Group 1: Experiment Weight test for short interval Recovery

	Weight test for short interval Recovery	
	Pre test	Post test
1	60kg	58 kg
2	46.6 kg	44.3 kg
3	60kg	57.4 kg
4	59kg	57.9 kg
5	58kg	56.7 kg
6	53.2kg	50.4 kg
7	63kg	60.5 kg
8	56.8kg	54kg
9	65.5kg	59.6 kg
10	51.6kg	49.5kg

Group 2: Experiment Weight test for Long interval Recovery

	Weight test for Long interval Recovery	
	Pre test	Post test
1	57.9kg	57 kg
2	46.1 kg	45.9 kg
3	64.3 kg	63.7 kg
4	56.4 kg	56.4 kg
5	64 kg	63 kg
6	52.9 kg	52.3 kg
7	62.1 kg	61.9 kg
8	53.9 kg	53.6 kg
9	60 kg	59.8 kg
10	49.3 kg	48.4 kg

Body Mass Index

Group 1: Experiment BMI = Weight / height m^2 for Short interval recovery

	Height test for short interval Recovery					
	Pre test			Post test		
	W	H	BMI	W	H	BMI
1	60kg	1.77m	16.94	58 kg	1.77m	16.38
2	46.6 kg	1.56m	14.93	44.3 kg	1.56m	14.19
3	60kg	1.64m	18.29	57.4 kg	1.64m	17.5
4	59kg	1.76m	16.76	57.9 kg	1.76m	16.44
5	58kg	1.77m	16.38	56.7 kg	1.77m	16.01
6	53.2kg	1.64m	16.21	50.4 kg	1.64m	15.36
7	63kg	1.69m	18.63	60.5 kg	1.69m	16.51
8	56.8kg	1.72m	16.51	54kg	1.72m	15.69
9	65.5kg	1.78m	18.39	59.6 kg	1.78m	16.74
10	51.6kg	1.63m	15.82	49.5kg	1.63m	15.18

Group 2: Experiment BMI = Weight / height m^2 for Long interval recovery

	Height test for Long interval Recovery					
	Pre test			Post test		
	W	H	BMI	W	H	BMI
1	57.9kg	1.75m	16.54	57 kg	1.75m	16.28
2	46.1 kg	1.62m	14.22	45.9 kg	1.62m	14.16
3	64.3 kg	1.79m	17.96	63.7 kg	1.79m	17.79
4	56.4 kg	1.67m	16.88	56.4 kg	1.67m	16.88
5	64 kg	1.73m	18.49	63 kg	1.73m	18.20
6	52.9 kg	1.62m	16.32	52.3 kg	1.62m	16.14
7	62.1 kg	1.66m	18.70	61.9 kg	1.66m	18.64
8	53.9 kg	1,71m	15.76	53.6 kg	1,71m	15.67
9	60 kg	1.74m	17.24	59.8 kg	1.74m	17.18
10	49.3 kg	1.60m	15.40	48.4 kg	1.60m	15.12