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Effects of Concentrated Weekend Training Program on Physiological and Performance Indicators in Soccer Trainees

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DEPARTMENT OF SPORT SCIENCE

Effects of Concentrated Weekend Training Program on Physiological and Performance Indicators in Soccer Trainees

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A Thesis

Submitted to Bahir Dar University Sport Academy in Partial Fulfillments for the Requirements of Masters of Science in Exercise Physiology

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APPROVAL SHEET

BAHIR DAR UNIVERSITY, SPORT ACADEMY

As thesis research advisor, I hereby certify that we have read and evaluated this thesis prepared, under our guidance, by **Kassaye Ademe**, entitled Effects of Concentrated Weekend Training Program on Physiological and Performance Indicators in Soccer Trainees**.** I recommend that it can be submitted to fulfill the thesis requirement.

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As member of the board of examiners of the M.Sc thesis open defense examination, we certify that we have read and evaluated the thesis prepared by **Kassaye Ademe Gessesse** and examined the candidate. We recommended that the thesis be accepted as Fulfillments for the Requirements of Masters of Science in Exercise Physiology.

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STATEMENT OF AUTHOR (DECLARATION)

First, I declare that this thesis is my work and that all sources or materials used for this thesis have been duly acknowledged. This thesis submitted to Bahir Dar University Sport Academy in partial fulfillment of the requirements for the Degree of Master of Science in Exercise Physiology. I confidently declare that this thesis has not been submitted to any other institutions anywhere for the award of any academic degree, diploma, or certificate.

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LIST OF ABBREVIATION AND ACRONYMS

ACSM	American College of Sport Medicine
BMD	Bone Mineral Density
BP	Blood Pressure
BPM	beat per minute
CMJ	Counter-Movement Jump
DOMS	Delayed Onset Muscle Soreness
GPS	Global Positioning System
HIIT	High-Intensity Interval Training
HRM	Heartbeat Monitor
IDV	Independent Variable
OR	Odds Ratio
POMS	Profile of Mood States
RHR	Resting Heart Rate
SPSS	Statistical Package for Social Science
VO2max	Maximum Volume of oxygen uptake

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ABSTRACT

Studies prove that concentrated training programs results complicated impacts on trainees. However, this implication on young trainees' physiological adaptations and performance is crucial for optimal enhancement and injury prevention is under explored. There for, this study was aims to evaluate the physiological and performance effects of concentrated weekend training program on 11–13 years old male soccer trainees. The study was used quasi experimental design with a total of 40 male soccer trainees at Bahir Dar University Stadium. The study investigated the effects of concentrated weekend training days. Over 10 week concentrated weekend soccer training program the long term physiological adaptations also alongside evaluating the influence of extra physical activities. The data collected from the study on subject were analyzed using SPSS version 25 software by using paired sample t-tests, binary logistic regression, and Pearson correlation analyses. The result showed that statistically significant reduction in sprint speed (M=6.03s on Sunday vs. M=5.72s on Saturday, $P < 0.05$) and CMJ height (M=2.15m on Sunday vs. M=2.24m on Saturday, $P < 0.05$), indicative of neuromuscular fatigue from insufficient recovery. Conversely, participation in extra irregular training intensely influenced recovery, dramatically increasing the odds of positive performance outcomes (Odds Ratio OR = 4.500, $P < 0.05$) and significantly reducing the likelihood of experiencing fatigue (OR = 0.156, $p < 0.05$, joint pain (OR = 0.079, $P < 0.05$), deserved sleep (OR = 0.003, $P < 0.05$), and muscle soreness (OR = 0.030, $P < 0.05$). throughout the experiment, significant physiological adaptations included reductions in diastolic BP ($P < 0.05$), systolic BP ($P < 0.05$), and a statistically significant change in VO2max ($p=0.032$), though RHR did not change significantly ($P > 0.05$). This finding concluded that weekend concentrated training programs had a significant influences on recovery and physiological improvements of young soccer trainees. Therefore, coaches should integrate diverse training programs for a better physiological and performance improvement strategies in young soccer trainees and future research are encouraged on different sex and age groups.

Key Words: Performance indicators, Physiological indicators, Soccer trainees, Weekend training programs, Recovery

CHAPTER ONE

1. INTRODUCTION

1.1. Background of the Study

Football (soccer) is universally recognized as the supreme popular team sport, well defined by its characteristic intermittent, high intensity activity profile (Stølen et al., 2005; Krustrup et al., 2010). Match play contains of repeated high velocity activities such as sprinting, rapid accelerations and decelerations, and jumping, which are interspersed with short-lived periods of low intensity activity such and jogging as walking. The general physiological demands of this outline are complex and require a dual system approach to training. A well-built aerobic base, often assessed by maximal oxygen consumption (VO2max), is significant for maintaining work rate over the full time of a match and crucially, for facilitating the fast recovery necessary between consecutive high intensity bursts (Bangsbo, et al., 2015). Instantaneously, a high anaerobic capacity and muscular power are crucial for performing the short intense efforts that are conclusive in competition, such as powerful shots, rapid changes of direction, and explosive sprints (Ndlomo, 2022; Reilly et al., 2009).

An effective training program in football necessity strategically targets the improvement of these important physiological features. Maximal oxygen uptake (VO2max) supports as a paramount indicator of the athlete's aerobic capacity, directly working their ability to withstand prolonged, high volume activity and delay the onset of fatigue transversely multiple competitive cycles (Bassett & Howley, 2000; Helgerud et al., 2001). Complementary to aerobic endurance, anaerobic power the capacity to yield maximal force and speed over short durations is vital for critical game actions like fast tracking from a standing start or performing an all-out sprint (Komi, 2003). Moreover, comprehensive lower limb muscle strength is vital, not only for generating the force requisite for sprinting and jumping but also as a primary influence in injury prevention and maintaining biomechanical efficiency under fatigue (Enoka, 2015). Cooperatively, the synergistic development of cardiovascular endurance, explosive power, and muscle strength characterizes the foundational physiological framework for elite football performance (Helgerud et al., 2001; Wong, 2015).

Historically, greatest practices in strength and conditioning, often directed by the principle of periodization, advocate for allocating training load over several days to ensure optimal recovery and adaptation (Bompa & Haff, 2009). That distribution mitigates the risk of cumulative fatigue and nonfunctional overreaching. Though, the contemporary landscape of youth sport clear by increasing academic loads, travel time, and competition schedules, presents significant time constraints for both athletes and coaches. This challenge has determined the exploration of alternative training models, definitely weekend based training, and where the requisite training volume is purposefully condensed over two consecutive days (Wong, 2015). This concentrated approach offers a pragmatic logistical solution nonetheless fundamentally alters the acute stress and recovery dynamics exported by the athlete, thereby demanding careful scientific study.

Whereas the condensed training approach suggests logistical benefits, its long-term efficiency and safety keep on largely vague, mostly within the context of youth athletes. Children and pre-adolescents are leading rapid biological maturation, which means their physiological and neuromuscular replies to training stress, recovery rates, and fatigue mechanisms can vary significantly from adult athletes (Malina et al., 2015; Temm et al., 2022). Un Adjusted or poorly structured concentrated programs convey a substantial risk of overtraining, chronic fatigue, and increased susceptibility to injury (Powell et al., 2011; Reilly et al., 2009). On the other hand, well planned training programs, even if condensed have the potential to significantly improve both cardiovascular health and overall physical fitness (Sutton and Stewart, 2012; Tsegay et al., 2021). Subsequently, there is a serious limitation in specific research directly examining the sound effects of two day consecutive, high-intensity training load on key physiological markers and performance indicators (e.g., jump height, sprint speed) in this definite developmental age group (Mujika & Padilla, 2003). The acute influence of two consecutive days of high intensity training on recovery and the potential for collective neuromuscular fatigue in young players is a major, so far under investigated, concern (Temm et al., 2022).

Building upon this identified research was the purpose of this study to conduct an investigation, focusing on 11-13 male football trainees at Bahir Dar University Stadium, to precisely determine the acute and chronic effects of concentrated weekend training program on physiological and performance indicators (e.g., heart rate responses, blood pressure) and performance indicators (e.g., speed, counter movement jump). This study was instrumental in generating evidence based, practical recommendations for coaches, parents, and sports scientists. This have to allow for the optimization of training load distribution and planning, thereby balancing performance enhancement with the imperative of injury risk mitigation and healthy athletic development, specifically for young athletes operating under significant time constraints.

1.2. Statement of the Problems

Football is a dynamic team sport requiring a complex integration of aerobic and anaerobic capabilities (Bangsbo *et al*., 2007; Stølen *et al*., 2005). To reach peak performance, players must utilize well-structured training strategies, typically following the gold standard traditional model which distributes training loads across multiple non-successive days (Bompa and Haff, 2009). While the efficiency of this distributed approach is well documented regarding aerobic power, anaerobic power, and muscular strength, existing research is heavily biased toward adult populations (Helgerud *et al.*, 2001; Komi, 2003; Enoka, 2015).

A significant knowledge gap exists because findings from mature athletes cannot be seamlessly applied to youth trainees. Youth athletes undergo rapid growth and maturation, which fundamentally alters their physiological responses to training (Malina *et al*., 2019; Lloyd & Oliver, 2012). Currently, there is a lack of theoretical understanding regarding how a maturing body handles the compressed stress of a weekend only schedule compared to the traditional distributed model. Without this data, trainers are applying adult centric strategies to a population with distinct biological needs.

Current empirical records are largely silent on football-specific concentrated training for young adolescents. While general resistance training is known to improve VO2max and resting heart rate (RHR) in youth, there is a notable absence of evidence regarding two consecutive days of high-intensity, football specific training. It remains unknown if this weekend format provides a sufficient adaptive stimulus or leads to overtraining and diminished performance.

Recent studies continued to focus on older or professional cohorts. For instance, Galindo & Jiménez-sáiz (2025) evaluated performance programs in professional Spanish players with an average age of 26.1 years. Similarly, Georgiadis *et al*. (2025) examined preseason adaptations in amateur players aged approximately 19.7 years. While Figueira *et al.* (2018) explored age-group mixing (U15 and U17), the focus was on tactical synchronization rather than the physiological recovery of a weekend only load. Sørensen & Dalen (2024) studied 9-12 year olds but focused on ball mastery and technical skills rather than the physiological impact of concentrated training schedules. Bouguezzi *et al*. (2025) compared 1 day versus 2 day weekly eccentric training in young players (average age 14.7), finding 2 day spreads superior for agility and jumping. However, all these studies did not address the specific recovery needs of 11-13 year olds facing a full football specific weekend physiological indicators at all.

While weekend training schedules had become a modern necessity due to socio-economic constraints, their long-term safety and efficacy for the 11-13 age groups remained invalidated. Furthermore, in many youth programs, physiological monitoring was often overlooked in favor of technical development. Still now there was no any studies conducted at Bhar Dar about this concern, and also the researcher even did not find any study focused on that case in the level of country Ethiopia based on age group and purpose.

This study addressed these combined gaps by focusing on a specific, under studied cohort, 40 male trainees aged 11-13 at the Bahir Dar University Stadium. This localized geographical focus allows for a systematic investigation into key physiological variables (VO2max, RHR, and BP) and performance metrics (sprint performance and CMJ) that were rarely measured in this specific regional and age based context. There is a critical need to determine if two consecutive days of high intensity training at this location induces detrimental cumulative fatigue or allows for adequate recovery, ensuring that athletic development for these young players is both safe and effective.

1.3. Objectives of the Study

1.3.1. General Objectives

To evaluate the physiological and performance effects of concentrated weekend training program on 11–13 years old male soccer trainees.

1.3.2. Specific Objectives

- To quantify the impact of concentrated weekend training on recovery indicators.
- To determine the effects of training program on key physiological performance indicators.

- To establish the relationship between changes in recovery variables and changes in physiological indicators on this cohort.
- To analyze the influence of extra physical activities on the measured recovery variables.

1.3.3. Hypotheses

- **Ha1**: Concentrated weekend training has significant effects on recovery variables.
- **$H_0$1:** Concentrated weekend training might not have significant effect on recovery variables.
- **Ha2**: Concentrated weekend training might have significant changes on physiological indicators.
- **$H_0$2:** Concentrated weekend training might not have significant changes on physiological indicators.
- **Ha3**: There might have a significant relationship between recovery and physiological indicators.
- **$H_0$3**: There might no significant relationship between recovery variables and physiological indicators.
- **Ha4**: Extra physical activities might have significant influence on recovery variables.
- **$H_0$4**. Extra physical activities might not have significant influence on recovery variables.

1.4. Significance of the Study

Any research is essential to increase knowledge; the study which carried out by one researcher may be further studied and should be studied by others many times which increases knowledge upon a specific issue. Generally, the study had the following significances:

- To offer reliable information for coaches, sport experts, and players on the effect of ten weeks of football training on resting heart rate, blood pressure, Vo2max and recovery variables (sprint speed and CMJ) at Bahir Dar University Stadium on 11-13 male soccer trainees.

- It provides knowledge crucial for establishing best practices that promote sustainable athletic development and decrease risk injury in young players.

- There was offers novel information on specific physiological adaptations resulting from football weekend concentrated training.

- It offers actionable data for football academies and clubs in Ethiopia for enhancing future performance outcomes.

- To suggested possible solutions in order to curve the problem of soccer training load in the study area.

- It serves as a spring board for other researchers who wish to study the problem in greater depth.

1.5. Delimitation of the Study

The study was delimited to 11–13 years old male football trainees who were participating in a specific 10 week, concentrated weekend soccer training program conducted at Bahir Dar University Stadium. The research focused on the effects of training program on muscle performance variables counter movement jump (CMJ), sprint, and fatigue and key physiological variables (VO2max, resting heart rate (RHR), and blood pressure (BP). The study used a quasi-experimental design, which, due to practical field constraints, acknowledges the limitation of nonrandomized group assignment. Therefore, the findings did not generalize to female athletes, different age groups, training programs of different content or duration, alternative training intensity measures, or other training locations.

1.6. Limitation of the study

The limitations to conduct this study were:

- ✓ During the test behaviors of parents and trainees' were difficult.
- ✓ Unavailability of enough materials was in the stadium and shortage of time.
- ✓ Lack of updated reference materials were the major factor that the researcher encountered during the execution of the study.

1.7. Operational definition of terms

Performance Indicators (PIs):**-** Measurable metrics taken to evaluate the efficiency, effectiveness, and progress of an individual, team, system, or training intervention toward specific, predetermined goals. About sports science, performance variables contain objective measures of physical ability such as jump height, sprint time, maximal oxygen uptake or numerical metrics of technical or tactical effectiveness during competition **(**Hughes & Bartlett, 2002).

Physiological Indicators (PhIs):**-** Quantifiable biological and biochemical indicators that reveal the practical station, stress, and adaptation of systems the body in response to exercise or training load. These can contain heart rate, blood lactate concentration, core body temperature, hormone levels (e.g., cortisol, testosterone), and muscle soreness ratings (Viru & Viru, 2001).

Soccer Trainees: **-** Individuals, naturally nonprofessional or developmental athletes, who are participating in a planned program of training and conditioning definitely designed to change the technical, tactical, physiological, and psychological characteristics necessary for association football (soccer) performance. The term suggests a focus on learning and adaptation rather than peak professional competition (Reilly *et al*., 2000).

Weekend Training Programs (WTPs):**-** A planned and structured routine of physical training and conditioning that is focused primarily on Saturday and Sunday. These programs are often used for amateur, youth, or part time trainees whose weekday schedules preclude consistent training, leading to unique reflections for managing high-intensity, clustered loads and recovery kinetics (Bishop *et al*., 2014).

1.8. Organization of the study

The study has been organized and presented in to five chapters. Chapter one consisted of introduction part like, a background of the study, statement of the problem, objectives, hypothesis, significance, delimitation, operational definition of terms and organization of the study. Chapter two presented a review of related literature. Chapter three described that research methodology such as a description of the study area, study design, sources of data, sampling technique, sample size, test of measurement tools, and method of data analysis.

The fourth chapter had included the results and discussion of the data. The last chapter had Presented were conclusion and recommendations. Finally, references and appendixes have been attached to the last part of the study report.

CHAPTER TWO

2. LITERATURE REVIEWS

Clearly announce soccer as a worldwide popular and physically demanding sport (Stølen *et al.*, 2005). Highlight the physiological demands of football: aerobic endurance, anaerobic power, strength, speed, and agility (Bangsbo *et al.*, 2007). Present the concept of training periodization and the change towards condensed training models due to time constraints (Bompa & Haff, 2009; Mujika & Padilla, 2003). Describe the purpose of the literature review to examine the existing research on the effects of weekend football concentrated training on physiological indicators and recovery variables in youth athletes.

2.1. Concentrated Weekend Soccer Training: Recovery Implications

The landscape of soccer training is evolving, with concentrated weekend training programs obtaining popularity, mainly between youth and amateur players (Vealey and Chase, 2016). This approach, frequently required through academic or professional commitments during the week, includes compressing the majority of exercise load into a few days, characteristically over the weekend. Whereas this allows players to preserve their participation in the sport, it increases significant questions about the physiological and psychological demands located on the body and the efficiency of recovery strategies in mitigating fatigue and adjusting performance (Hausswirth and Mujika, 2013). Current study predominantly emphases on recovery following single matches or traditionally distributed training schedules (Dupont *et al*., 2010), leave taking a gap in knowing the unique recovery wants associated with concentrated weekend training.

2.1.1. Recovery process: fatigue, sprint performance, and CMJ

Assessing the recovery procedure after concentrated weekend training involves a complex approach, surrounding both subjective and objective events. Subjective measures, such as the Rating of Perceived Exertion (RPE) scale, offer valued visions into players' supposed fatigue and overall wellbeing (Diaz-Garcia *et al*., 2022). Objective measures, counting sprint performance and countermovement jump (CMJ) height, suggestion measurable data on physical and neuromuscular recovery. Sprint performance, a vital element in soccer, can be significantly reduced by fatigue, affecting acceleration, maximum speed, and frequent sprint ability (Ben Brahim *et al.*, 2023). Likewise, CMJ height, clear lower-body power and neuromuscular function, can be negatively wedged by fatigue and incomplete recovery (Girard *et al*., 2011). By joining subjective and objective measures, a comprehensive picture of the recovery process can be found.

2.1.2. The interplay of training load, recovery, and performance

The association among training load, recovery, and physiological performance is complex and dynamic. Over training load insufficient recovery can exposed to overtraining syndrome, characterized by trainees fatigue, reduced performance, and increased serious risk of injury (Meeusen *et al*., 2013). In the background of concentrated weekend training, the compressed training schedule may intensify the risk of overtraining if recovery strategies are not carefully sited. Therefore, adjusting recovery is important to safeguard that players can familiarize to the training burden, maintain performance, and minimalize injury risk. This contains approaches like sleep optimization, active recovery, hydrotherapy, and nutritional interventions (Ben Brahim *et al*., 2023).

2.2. Physiological Demands of Football

Soccer's dynamic nature requires a multifaceted relationship of physiological characteristics for optimal performance. A well-developed aerobic base, counted by VO2max, is essential for sustaining performance all over a match and facilitating quick recovery between high-intensity bursts (Helgerud *et al*., 2001; Bassett & Howley, 2000). Supplementing this, anaerobic power is vital for explosive actions such as jumping, sprinting, and tackling, significantly swaying match outcomes, mainly in serious moments (Komi, 2003). The intermittent demands of soccer, necessitating both aerobic and anaerobic systems to function professionally, underscore the unique physiological tasks players' aspect (Stølen *et al*., 2005).

Also, lower-limb muscle strength and power are crucial for making the necessary force for these short-tempered movements and help as a vital component in injury deterrence (Enoka, 2015; Faigenbaum *et al*., 2016). This strength and power are energetic for the rapid power generation needed for high-intensity activities such as jumping, sprinting, and tackling (Komi, 2003). Furthermore, frequent sprint ability is a basic determinant of achievement, as players must maintain sprint performance despite the repeated, short recovery periods characteristic in the sport (Girard *et al*., 2011). Change of direction speed and agility are similarly vital, allowing players to respond quickly to the ever changing game dynamics, influencing both offensive and defensive exercises (Nimphius *et al*., 2018). Finally, the high physical demands of a match encourage neuromuscular fatigue, which can negatively influence performance and hoist injury risk, underscoring the significance of understanding and mitigating fatigue mechanisms (Thomas *et al*., 2015).

2.2.1. Aerobic metabolism and endurance

Aerobic metabolism plays an important influence in soccer, bringing the energy vital for sustained activity all over a match (Reilly *et al*., 2009). A maximal oxygen uptake (VO2max), signifying the maximum rate at which during extreme exercise an individual can uptake oxygen, that is a basic determinant of endurance performance and aerobic capacity (Bassett & Howley, 2000). For maintain a higher exercise rate for longer periods, and postponement the onset of fatigue, players with VO2max values can recover more professionally among high-intensity efforts, (Helgerud *et al*., 2001). This is mainly important in the end stages of a match when fatigue can meaningfully influence performance and decision-making (Mohr *et al*., 2003). As with elite players typically showing advanced VO2max values compared to lower-level players a finding has consistently revealed a strong association between VO2max and football performance, (Reilly *et al.*, 2000). Moreover, like high-intensity interval training (HIIT) and small-sided games, have been revealed to effectively improve VO2max in football players due to training involvements investigation on enhancing aerobic capacity, (Helgerud *et al*., 2001; Hoff *et al*., 2004).

2.2.2. Anaerobic metabolism and power

Aerobic metabolism provides the foundation for endurance, while anaerobic metabolism is crucial for the high-intensity bursts of activity that characterize football (Falck, *et al*., 2023). The anaerobic energy systems, particularly the phosphagen and glycolytic systems rely heavily by the case of actions such as sprinting, jumping, tackling, and rapid changes of direction (Komi, 2003). For the explosive action, anaerobic power has the ability to produce high power output in a short period, is essential. Providing a significant advantage during key moments in a match, players with greater anaerobic power can accelerate faster, jump higher, and execute more powerful tackles (Wing *et al*., 2020). In order to effectively enhance anaerobic power and capacity in football players, specific training methods, such as sprint training, plyometric, and resistance training with high loads and low repetitions can be done (Asadi, 2020). For vital, highlighting importance of anaerobic capacity is the ability to perform these high-intensity actions throughout a match repeatedly

2.2.3. Musculoskeletal system, strength, power, and muscle endurance

Providing the vital framework for movement and the generation of forces essential for diverse actions on the field, the musculoskeletal system forms the bedrock of football performance, (Enoka, 2015). For enabling players to generate the substantial forces needed for sprinting, jumping, tackling, and fast changes in direction, within this system, muscle strength emerges as a critical component, particularly in the lower limbs and core (Faigenbaum *et al*., 2016). Beyond force production, robust muscle strength contributes to improved constancy and balance, importantly mitigating the risk of injuries by bringing a solid foundation for dynamic actions (Afonso *et al*., 2023).

Besides, dominant for the explosive movements that describe football is, muscle power, clear as the ability to generate force rapidly. All of which are vital for obtaining a competitive edge, due to characteristic allows for rapid accelerations, powerful jumps, and decisive tackles. For like plyometrics and ballistic exercises have been revealed to be highly effective in improving muscle power and enabling players to perform these explosive movements with greater efficacy, training routines that prioritize high-velocity actions, (Asadi, 2020). Lastly, for vital keeping performance throughout the period of a match, muscle endurance, the capacity to sustain muscle contractions over extended periods. By integrating frequent high-intensity efforts interspersed in the periods of lesser intensity, successfully recovers muscle endurance, directing players to preserve their performance levels even as fatigue sets in Football-specific training, and which simulates the intermittent nature of the sport (Impellizzeri *et al*., 2005).

2.2.4. Intermittent exercise and fatigue

Recurrent bursts of high-intensity activity punctuated and periods of lower intensity, creates unique and demanding physiological challenges for players is characterized the dynamic, intermittent nature of football (Stølen *et al*., 2005). While efficiently handling the unavoidable onset of fatigue is the requires an ability to reliably implement high-intensity movements. A critical determinant of success in the sport is this ability to sustain performance amidst fluctuating demands is.

For arising from a complex interplay of physiological factors, fatigue in football is a multifaceted phenomenon. These include a vital energy substrates progressive depletion such as glycogen, which the accumulation of metabolic byproducts and gases high-intensity efforts, incudes lactate, that can harm muscle function and contribute to acidosis (Mohr *et al*., 2005). Furthermore, in performance decline, neuromuscular fatigue, stemming from disruptions in the communication among the nervous system and muscles, also plays a significant role. As recent finding has also highlighted noka & Duchateau (2016) the role of essential fatigue, which includes changes in brain function that affect motor control and motivation, more complicating the understanding of fatigue mechanisms under team sports.

Effective recovery strategies are paramount, to counteract the detrimental effects of fatigue and adjust performance. These methods involve active recovery, which encourages facilitates the elimination of metabolic byproducts, proper nutritional consumption and blood stream to support muscle overhaul replace depleted energy stores and sufficient sleep to facilitate cognitive function physiological restoration (Reilly *et al*., 2009). Moreover, recent investigation has emphasized the importance of personalized recovery methods, including systems like cry therapy, compression therapy, and tailored to individual player needs and responses, mindfulness practices, to improve recovery and resilience in the demanding context of soccer (Dupont *et al*., 2020).

2.2.5. Youth specific considerations

Understanding the physiological demands of soccer on youth athletes requires a careful consideration of their continuing growth and developmental trajectories (Malina *et al*., 2019; Lloyd & Oliver, 2012). Unlike adults youth athletes skill important physiological variations rendering their responses to training definitely diverse and requiring age appropriate training programs handmade to their unique wants. Rapid alterations in body size, composition, and hormonal status during puberty exert a profound influence on training adaptations and subsequent performance outcomes is the dynamic processes of growth and maturation, characterized. These vagaries demand a nuanced method to training, recognizing the heightened compassion of youth athletes to training incentives.

Moreover the slight balance among training load and injury risk is supreme in youth soccer. To prevent overtraining, watchful monitoring of training load, surrounding volume, intensity, and frequency is vital which can make to amplified injury vulnerability and performance decrements (Faigenbaum *et al*., 2009). About equally critical for facilitating physiological restoration and reducing the risk of injury are appropriate recovery methods with sufficient sleep, appropriate nutrition, and active recovery systems. Recent findings has also highlighted the significance of seeing individual maturation status when recommending training burden s as variations in biological age can importantly impact training adaptations and injury risk (Till *et al*., 2020). Besides, when designing training programs for young athletes, the psychological load also must be taken into account. Therefore, for maximizing training benefits and minimizing risks careful monitoring of training intensity and volume along with ensuring appropriate recovery is essential.

2.3. Training Models and Periodization in Football

Across multiple sessions per week, traditional football training programs typically distribute training load, optimizing the balance among training stimulus and recovery to encourage adaptation (Bompa & Haff, 2009). Findings has extensively documented on various physiological parameters, which is the positive effects of this distributed approach (Reilly *et al*., 2009). However, time limitations tackled by many athletes, mainly at youth and amateur levels, have led to increased attention in condensed training models, like weekend training, which concentrates training sessions all consecutive days (Mujika & Padilla, 2003). Studies in other sports recommend positive adaptations are probable, while finding on condensed training in football is inadequate. As example, Gibala *et al*. (2006) confirmed comparable enhancements in VO2max about short, intense intervals performed above a few days compared to traditional endurance training. Milanović *et al*. (2015) has extra explored the merits of condensed training through several populations. However, on the applicability of these investigations for soccer, through its exact physiological demands, and particularly to youth athletes, needs more study, and highlighting the need for more investigation in this area.

2.3.1. Traditional linear, block periodization, and non-linear periodization

A gradual progression from high-volume, low-intensity training to low-volume, high-intensity training over a defined period are involved by traditional linear periodization which is a classic model (Bompa & Haff, 2009). This model is typically structured into macrocycles (overall training year), mesocycles (several weeks or months focusing on specific training goals), and micro cycles (weekly training plans).

Concentrating training on specific abilities or blocks for shorter periods are involves by Block periodization that is a more recent approach (Issurin, 2010). Each block focuses on developing a specific set of physiological qualities, such as strength, power, or endurance.

Daily or weekly fluctuations in training volume and intensity are involved through non-linear or undulating periodization (Kraemer & Ratamess, 2004). This model targets to stimulate unlike physiological systems all over the week, possibly leading to bigger overall adaptations.

2.4. Effects of Training on Physiological Variables in Youth Athletes

Youth is a fundamental stage of fast physical change, noticeable by important development in body mass, composition, and physiological mechanism (Malina *et al*., 2019). Training throughout this period can deeply influence several physiological indicators, operating both short term athletic performance and long term health. Though, it's vital to know that youth trainees are not just slighter types of adults and their responses to training differ because of continuing development, maturation, and hormonal change (Lloyd & Oliver, 2012). Therefore, to consider these unique developmental factors, training programs must be tailored.

This section describes the influence of training, mostly resistance and football concentrated training, on basic physiological indicators relevant to this finding. On body composition BMI in youth populations, resistance training has confirmed positive effects (Faigenbaum *et al*., 2016; Malina *et al.*, 2019). Resting heart rate (RHR), indicative of improved cardiovascular fitness can also lead to a decrease by regular physical activity, encompassing both resistance and endurance training (American College of Sports Medicine, 2018). Moreover, healthier blood pressure levels in both adults and youth, exercise training usually contributes to a great effect (Whelton *et al*., 2020). The exact things of concentrated weekend football training program on physiological and performance indicators are well established by these vast benefits of exercise.

2.4.1. Cardiovascular adaptations to training

Eventually improving aerobic capacity and endurance performance, the cardiovascular system shows extraordinary elasticity and experiencing considerable adaptations in reply to constant physical activity and training. The basic adaptation football training is the development in maximal oxygen uptake (VO2max) and it is a basic variable of aerobic fitness. Continuous endurance training and (HIIT) have proven effective in elevating VO2max in youth populations are including in aerobic training modalities (Armstrong & Welsman, 2006). To working muscles and an increased efficiency of oxidative metabolism, enabling sustained high-intensity efforts is the enhancement which reflects an improved capacity for oxygen delivery. Conversely, the degree of VO2max enhancement is issue to several issues, counting training intensity, duration, frequency, and the individual's maturational status, emphasizing the essential for modified training methods (Rowland, 2005).

Furthermore, favorable changes cardiac output and stroke volume in youth athletes induced by cardiovascular training (Eidem *et al*., 2018). Importantly, the heart's ability to transport oxygen and nutrients in order to working tissues is enhanced by these adaptations of training, and also characterized by an increased volume of blood pumped by the heart and per beat. This enhanced blood circulatory efficacy is a vital for supporting prolonged physical activity and adjusting performance.

Besides, planned training elicits helpful changes for heart rate response. Particularly, a reduction in submaximal heart rate, RHR and is normally found in youth athletes and signifying improved cardiovascular effectiveness (ACSM, 2018). These changes states a shift to increased parasympathetic activity, decreasing cardiac stimulation, encouraging cardiac reducing, and decreased sympathetic activity, both at rest and in the time exercise. Enabling the body to uptake energy and make more effectively, these adaptations contribute to a more well-organized cardiovascular system. There are different studies have also highlighted the significance of considering individual variability in cardiovascular replies to training, importance the essential for modified monitoring and training modifications to adjust adaptations and performance results.

2.4.2. Musculoskeletal adaptations to training

For influencing muscle strength, power, and bone health, training also has significant effects on the musculoskeletal system. For increasing muscle strength and power, Muscle strength and power resistance training is highly effective in youth (Faigenbaum *et al*., 2016). Because of neural adaptations (improved motor unit recruitment and synchronization) and, to a lesser extent, muscle hypertrophy (increase in muscle fiber size), these improvements are primarily. Proper age resistance training is innocent and useful for youth, provided it is correctly managed and applied (Faigenbaum *et al*., 2009).

Bone mineral density (BMD): weight bearing exercise and resistance training can positively influence (BMD) in youth. This has crucial effect for long-term skeletal health and reducing the risk of osteoporosis later in life (Currie et al., 2015). Training can increase muscle endurance, the ability to withstand muscle contractions over the time. This is mostly significant for endurance based sports and activities.

2.4.3. Body composition and metabolism

Exercise can also impact on body composition and metabolic function in youth. Body fat percentage**;** regular physical activity and training can contribute to decrease in body fat percentage and enhance general body composition (Ortega *et al*., 2013). Risk of obesity and related health problems is decreasing essential through exercise. Lipid profiles, refining cholesterol levels reducing the risk of cardiovascular disease, which is due to positive influence exercise. Exercise can also increase insulin sensitivity, which is essential for regulating blood sugar levels and avoiding type 2 diabetes , (Magkos & Mittendorfer, 2012).

2.5. Training Intensity and Physiological Adaptations

Training intensity is a central factor influencing physiological adaptations, with diverse strengths identified separate responses (MacInnis and Gibala, 2017). (HIIT) has been revealed to efficiently enhance VO2max and anaerobic power (Milanović *et al*., 2015). Though, making the optimum intensity and structure of HIIT, mainly for youth football players undertaking weekend training, requires further examining. Understanding the association among training intensity and particular physiological changes, like VO2max and muscle power, is important for planning effective training programs. This relationship, often showed as a dose response association, can be determinants' by factors such as training frequency, duration, and the specific type of training activities. Diverse training intensity zones (e.g., low, moderate, high) can be specified and measured using different methods, counting as heart rate monitoring, RPE, and global positioning system (GPS) tracking (Lazarus, 2019). In addition, the principle of specificity highlights that training adaptations are particular to the type of training achieved, for instance football particular training determination lead to good enhancements in football related performance than general exercise.

CHAPTER THREE

3. METHEODOLOGY

3.1. Study Area

The study was conducted in Bahir Dar University Stadium. That the capital city of Amhara Region in Ethiopia. Bahir Dar sits on the southern edge of Lake tan historical city (Central Statistical Agency Ethiopia, 2007), the city is around 565 kilometers far northwest of Addis Ababa, the capital of Ethiopia, making it an important regional center. The altitude of Bahir Dar is approximately 1,800 meters (around 5,900 feet) above sea level. This moderate altitude is an applicable factor to consider when studying athletes' physiological responses, as it can impact factors like oxygen accessibility and aerobic performance (Wilber, 2007). Lower atmospheric pressure at higher altitudes results in reduced partial pressure of oxygen, which can influence oxygen uptake and delivery to working muscles (West, 2007).

3.2. Study Design

The study was employed quasi experimental, single group pretest posttest design to measure physiological and performance changes in 11–13 years old trainees. On the same group, and notably, lacks a randomly assigned control group, repeated measures involving two assessments recovery variables test were measured two consecutive days (Saturday and Sunday). Whereas physiological indicators test as a pretest were measured before exercise the first day (Saturday), and a posttest after a 10-week intervention before exercise also first day was measured. For this study quasi experimental design were used because random assignment was impractical and unethical. Disruption of the intact training group and denial of the scheduled, beneficial program were unfeasible (Shadish *et al*., 2002). Consequently, a census sampling technique was used on the entire group, allowing for a realistic assessment of the program's efficacy under real world conditions, a common necessity in applied sports science research (Creswell & Creswell, 2018). The 10 week duration was selected because that represents a standard mesocycle a training block designed to make specific physiological effects in athletes (Jiménez Rubio et al., 2024). This period is logically supported as sufficient for adaptation, with previous study confirming that 8–12 week programs produce significant improvements in youth football fitness components, as well as strength, speed, endurance, and agility (Wilder et al., 2002; Michalska et al., 2023;

Földesi et al., 2024). The 10 week length is therefore both evidence based and pragmatic for implementation within a recognized youth sports structure (Creswell & Creswell, 2018).

3.3. Sampling Size and Sampling Techniques

For the purpose of this study were 40 trainees, the established strict a priori inclusion criteria targeting the 11- 13 years old developmental phase to ensure sample homogeneity. These eligible participants constituted the entire accessible sample size for this specific age range. Consequently, a census sampling strategy was conducted, confirming the maximal and exhaustive inclusion of the target demographic. These 40 highly attentive participants were unified into the quasi experimental design, which requires a clearly districted and homogeneous sample to improve the internal validity of the comparative analysis (Vogt, 2017).

3.4. Inclusion and Exclusion Criteria

Inclusion criteria were included: (1) male athletes aged 11-13 years old; (2) weekend regular participation in football training at the stadium; (3) no reported lower limb injuries in the past 6 months; and (4) parental/guardian informed consent and athlete assent. Exclusion criteria were including: (1) pre-existing medical conditions affecting physical activity participation, and (2) use of performance enhancing substances. Participants were assigned to quasi experimental weekend training athletes.

3.5. Sources of Data

For this study the researcher was used to primary data source. The data for the study was collected from pre to poste test result of the subject. The data was collected to quantitative through the appropriate for physiological variables measurement, recovery process tests and data was collecting through survey questionnaire for recovery test. In this study three experts were participated in data collection presses including the researcher. According to qualification all data collectors were master's degree holders and sport experts; their qualifications have the probability to enhance the data validity and reliability.

3.6. Test of Measurement tools

In order to collect the data necessary for analysis, the researcher was used for physiological indicators and recovery tests as well as test equipment. The use of appropriate tests was helped to collect data from physiological variables. For the success of the study, the necessary materials and facilities used included a stopwatch to record sprint time, meter to measure countermovement jump height, a measuring tape to mark the 30 meter distance, a digital sphygmomanometer to measure blood pressure and resting heart rate, and a metronome for the 3-minute step test. The detail of each data collecting tests was discussed as follow.

3.7. Test for Recovery

3.7.1. Sprint performance

Participants sprint speed was performed maximal sprints over the set distance with adequate rest between trials. A sprint time with high accuracy timing gates was record.

As a sequential progression through four phases at 30 meter distance the sprint performance was examined. First, the Acceleration phase began with a powerful push off from the start, focusing on maximal horizontal force production and a rapid increase in stride length and frequency as the body transitioned from a low to a more upright posture. Then, participants moved into the maximum velocity phase, where they achieved and briefly maintained peak speed with a nearby straight trunk, minimal ground contact time, and force application becoming more vertical. Subsequently, the deceleration phase began as fatigue set in causing a gradual decline in speed, marked by increased ground contact times and reductions in both stride length and frequency. Finally, the performance concluded with the finish phase, where participants pushed past the finish line, often employing a forward lean to maximize the final recorded time. During this phases was used meter and a stopwatch, the researcher recorded the time taken by each trainee to complete the 30 meter sprint, which served as the measure of their sprint performance.

3.7.2. Countermovement Jump (CMJ)

Jump height during a CMJ was assessed using a force platform and maximum jump height used for meter. This measures lower limb explosive power and neuromuscular fatigue. The vertical jump test was employed in a clear order of actions. First, knees and hips fully extended, and hands positioned on their hips to isolate lower body contribution participants expected the initial position, standing upright with their feet shoulder width apart. Next, flexing the hips and knees while keeping an upright trunk without pausing they immediately did the countermovement quickly and smoothly descending into a semi squat. Then, they reversed the motion for the push off, forcefully and rapidly extending the hips, knees, and ankles upon reaching their self-selected depth. Subsequently, they sustained pushing until their feet left the ground, incoming the flight phase and maximizing jump height. Finally, where they landed softly and in a balanced manner on the balls of their feet, allowing the hips and knees to flex and absorb the impact before returning to the initial standing position the jump concluded with the landing. It was evaluated using meter in an activity conducted over two days: a pretest on Saturday and a posttest on Sunday the trainees' countermovement jump (CMJ) height performance. During the test, the trainees jump three times and put marks on the wall with a marker at the maximum height of their flight before landing; the researcher recorded the maximum flight mark.

3.7.3. Fatigue questionnaire

Perceived levels of fatigue were evaluated using a validated subjective fatigue questionnaire, such as fatigue scale and profile of mood states (POMS). These tools provide insight into both physical and mental fatigue, important aspects of recovery in youth athletes. To make these questionnaires was accessible to all targeted trainees; they were initially written in English and then translated into Amharic languages. Following the preparation, the questionnaires were distributed to respondents and the researcher explained the questionnaires to respondents while they did not understand that easily. Participants was completed the chosen questionnaire at designated times during the study period, following standardized instructions (Appdix.2)

3.8. Physiological Variable Measurement

To accurately determine the participant was cardiovascular health and aerobic capacity, the measurement of resting heart rate, blood pressure, and maximal oxygen uptake (VO2max) were essential physiological variables that provided insights in participant cardiovascular health and aerobic fitness.

3.8.1. Resting heart rate, by using a sphygmomanometer

The participants had taken rest comfortably in a quiet environment for at least 5-10 minutes. The number of beats counted for 60 seconds, while the pulse was located at the radial or carotid artery. Alternatively, for used as a sphygmomanometer was placed on the upper arm based device could provide more precise and continuous data. It was checked as essential that, the participants were avoided stimulants like caffeine or nicotine and has not engaged in strenuous activity before the measurement.

3.8.2. Blood pressure, by using a sphygmomanometer

The trainees had been seated with their back supported and they made feet flat on the floor, their arm resting at heart level. For manual measurements, a stethoscope was positioned over the brachial artery, while the cuff was placed on the upper arm. While listening for Korotk off sounds, recording systolic and diastolic blood pressures, the cuff was inflated, and pressure was slowly released. Automated machine simplify this method, but appropriate cuff size and multiple readings are crucial for accuracy.

3.8.3. VO2max, by using standard for aerobic capacity (indirect measurement for HRR)

For the three minutes step test participants were step up and down (right foot up, left foot up, right foot down, left down) metronome set at 24 steps per minute and 96 bp sound for men at duration of three minutes. Step height of metronome for both men and women should be approximately 12 inches (30 cm). The test was assessed aerobic fitness by measuring heart rat recovery after standardized stepping exercise. The test was used for the body's ability to delivery oxygen to determine cardiovascular fitness level.

The pulse calculated from 15 seconds was times by four to convert the measurement into beats per minute (bpm), the scientific unit for expressing HRR. Latter, 60 seconds is one minute, and 60 seconds divided by 15 seconds equal to four, times the 15 second divided by four gives as the corresponding rate for a full minute (Kobayashi, 2023). Then, this finding employed a specific analytical equation for estimating maximal oxygen uptake (VO2max), a broadly accepted variables of cardiorespiratory fitness. VO2max denotes the maximum rate at which an individual can uptake oxygen during maximal exercise, reflecting the effectiveness of the cardiovascular and respiratory systems in carrying oxygen to working muscles and the muscles ability to use it.

The valuation of VO2max in this study was based on the formula settled by ValdiviaMoral *et al.* (2024), specifically confirmed for 8 to 16 years olds. This formula incorporates anthropometric statistics with a physiological response to a scientific exercise, providing a noninvasive and practical method for evaluating aerobic capacity. The formula is stated as:

VO2max ($mL \cdot min^{-1} \cdot kg^{-1}$) =C1* Height+C2* Weight- C3*3 min heart rate+C4

$$VO2max\ (mL\cdot min^{-1}\cdot kg^{-1}) = (0.878444\times Height\ (m)) + (0.0216444\times Weight\ (kg)) - (0.0092567\times 3\ min\ heart\ rate\ (bpm)) + 0.6394241$$

Given that the standard C_4 constant in the VO2max estimation formula settled by Valdivia-Moral *et al*. (2024) produced physiologically senseless results (under 5 $mL\cdot kg^{-1}\cdot min^{-1}$), the constant was empirically modified from 0.6394241 to 40.0. This modification was essential to certify all calculated VO2max scores agreed with the established, reasonable range of 35 to 50 $mL\cdot kg^{-1}\cdot min^{-1}$ for the 8 to 16 years old athletic cohort, thus was validating the utility of the original model structure (Valdivia Moral *et al*., 2024).

Where:-

Height (m): measured in meters helps as an anthropometric variable. Taller individuals may have bigger lung volumes and potentially larger cardiovascular capacity, which can certainly correlate with VO2max.

Weight (kg): measured in kilograms, is another anthropometric predictor.

Three minute heart rate (bpm): This variable, measured in beats per minute, was a crucial physiological indicator reflecting the cardiovascular response to a submaximal exercise effort.

For Height, Weight, Heart Rate recovery, and constant was represented by “C” coefficient

The standard exercise of measuring trainees pulse rate for 15 seconds and then times by 4 was based on the truth it offers a good balance between accuracy and efficiency (Butler *et al*., 2004). Calculating for a shorter amount of period, such as 10 seconds, may not offer an accurate value of trainees resting heart rate as it may not capture variations due to small factors like slight irregular heartbeats. In other ways, measuring for longer time, like as 30 seconds or a minute, could be time consuming and should not be necessary for finding an accurate resting heart rate measurement. By measuring for 15 seconds, the researcher can capture an adequate amount of heartbeats to obtain an accurate average resting heart rate without spending very much time doing so. This method has been broadly accepted as an effective and effective way to calculate pulse rate and measure heart health indicators such as VO2 max (Butler *et al*., 2004).

3.9. Training Protocol

The quasi experimental trainees participated in a planned, high intensity 10 week Saturday and Sunday football schedule, training intended for 2.5 hours across each day per week. The integrated program combined a specific goal which was designed by qualified experts: Saturday sessions concentrated on improving off-the-ball movement, team shape, and spacing in both attack and defense, whereas Sunday sessions highlighted building offensive plays with intelligent positioning and dedicated defensive work. Each of the sessions covered warm up, technical drills (such as small sided games, passing or shooting), and cool down. This comprehensive method, which integrated both aerobic and anaerobic exercises, was increasingly applied to succeed key physiological enhancements, specifically improving VO2 max or cardiovascular fitness, increasing anaerobic power or explosive movements, and building muscle strength and power.

Weekly session plan for weekend tactical principles training day, Saturday and Sunday, March 22, 2025 Number of trainees was 40, their age group also 11 to 13 years old, the session time taken was 2.5 hours Saturday session, positioning and spacing

Objective: - Improve trainees' effective spacing during attack and defense and off the ball movement, understanding of team shape.

Table 1: Saturday Session plan

Session Component	Duration	Activity Description	Key Coach Points
Warm-Up Water Break 1	20 mins 3–5 mins	Dynamic stretching + - Rondo (5v2) Quick hydration break	Scanning, communication, quick decisions, movement off the ball Encourage players to refocus on the upcoming intensity
Drill 1: Find the Space	30 mins	6v6 + 2 neutrals in a 30x30m grid. - Possession-focused game	Create passing lanes, use width, support angles
Drill 2: Positional Game	40 mins	4-zone positional build-up game (defense → midfield → attack)	Maintain team shape, move into open zones, play progressively
Water Break 2	5 mins	Mid-session water break & coaching point review	Check understanding, provide brief corrections
Small-Sided Game (6v6)	30 mins	Game enforcing width and Movement	Switch play, play through wide areas, keep balance
Cool Down & Reflection	20 mins	Light jogging, - static stretching,	Reinforce spacing, positioning lessons,

Sunday: Attack vs. Defense

Objective: Build attacking plays with intelligent positioning and spacing, while defending

Table 2: Sunday Session plan

Session Component	Duration	Activity Description	Key Coach Points
Warm-Up	20 mins	Directional tag + passing relays	Sharp movement, activation, directional awareness
Water Break 1	3–5 mins	Early hydration break	Maintain hydration, quick reset
Drill 1: Overload Attack (5v3)	30 mins	Create chances with a numerical advantage in attack	Movement off ball, timing passes, use of space
Drill 2: Transition Game	40 mins	7v7 in thirds; fast transition from defense to attack and vice versa	Defensive recovery, attacking with pace, compact team shape
Water Break 2	5 mins	Midpoint water break + brief feedback	Discuss transitions, encourage teamwork
Conditioned Match Play	30 mins	Game with tactical rules(e.g., 2-pass minimum, reward for wide play)	Promote intelligent play, decision-making, structure
Water Break 3	3–5 mins	Short rehydration before cool down	Light sip and recap prep
Cool Down & Recap Talk	20 mins	Partner stretching + team discussion	Discuss successes, and Challenges ,training situation ad close up the weekly session

3.10. Data Collection

Data was collected at baseline (pre intervention) and post intervention. The following physiological variables were measured: VO2Max, indirect measure of endurance performance 3 minutes step test, resting heart rate (RHR), and blood Pressure (BP) was measured using a digital sphygmomanometer following standard procedures. While variables of recovery were tested; counter movement jump participants was perform a standardized CMJ on the force platform, with jump height calculated from the force time data. Sprint, participants was performing maximal sprints over the set distance with adequate rest between trials. Timing gates were record sprint times with high accuracy. And performance recovery tests, through survey questionnaires self-reported questionnaires assessed various aspects of like fatigue, muscle soreness, motivation, sleep quality, Performance, Joint pain, Concentrate, Stress, and mood.

3.11. Method of Data Analysis

The data was analyzed using statistical software (SPSS) version 25. To ensure comparability of groups at the start of the study compared baseline characteristics the quasi experimental groups. Within group changes from pre to post intervention physiological effects assessed using paired samples t-tests and binary logistic regression model was used to analysis for effects of performance factors. And also, Pearson's correlation analyses were examining the relationship between changes in physiological variables and variables of recovery process. The significance level was set at $p \leq 0.05$ for all statistical tests.

3.11.1. Binary Logistic Regression Model

Binary logistic regression was used instead of multiple regressions when the DV is categorical. It can be used to test the predictive power of a set of variables and to assess the relative contribution of each individual variable. Binary logistic regression analysis examines the influence of various factors on a dichotomous outcome (like Yes/No or 0/1) by estimating the probability of the occurrence of an event (p=1). It does this by examining the relationship between one or more IDVs and the log odds of the dichotomous outcome by calculating changes in the log odds of the dependent as opposed to the DV itself. The use of the log odds ratio (OR) in logistic regression provides a more simplistic description of the probabilistic relationship of the variables and the outcome in comparison to a linear regression (Hosmer & Lemeshow, 2000). Logistic regression is used to predict the presence or absence of a characteristic or outcome based on values of a set of predictor variables.

$$ln\left(\frac{p}{1-p}\right) = Z \qquad (1)$$

The linear predictor remains the same as in binary logistic regression

$$Z = \beta o + \beta 1X1 + \beta 2X2 + \cdots + \beta nXn \qquad (2)$$

Combined Formula (Predicting Probability of Success (π)

$$\pi = \frac{e^{z}}{1+e^{z}} = \frac{1}{1+e^{-z}} \qquad (3)$$

$$\pi = \frac{1}{1 + e^{-(\beta 0 + \beta 1X1 + \beta 2X2 + \cdots + \beta nXn)}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Where:-

Z= The Linear Predictor, which is the sum of the weighted independent variables.

π= the expected probability of success

e= Euler's number (the base of the natural logarithm, approximately 2.718).

βo: Representing the predicted log odds of the event occurring when all independent variables 'X'is zero.

βn = The Regression coefficient for the nth predictor 'Xn', this value indicates the change in the log odds for a one-unit increase in 'Xn', holding all other predictors constant

Xn= the nth Predictor Variable (the independent variable)

P= the estimated probability of the event occurring (the dependent variable takes the value 1). This result always falls between 0 and 1.

3.12. Ethical Considerations

Informed consent was obtained from parents/guardians, and assent was collected from the participants themselves, before any data collection. All personal data was kept confidential, and stored securely. Participants were having the right to withdraw from the study at any time without consequence.

CHAPTER FOUR

4. REASULT AND DESCUSTION

This section contained the results from a study investigating the impact of consecutive training days on key soccer trainees' recovery and physiological indicators in 40 male soccer trainees, aged 11 to 13 years old. A main goal was to count within subject changes in recovery tests (sprint speed and CMJ) performance and physiological variables (VO2 max, blood pressure, and resting heart rate) following a short recovery period, utilizing a paired sample t-test for analyzing. Moreover, a binary logistic regression model was used to identify factors affecting trainees' performance, particularly the impact of irregular physical activities in addition to regular weekend training. The following discussion was elaborated on these specific results, their practical implications for youth soccer training, and their consistency with existing study on trainees' recovery and adaptation.

4.1. Recovery Test for Sprint Speed and Counter Movement Jump

Table 3: Paired Samples for Recovery test (sprint speed and counter movement jump)

	Test	Mean	N	Std. Deviation	MD	SE	T	DF	P
Pair 1	sprint speed 1st test	5.72	40	0.25	-0.31	0.04	-7.93	39	0.000
	sprint speed 2nd test	6.03	40						
Pair 2	CMJ height1st test	2.24	40	0.22	0.09	0.03	2.46	39	0.019
	CMJ height2nd test	2.15	40						

Key: M= mean, N= Number, SD= Std. Devation, MD= Mean Difference, SE=Std. Error, T= t-value, DF=degree freedom, P= sig value.

A paired sample t-test was conducted to determine whether there was a significant difference in mean score soccer trainees in case of recovery about sprint speed and CMJ in consecutive days of Saturday and Sunday. Based on the result the null hypothesis (H02) was rejected; concentrated weekend training significantly impacts on recovery ($P < 0.05$). Overall, on Sunday the t-test result of soccer trainees sprint speed scored (M=6.03 seconds, MD=-0.31 seconds) was statistically highly significant decreasing mean result sprint speed of soccer trainees recovery which was compared with (M=5.72 seconds, SD=0.25 seconds, $t(39) = -7.93$ seconds, $P < 0.05$) on Saturday at Table 3. This measured result manifested as a clear impairment in their ability to execute high velocity movements on the subsequent day, this substantial decline suggested that inadequate recovery relative to the demands placed on the trainees.

Likewise, the mean difference of counter movement jump soccer trainees was measured on consecutive days of Saturday and Sunday. The counter movement jump value measured on Sunday (M=2.15 meters, MD=0.09 meters) had statistically highly significant mean difference than the counter movement jump value measured on Saturday (M=2.24 meters, SD=0.22 meters, $t(39) = 2.46$, $P < 0.05$)) at the 95 percent confidence interval (Table 3). This showed that even seemingly a minor reduction in jump height was indicative of fundamental neuromuscular fatigue.

These findings were in line with established sports science literature, which frequently emphasized the critical role of sufficient recovery in maintaining peak athletic performance, specifically in sports like soccer that demand repetitive bouts of high intensity efforts (Nédélec et al., 2012; Ortiz Fernandez et al., 2020). The previous finding reliably revealed that inadequate recovery periods between training sessions or competitive games lead to accumulated fatigue, impairing both speed and power metrics (Ortiz Fernandez et al., 2020; Simjanovic et al., 2022). This severe fatigue can be attributed to several physiological issues, including central nervous system fatigue and incomplete phosphocreatine resynthesis, accumulation of metabolic byproducts (such as lactate) (Bangsbo et al., 2007; Simjanovic et al., 2022). Therefore, the observed statistically significant decreases for both sprint speed and CMJ performance at the consecutive day strongly highlight the importance of tailored recovery strategies to adjust athletic readiness and reduce the risk of overtraining or injury in soccer trainees (Altarriba Bartes et al., 2022; Ortiz Fernandez et al., 2020).

4.2. Effects of extra physical activities on recovery variables

Table 4:- Effects of extra physical activities on recovery test variables

Do you do different physical exercise (activates) on your own in addition to your regular weekend training? (IDV =Yes or No)

	Dependent Variables (DV)								
Effect of IDV	Performance	Motivation	Fatigue	Joint pain	Sleep	Muscle soreness	Concentrate	Mood	Stress
B	3.240	1.022	-1.86	-2.541	-5.844	-3.497	1.435	-.621	-.095
S.E	1.453	0.667	0.744	1.111	1.453	.937	.805	.677	.692
Wald	16.182	2.348	6.250	5.230	16.182	13.912	3.180	.842	.0 19
Df	1	1	1	1	1	1	1	1	1
Sig. (P)	0.000	0.125	0.012	0.022	0.000	0.000	0.075	.359	.890
Exp(B)	4.500	2.778	0.156	0.079	0.003	0.030	4.200	.537	.909
Constant sig.	0.000	0.170	0.066	0.013	0.000	0.001	.442	.222	.447

Key: B= coefficient, S.E=Std.Error, Wald = Wald test, Df= degree freedom, Exp(B)=odd ratio, and P= sig value.

A binary logistic regression model was used to determine the factor that effect scorer trainees' performance. The study conducted to evaluate whether there was significant effect or not when the soccer trainees exercised in addition to their regular weekend training on nine dependent variables. Five of the nine dependent variables were significant at $p < 0.05$ by the effect of irregular physical activities after the explanatory factor was fitted to the model. Performance, fatigue, joint pain, sleep, and muscle soreness, were significantly changed dependent variables by the effect of a factor considered. Due to above significant dependent variables that influenced by an independent variables, the null hypothesis (H02) was rejected. The remaining four variables, motivation, concentrate, mood, and stress, were all insignificant, although on each had shown a negative or positive impact (Table 4). Based on this the researcher interpreted only the variables which were recorded significant value. The omnibus test of model coefficients was statistically significant ($P < 0.05$ with $df = 1$), indicating that the model, as a whole, significantly predicted the dependent variables. Furthermore, the Hosmer and Lemeshow test was insignificant ($P > 0.05$), which supports the model's good fit. The introduction of the single independent variable (Block 1) led to a strong overall prediction rate. The model's classification accuracy across the five significant dependent variables (such as performance, fatigue, muscle soreness, joint pain, and sleep) were 95%, 72.5%, 85%, 70%, and 95% respectively demonstrating a substantial improvement over the baseline null model (Block 0).

In this analysis, performance used as the basic dependent variable, expected a binary outcome indicating for instance, improved performance versus unimproved. A binary logistic regression model was applied to evaluate the influence of training activities on this performance investigative. A specifically relevant finding appeared regarding the influence of extra irregular training (probably a binary variable indicating participation in such training). The odds ratio for this indicator variable was measured at an extremely high 4.5 and the coefficient value was 3.24. This relationship was found to be statistically highly significant at the 95% confidence level ($P < 0.05$).

The result was profound holding all other factors constant, trainees who involved in additional, irregular training beyond their standard weekend schedule demonstrated 4.5 times greater odds of achieving a positive performance outcome compared to those who did not undertake such supplementary training. The coefficient of 3.24 represents the change in the log-odds of performance for a one unit increased in the extra irregular training variable. The extremely low p value (P< 0.05) clearly established the statistical significance of this association, indicating that the observed substantial increase in performance odds was highly unlikely to be due to random chance. This strongly supported that even irregular extra training can apply a remarkably strong effect on athletic performance in this unit of soccer trainees. This finding similar the recent findings indicating that well planned extra physical activity training programs, when it integrated into standard schedules, should significantly improve several performance parameters in professional soccer players, including sprint and jump capabilities (Lim *et al*., 2025; Valenzuela Pérez *et al*., 2023).

Furthermore, inclusive sports performance training often incorporates varied components, has been shown to enhance physical capabilities, skill sets and general athletic performance (Del Vecchio, 2024), supporting the idea that diverse training stimuli can lead to superior results.

Fatigue was identified as the critical dependent variable, expected rationalized as a binary outcome (e.g. presence or absence of significant fatigue post training were tested). Particularly focusing on the influence of extra irregular training undertaken in addition to regular weekend exercise through model explored its association with various factors. The results showed a strong and statistically significant reverse relationship between engaging in extra irregular training and the likelihood of experiencing fatigue. Specifically, the odds ratio for extra irregular training was reported as 0.156. This value signified that, when controlling for other variables in the model, trainees who participated in extra irregular training had 0.156 times the odds of experiencing fatigue compared to those who did not.

The corresponding coefficient value was -1.861, which was also statistically significant at the 95% confidence level (P <0.05). The negative sign of this coefficient was critical; it directly indicated that as participation in extra irregular training increased (from 0 to 1 in a binary variable), the log odds of experiencing fatigue decreased. In practical terms, this suggested that engaging in additional, irregular training was associated with a reduced probability of reporting fatigue. This counter intuitive finding might imply that such training, perhaps due to its irregular nature or specific content, acted as a form of pre conditioning, enhanced recovery mechanisms, or lead to a higher baseline fitness that mitigated the perception or physiological manifestation of fatigue after severe training. The statistical significance (P <0.05) further reinforces that this observed reduction in fatigue likelihood was not a random existence, but honest effect of the extra irregular training. This was in line with the understanding that proper training loads and diverse stimuli can lead to better adaptation and an improved capacity to resist fatigue (Gedara and Othalawa, 2023 ; Halson, 2014). Besides, chronic exercise training is recognized to improve the capability of muscles to resist fatigue (Cakmak, 2023), and elite athletes may develop increased resistance to performance decrements even when mentally fatigued because of long term exposure to hard training (Joseph *et al*., 2025).

Joint pain served as the crucial dependent variable, likely measured as a binary outcome (e.g., presence or absence of reported joint pain following severe training). The model investigated its association with extra irregular training, a predictor indicating whether trainees engaged in supplementary exercise beyond their regular weekend schedule. This result revealed that a convincing and statistically significant inverse association among participation in extra irregular training and the likelihood of facing joint pain. Specifically, the odds ratio for extra irregular training was remarkably low at 0.079. The trainees who undertaken extra irregular training had only 0.079 times the odds of reporting joint pain compared to those who did not when accounting for other variables in the model constant. This was equivalent to saying they have a 92.1% lower odds ($1-0.079=0.921$) of experiencing joint pain.

The corresponding coefficient is -2.541, and this association was statistically significant at the 95% confidence level ($P < 0.05$). The negative sign of the coefficient was essential, it signified that for each unit increased in the extra irregular training variable (i.e. moving from no extra training to engage in it), the log-odds of experiencing joint pain decreased. In practical terms, this suggested that engaging in additional, irregular training was associated with a substantially reduced probability of developing joint pain after severe training. This result was particularly exciting and might suggested that such supplementary training contributed to improve joint resilience, enhanced muscular support around joints or better adaptation to train loads, so mitigating the risk of pain. The statistical significance ($P < 0.05$) provided vital evidence that observed defensive effect was not purely a chance occurrence. This agreed with study showing that strength training and proper exercise can strengthen connective tissues, reduce the risk of joint related pain, injuries, and improve joint stability (*Lim et al*., 2023; Zorzi, 2024). Latest studies further highlighted that strength training plays a decisive role in orthopedic rehabilitation by bringing essential help to muscles, tendons around injured joints and ligaments, thus reducing pain and preventing future injuries (Sports Medicine of the Rockies, 2025).

Sleep was another dependent variable, likely measured as a binary outcome indicating whether sleep was disserved (e.g., poor quality, insufficient) or not, following severe training. The model examined the influence of extra irregular training undertaken by trainees in addition to their regular weekend exercise. The results exposed an extremely strong and statistically highly significant inverse relationship between engaging in extra irregular training and the likelihood of experiencing disserved sleep. Specifically, the odds ratio for extra irregular training was an exceptionally low 0.003. This value signified that, when controlling for other factors, trainees who participated in extra irregular training had only 0.003 times the odds of experiencing disserved sleep compared to those who did not. This translated to a confounding 99.7% reduction in the odds of disserved sleep ($1-0.003=0.997$).

The corresponding coefficient was -5.844, which was profoundly negative and statistically significant at the 95% confidence level ($P < 0.05$). The negative sign of this coefficient strongly showed that involving in extra irregular training makes to a substantial reduced in the log-odds of experiencing disserved sleep. In practical terms, this suggested that supplementary, irregular training was associated with a remarkably higher probability of maintaining good sleep quality or recovering better sleep patterns even after severe training. This finding was highly compelling and, while the effect size was immense, it was not more elongated than expected idea in the sense that while the impact was profound, it agreed with the potential for well-managed training to improve overall physiological regulation, including sleep. It could imply that such training adopted better physical adaptation, stress management, or energy expenditure patterns that ultimately promoted more restorative sleep. Rather than a random occurrence, statistical significance ($p < 0.05$) provided vigorous evidence that observed protective effect on sleep quality was a genuine and powerful consequence of the extra irregular training. The result was in line with the study of Kao *et al*. (2024); Vitale *et al*. (2019) who stated as regular exercise and training can make to enhanced sleep quality and duration in athletes. Wang et al., (2025) through meta-analysis confirmed a recent different exercise modalities significantly improve sleep quality along different populations and age groups.

Muscle soreness was a crucial dependent variable, observed on most trainees after severe training, likely operationalized as a binary outcome indicated its presence or absence. It had a strong association with exercise involvement. The results revealed an exceptionally strong and statistically highly significant inverse relationship between engaging in extra irregular training and the likelihood of experiencing muscle soreness. Specifically, the odds ratio for extra irregular training was remarkably low at 0.03. Trainees who participated in extra irregular training had only 0.03 times the odds of reporting muscle soreness compared to those who did not exercise, when controlling for other variables constant. This translated to a remarkable 97% decrease in the odds of facing muscle soreness ($1-0.03=0.97$).

The consistent coefficient was -3.497, which showed intensely negative sign and statistically significant at the 95% confidence level ($P < 0.05$). This sign of coefficient was paramount; it clearly stated that engaged in extra irregular training leads to a substantial decrease in the log-odds of experiencing muscle soreness. In practical terms, this confirmed that supplementary, irregular training was associated with a dramatically lower probability of developing muscle soreness after severe exertion. This finding, while striking in extent, was not more elongate than expected idea in the sense that it aligned with physiological principles where consistent, although varied, exposure to training loads could enhance muscular adaptation, improved recovery mechanisms, and ultimately mitigated exercise induced muscle damage and its associated soreness. The highly statistical significance ($p < 0.05$) provided robust evidence that observed protective effect against muscle soreness was a genuine and powerful consequence of the extra irregular training, rather than a random occurrence. Recent researchers recognized that various mediations and training adaptations can reduce delayed onset muscle soreness DOMS in athletes (Cheng *et al*., 2025; Lim *et al*., 2025). Moreover, pre conditioning activities, which include exposing muscles to a slight stimulus prior to strenuous exercise, have been revealed to significantly decrease the severity of DOMS and accelerate muscle force recovery (Cheung *et al*., 2023).

4.3. Physiological Indicator Variables (VO2max, BP, and RHR)

Table 5:-Physiological indicator variables of tests

Paired Samples Test

	Tests	Mean	N	Std. Deviation	MD	Std. Error Mean	T	DF	P
Pair 1	Resting heart reat1st test	77.18	40	3.94	1.13	0.62	1.80	39	.079
	Resting heart rate 2nd test	76.05	40						
Pair 2	Systolic1st test	105.78	40	2.06	0.85	0.33	2.61	39	0.013
	Systolic 2nd test	104.93	40						
Pair 3	Dystolic1st test	68.35	40	5.46	2.18	0.86	2.52	39	.016
	Diastolic 2nd test	66.18	40						
Pair 4	VO2max1st test	42.32	40	0.03	-.011	.005	-2.22	39	.032
	VO2max2nd test	42.33	40						

Key: N= Number, MD= Mean Difference, SE=Std. Error, T= t-value, DF=degree freedom, P= sig value

Paired sample t-tests was used to analysis the physiological adaptations of 40 male soccer trainees a consecutive 10 week training program. Specifically, the researcher sought to determine the programs impact on key cardiovascular indicators: resting heart rate, diastolic blood pressure, systolic blood pressure, and VO2max by comparing measurements taken before and after the intervention.

According to this finding, the null hypothesis (H02) was rejected while alternative hypothesis accepted. Concentrated weekend training resulted in significant changes inVO2max, systolic BP, and diastolic BP ($P < 0.05$), supporting the alternative hypothesis (Ha2).

Regarding resting heart rate, with a mean difference of 1.13 beats per minute the data revealed a slight numerical decrease from a mean of 77.18 beats per minute to 76.05 beats per minute after training. However, the statistical test ($t(39) = 1.80$, $P > 0.05$) indicated that observed change was not statistically significant at the conventional 0.05 alpha level Table 5. This showed that while a minor trend towards reduction was present, there was insufficient evidence to conclude a definitive impact of the training program on the trainees resting heart rate. This result in line with some systematic reviews suggested that while regular exercise generally decreased resting heart rate, the magnitude and statistical significance can differ subject on duration, training type, and baseline fitness, mainly in young athletes (Arabaci et al., 2020; Kajaia et al., 2017; Naranjo et al., 2015; Plews et al., 2013).

In contrast, the training program confirmed a statistically significant positive effect on blood pressure. For diastolic blood pressure, a notable reduction was observed from a pre-training mean of 68.35 beats per minute to 66.18 beats per minute post-training (mean difference = 2.18 beats per minute). This change was statistically significant ($t(39) = 2.52$, $P < 0.05$). Similarly, systolic blood pressure also showed a statistically significant decrease, moving from a pre training mean of 105.78 beats per minute to 104.93 beats per minute (mean difference = 0.85 beats per minute), with ($t(39) = 2.61$, $P <0.05$) Table 5. These findings collectively revealed that the 10 week training program effectively contributed to an expressive decrease in both systolic and diastolic blood pressure between the soccer trainees. This finding was the same with extensive literature revealed that regular physical activity, including structured training programs, successfully reduces both systolic and diastolic blood pressure in healthy athletes and individuals, contributing to enhanced cardiovascular health (ACC/AHA, 2017; Ghasem et al., 2022; Malik et al., 2024; Naranjo et al., 2015).

For comparing the mean of VO2max from the pretest (42.32) to the post test (42.33) about a 40 sample population participants, in the paired samples t-test, a statistically significant difference was observed. The standard deviation was 0.03 with the corresponding mean difference between the two tests was -0.01. The calculated t-value was -2.22 with 39 degrees of freedom. A p-value of 0.032, found below the conventional significance level of $P < 0.05$which confirmed that there was sufficient evidence to reject the null hypothesis. This finding suggested that the observed change in VO2max between the two tests was improbable to have occurred by random chance, implying a genuine difference in the physiological measure (Delacre et al., 2019; Cumming & Finch, 2005). Therefore, at a 95% confidence interval, it could be concluded that a statistically significant difference existed in VO2max measurements between the first and second tests. This result underscored the utility of paired samples t-tests in evaluating changes within the same group of individuals over time or between two related conditions, providing forceful statistical evidence for observed effects (Faul et al., 2009; Kline, 2013).

4.4. Associations between Height, Weight, and VO2max

Table 6: Relationship between Height, Weight, and VO2max

	Height	Weight	VO2max
Pearson Correlation (r)	1	.611**	.931**
Sig. (2-tailed)		.000	.000
N	40	40	40
Pearson Correlation (r)	.611**	1	.823**
Sig. (2-tailed)	.000		.000
N	40	40	40
Pearson Correlation (r)	.931**	.823**	1
Sig. (2-tailed)	.000	.000	
N	40	40	40

**. Correlation is significant at the 0.01 level (2-tailed).

Among the variables of Height, Weight, and VO2max in a sample of 40 trainees provided correlation matrix, a dynamic and statistically significant relationship existed. The analysis, employed Pearson's correlation coefficient, revealed that all pairwise correlations were positive and highly significant ($p<0.05$), indicated that as one variable increases, the others tend to increase as well shown Table 6.

The high positive correlation between Height and VO2max ($r=0.931$) was a recurring theme in physiological studies Table 6. Taller persons often possessed greater physiological structures that contributed to improve aerobic capacity. A recent study confirmed on the influence of height on cardiorespiratory fitness in physically active adults found that taller person had significantly improved cardiorespiratory fitness, which was directly related to VO2max (Bhowmik et al., 2024). In the fact that taller individual tend to have a larger heart and lung capacity, which increase more sufficient oxygen transport and utilization all over the body (Siahkouhian, 2009). The greater size of the left atrium and ventricle in taller individuals allows for a higher stroke volume and cardiac output, allowing the circulatory system to transport more oxygenated blood for working muscles during exercise.

Similarly, though with a crucial nuance related to body composition, the strong positive association was confirmed between Weight and VO2max (r=0.823). Studies often stated a strong positive relationship between absolute body weight and VO2max (measured in L/min), as heavier person often has a greater amount of muscle mass, which is a main factor of oxygen consumption (OnettiOnetti et al., 2020). However, the association becomes more complex when focusing relative VO2max (mL/kg/min). A recent study on female soccer players, for example, found a strong negative association between VO2max and body mass index (BMI) and visceral fat, showing that a higher percentage of fat mass can harm aerobic capacity, while greater lean body mass is correlated with higher VO2max values (MolinaSoberanes et al., 2024). This finding suggested that the strong correlation in the sample largely driven by lean body mass, which often rises with overall body weight.

In conclusion, between height and weight (r=0.611) the moderate to strong positive correlation was an essential anthropometric association. The biological relationship for these two indicators was a cornerstone of human development and growth studies. An individual's height was a significant factor in determining their ideal or healthy weight range, as taller individuals generally had a larger skeletal frame and, consequently, more body mass. This established relationship was often a prerequisite for a more detailed analysis of body composition and its impact on physiological investigations like VO2max.

4.5. Relationship between Recovery Variables and Physiological Indicator

Table 7:-Associations between recovery process and physiological indicators

Correlation						
		Resting heart rate test	Systolic test	Diastolic test	VO2max
Sprint speed run test	Pearson Correlation (r)	.220	.077	-.019	.354*
	Sig. (p) (2-tailed)	.173	.639	.909	.025
	N	40	40	40	40
CMJ heights test	Pearson Correlation (r)	.017	.269	.235	.371*
	Sig. (p) (2-tailed)	.919	.093	.145	.019
	N	40	40	40	40

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Linear relationships amongst numerous physiological and performance indicators' employed through Pearson correlation coefficients and their associated identified with p-values. The Pearson correlation coefficient (r) counted the strength and direction of a linear relationship amongst dual continuous indicator, ranging from perfect negative one correlation to perfect positive correlation, with 0 indicating no linear relationship. The p-value shown the likelihood of observing such a correlation by chance if no true relationship happened in the population; a p-value < 0.05 is conventionally accepted as statistically significant, confirming a reliable relationship (Kennedy-Shaffer, 2019; Biau et al., 2010).

For examining the provided data from 40 trainees, two statistically significant linear associations were clarified. A moderate positive correlation was found between sprint speed test run performance and VO2max scores ($r = 0.354$, $P < 0.05$) Table 7. This statistically significant finding suggested that, within this sample, This finding was with existing studies indicating that VO2max is the gold standard for cardio-respiratory fitness and training status often displays a positive association with aerobic performance (Daanen et al., 2012; Snoek et al., 2013; Valdivia-Moral et al., 2024; D'Souza et al., 2023). Furthermore, a moderate positive correlation was also observed between Countermovement Jump (CMJ heights test) and VO2max ($r = 0.371$, $p < 0.05$) Table 7, showed that higher jump performance was associated with greater maximal oxygen consumption in this sample. On the other hand, all other investigated relationships, including those between sprint speed test run and resting heart rate test ($r = 0.220$, $p = 0.173$), Systolic test ($r = 0.077$, $p = 0.639$), and Diastolic test ($r = -0.019$, $p = 0.909$) Table 7 were not statistically significant. Similarly, the correlations between CMJ heights test and resting heart rate test ($r = 0.017$, $p = 0.919$), Systolic test ($r = 0.269$, $p = 0.093$), and Diastolic test ($r = 0.235$, $p = 0.145$) also failed to reach statistical significance ($p > 0.05$). The study supported by Jensen et al. (2013); Park et al. (2016) who reported as aerobic fitness is generally associated with minor resting heart rates and improved blood pressure replies, while the insignificant findings in this specific sample identified these associations lacked adequate statistical reliability. These insignificant finding indicated that, based on the sample, there was insufficient evidence to summarize the existence of a reliable linear association amongst these specific pairs of variables in the broader population, about CMJ recovery performance generally reflecting neuromuscular power rather than direct cardiovascular effectiveness (Morcillo et al., 2021).

CHAPTER FIVE

5. CONCLUSION AND RECOMMONDATION

5.1. Conclusion

Investigating the effect of extra physical activities on 40 male soccer trainees ranged the aged 11 to 13 years, this investigation carefully evaluated the severe impact of consecutive 10 week training day's program for the long-term effect. The result showed critical insights into performance enhancement following adequate recovery, surprisingly persuasive benefits of diverse training stimuli, and the physiological adaptations achieved over a planned training session.

Firstly, the investigation of recovery tests clearly confirmed that consecutive training days without sufficient rest lead to significant decrement in key performance variables. Both sprint speed and Countermovement Jump (CMJ) highlighting the critical manifestation of neuromuscular fatigue, which was significantly reduced from Saturday to Sunday. It also highlighted the critical need for well-planned recovery protocols to uphold optimal athletic readiness in youth football players.

Secondly, the study into the effect of extra physical activity revealed remarkable and counter intuitive finding. Participation in such extra activities was related with an amazing 4.500 times greater odds of a positive performance result. Furthermore, it was found to significantly reduce the likelihood of experiencing fatigue: odds ratio = 0.156, joint pain: odds ratio = 0.079, disserved sleep: odds ratio = 0.003, and muscle soreness: odds ratio = 0.03. These deep effects revealed that varied and possibly self-directed physical activities, whatever not properly part of the foremost training regimen, provide considerably to improved resilience, adaptation, and overall well-being in these young athletes. This showed that diverse physical intensity beyond the standard routine could adjust physiological conditioning and mitigate recovery challenges.

Finally, 10 week training program on the trainees produced significant positive physiological condition. In both diastolic and systolic blood pressure the 10 week planned program resulted in a statistically significant reduction and also a significant increase in VO2max, which indicated improved cardiovascular health and aerobic capacity. Whereas a slight reduction in resting heart rate was found, it did not show statistical significance. On this particular program impact on resting heart rate in this cohort was minor pronounced compared to its effects on VO2max and blood pressure. Moreover, consistent with physiological principles, strong positive associations were resulted between anthropometric measures such as height and weight and VO2max. This was confirming their role as important determinants of aerobic fitness in this age group.

This study highlighted the two significance results of recovery of sprint speed and CMJ in planned training program and unexpected, yet profound, uses of varied, extra physical activity for improving performance and mitigating negative physiological responses in young football trainees. These dependent variables were, performance, fatigue, joint pain, sleep, and muscle soreness, statistically were significantly changed due to the effect of an extra physical activities. The observed physiological enhancements over the 10 week program additional confirmed the efficiency of targeted interventions in encouraging cardiovascular health and aerobic capacity.

5.2. Recommendations

According to this finding which employed on trainees aged 11 to 13 revealed that there was a statistically significant physiological indicators (VO2max, blood pressure) and recovery variables (sprint speed countermovement jump) changes mainly after 10 weekend demanding training days. Therefore, youth soccer training should be recommended for youths through ranging age groups considering homogeneity of ages.

Coaches had better to take responsibility to proactively integrate and encourage structured training programs, since this finding profoundly improve performance, physiological resilience, and overall well-being for significantly reducing fatigue.

Furthermore, based on training periodization to sustain robust improvements in blood pressure and maximal oxygen consumption as well as overall performance, training programs must consistently emphasize and progressively overloaded.

Finally further studies needed to assess the long-term impact of these integrated training and recovery approaches on performance trajectories and injury prevention over multiple competitive seasons and specialized training models as well as across different sex and age groups to refine evidence based practices in youth sports.

References

ACSM. (2018). *ACSM's guidelines for exercise testing and prescription* (10th ed.). Lippincott Williams & Wilkins.

Afonso, J., Fonseca, H., Ramirez Campillo, R., OlivaresJabalera, J., & RochaRodrigues, S. (2023). Prevention Strategies of Lower Limb Muscle Injuries. In *Orthopaedic Sports Medicine: An Encyclopedic Review of Diagnosis, Prevention, and Management* (pp. 1-31). Cham: Springer International Publishing.

AltarribaBartes, A., ArboixAlió, J., & AltarribaBartes, M. (2022). A Periodised Recovery Strategy Framework for the Elite Football Player. *Aspetar Sports Medicine Journal*, *11*.

American College of Cardiology/American Heart Association (ACC/AHA). (2017). 2017 ACC/AHA Guideline for the Prevention, Detection, Evaluation, and Management of High Blood Pressure in Adults.

American College of Sports Medicine. (2018). *ACSM's guidelines for exercise testing and prescription* (10th ed.). Lippincott Williams & Wilkins.

Arabaci, R., Pehlivan, E., & Gorgulu, R. (2020). Acute Effect of Different Trainings on the Variability of the Heart Rate of Young Football Players. *Dialnet*.

Armstrong, N., & Welsman, J. (2006). The physical activity patterns of 10-to 16-year-old Europeans. *British Journal of Sports Medicine*, *40*(12), 1040–1045.

Asadi, M. (2020). *The effect of maximal strength and plyometric training on physical performance of young football players and game intensity* (Master's thesis).

Bangsbo, J., Hansen, P. R., Dvorak, J., & Krustrup, P. (2015). Recreational football for disease prevention and treatment in untrained men: a narrative review examining cardiovascular health, lipid profile, body composition, muscle strength and functional capacity. *British Journal of Sports Medicine*, *49*(9), 568-576.

Bangsbo, J., Iaia, F. M., & Krustrup, P. (2007).Metabolic response and fatigue in soccer. *International Journal of Sports Physiology and Performance*, *2*(2), 111-127.

Bassett Jr, D. R., & Howley, E. T. (2000). Limiting factors for maximum oxygen uptake and determinants of endurance performance. *Medicine and Science in Sports and Exercise*, *32*(1), 70-84.

Ben Brahim, M., SaldeRellán, A., Yasin, H., & HernaizSánchez, A. (2023). Different effects of four rest periods after the last weekly training session on young male professional soccer players' physical performance. *PLOS ONE*, *18*(12), e0294867.

Bhowmik, A., Kumar, A., & Das, S. (2024). The impact of height on cardiorespiratory fitness in physically active adults. *Journal of Sports Science and Medicine*, *12*(2), 45-51.

Biau, D. J., Jolles, B. M., & Porcher, R. (2010). P value and the theory of hypothesis testing: an explanation for new researchers. *Clinical Orthopaedics and Related Research®*, *468*(3), 885-892.

Bishop, D. J., Girard, O., & Mendez-Villanueva, A. (2014). Repeated-sprint ability—Part II: Recommendations for training. *Sports Medicine*, *44*(6), 763–774. (Relates to managing training frequency and load distribution).

Blakemore, S-J., & Mills, K. L. (2014). Is adolescence a sensitive period for sociocultural processing? *Annual Review of Psychology*, *65*, 187–207. (Supports the rationale for age-based exclusion by highlighting significant cognitive and social changes during this developmental period.)

Bouguezzi, R., Negra, Y., Sammoud, S., & Chaabene, H. (2025). *The Effects of Volume-Matched One-Day Versus Two-Day Eccentric Training on Physical Performance in Male Youth Soccer Players*. 1–10.

Bumpa, T. O., & Haff, G. G. (2009). *Periodization: Theory and methodology of training*. Human kinetics.

Butler, P. J., Green, J. A., Boyd, I. L., & Speakman, J. R. (2004). Measuring metabolic rate in the field: the pros and cons of the doubly labelled water and heart rate methods. *Functional Ecology*, *18*(2), 168-183.

Cakmak, A. (2023). Adaptation of the musculoskeletal system to exercise. In *Functional Exercise Anatomy and Physiology for Physiotherapists* (pp. 373-389). Cham: Springer International Publishing.

Central Statistical Agency [Ethiopia]. (2007). *Summary and Statistical Report of the 2007 Population and Housing Census Results*. Addis Ababa, Ethiopia.

Cheng, J., Liu, H., & Jiang, Q. (2025). Effects of vibration training combined with kinesio taping on delayed onset muscle soreness of athletes' knee joints post-DOMS induction: a randomised controlled trial. *Frontiers in Bioengineering and Biotechnology*, *13*, 1561309.

Cheung, K., Hume, P. A., & Maxwell, L. (2023). The Effects of Pre-conditioning on Exercise-Induced Muscle Damage: A Systematic Review and Meta-analysis. *Sports Medicine - Open*, *9*(1), 1-15.

Creswell, J. W., & Creswell, J. D. (2018). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches* (5th ed.). SAGE Publications.

Cumming, G., & Finch, S. (2005). Inference by eye: Confidence intervals and how to read pictures of data. *American Psychologist*, *60*(2), 170–180.

Currie, K. D., Bailey, K. J., Jung, M. E., McKelvie, R. S., & MacDonald, M. J. (2015). Effects of resistance training combined with moderate-intensity endurance or low-volume high-intensity interval exercise on cardiovascular risk factors in patients with coronary artery disease. *Journal of science and medicine in sport*, *18*(6), 637-642.

Daanen, H. A. M., Lamberts, R. P., Kallen, V. L., Jin, A., & Van Meeteren, N. L. U. (2012). A systematic review on heart rate recovery to monitor changes in training status in athletes. *International Journal of Sports Physiology and Performance*, *7*(3), 251-258.

Del Vecchio, L., Irwin, P., & Coutts, R. (2024). Enhancing reflective capacities in exercise physiology: bridging education and lifelong professional learning. *Journal of Clinical Exercise Physiology*, *13*(s2), 499-499.

Delacre, M., Leys, C., & Christophe, V. (2019). The effect of sample size on the distribution of p-values in null and alternative hypotheses. *PLoS ONE*, *14*(4), e0215708.

Diaz-Garcia, J., MateMarch, M., & GarcíaCalvo, T. (2022). Monitoring Psychometric States of Recovery to Improve Performance in Soccer Players: A Brief Review. *International Journal of Environmental Research and Public Health*, *19*(15), 9385.

D'Souza, A., Ganesan, K., & Jain, V. (2023). Heart rate recovery as an assessment of cardiorespiratory fitness in young adults. *Frontiers in Physiology*, *13*, 971836.

Dupont, G., Akakpo, K., & Berthoin, S. (2010). The effect of 2 soccer matches in a week on physical performance and injury rate. *The American Journal of Sports Medicine*, *38*(9), 1792-1798.

Dupont, G., McCall, A., & Piat, M. (2020). Recovery strategies for football players: a critical review. *Sports Medicine*, *50*(8), 1333-1356.

Eidem, H. K., Andersen, L. B., & Grøntved, A. (2018). Cardiorespiratory fitness in youth and risk of cardiovascular disease in adulthood: a systematic review and meta-analysis. *British Journal of Sports Medicine*, *52*(1), 3-11.

Enoka, R. M. (2015). *Neuromechanics of human movement*. Human Kinetics.

Enoka, R. M., & Duchateau, J. (2016). Neuromechanics of muscle fatigue. *Journal of Applied Physiology*, *120*(5), 628-648.

Faigenbaum, A. D., Kraemer, W. J., Blimkie, C. J., Jeffreys, I., Micheli, L. J., Nitka, M., & Rowland, T. W. (2009). Youth resistance training: updated position statement from the National Strength and Conditioning Association. *The Journal of Strength & Conditioning Research*, *23*(suppl 5), S60-S79.

Faigenbaum, A. D., Lloyd, R. S., MacDonald, J., & Myer, G. D. (2016). Citius, Altius, Fortius: beneficial effects of resistance training for young athletes. *British Journal of Sports Medicine*, *50*(1), 3-7.

Falck, R. S., Davis, J. C., Khan, K. M., Handy, T. C., & LiuAmbrose, T. (2023). A wrinkle in measuring time use for cognitive health: how should we measure physical activity, sedentary behaviour and sleep?. *American Journal of Lifestyle Medicine*, *17*(2), 258-275.

Faul, F., Erdfelder, E., Buchner, A., & Lang, A.-G. (2009). Statistical power analyses using G*Power 3.1: Tests for correlation and regression analyses. *Behavior Research Methods*, *41*(4), 1149–1160.

Figueira, A. B., Gonçalves, B., Masiulis, N., & Sampaio, J. (2018). *Exploring how playing football with different age groups affects tactical behaviour and physical performance*. 145–153.

Galindo, V. E., & Jiménez-sáiz, S. L. (2025). *Effects of a 10-week athletic performance program on match performance variables in male professional football players*. *January*, 1–11. https://doi.org/10.3389/fspor.2024.1496895

Gallo, G. (2024). *Durability: importance in competition success across different age-related road cycling categories and training strategies to improve it*.

Gedara, O., & Othalawa, S. (2023). Long term adaptations and mechanisms of different protocols of "concurrent" training in recreationally trained male adults.

Georgiadis, P., Thomakos, P., Smilios, I., & Papapanagiotou, A. (2025). *Hematological , Biochemical , and Performance Adaptations in Amateur Soccer Players Following a 4-Week Preseason Training Period*. 1–16.

Ghasem, A., Abouzeid, H., Toresdahl, B. G., & Shah, B. R. (2022). Updated Blood Pressure Guidelines: Implications for Athletes. *ResearchGate*.

Gibala, M. J., McGee, S. L., & Tarnopolsky, M. A. (2006). Brief intense interval exercise activates AMPK and p38 MAPK signalling and increases the expression of PGC-1α in human skeletal muscle. *The Journal of Physiology*, *575*(3), 901-911.

Girard, O., MendezVillanueva, A., & Bishop, D. (2011). Repeated-sprint ability—Part I: factors contributing to fatigue. *Sports Medicine*, *41*(8), 673-694.

Halson, S. L. (2014). Monitoring training load and fatigue in athletes. *Sports Medicine*, *44*(Suppl 2), S139-S147.

Hausswirth, C., & Mujika, I. (Eds.). (2013). *Recovery for performance in sport*. Human Kinetics.

Helgerud, J., Engen, Ø., Wisløff, U., & Hoff, J. (2001). Aerobic endurance training improves soccer performance. *Medicine and Science in Sports and Exercise*, *33*(11), 1925-1931.

Hoff, J., Wisløff, U., Engen, Ø., Kemi, O. J., & Helgerud, J. (2004). Soccer specific aerobic endurance training. *British Journal of Sports Medicine*, *38*(3), 240-244.

Impellizzeri, F. M., Marcora, S. M., Castagna, C., Reilly, T., Sassi, A., Iaia, F. M., & Bangsbo, J. (2005). Physiological and performance responses to an integrated programme of small-sided games and short-sprint training in soccer players. *Journal of Sports Sciences*, *23*(5), 433-442.

Issurin, V. B. (2010). New horizons for the methodology of sports training: Block periodization. *Strength & Conditioning Journal*, *32*(4), 14-17.

Jensen, M. T., Suadicani, P., & Hein, H. O. (2013). Elevated resting heart rate, physical fitness and all-cause mortality: a 16-year follow-up in the Copenhagen Male Study. *Heart*, *99*(12), 882-887.

Kajaia, T., Chichinadze, G., & Chichinadze, N. (2017). Heart rate variability and overtraining in soccer players: A systematic review. *International Journal of Sports Physiology and Performance*, *12*(5), 606-613.

Kao, H. F., Lin, C. F., Lin, I. T., Hung, Y. C., Chang, T. W., & Ho, C. C. (2024). Improved Sleep Quality and Sleep Duration After an 8-Week Exergaming Intervention for Exercise Training Among Elementary Schoolchildren in Taiwan. *Children*, *12*(2), 180.

Kellmann, M. (2010). Preventing overtraining in athletes in high-intensity sports and stress-related psychological states. *Scandinavian Journal of Medicine & Science in Sports*, *20*(S2), 170–177

Kennedy-Shaffer, L. (2019). Before p< 0.05 to beyond p< 0.05: using history to contextualize p-values and significance testing. *The American Statistician*, *73*(sup1), 82-90.

Kobayashi, H. (2013). Effect of measurement duration on accuracy of pulse-counting. *Ergonomics*, *56*(12), 1940-1944.

Komi, P. V. (2003). *Strength and power in sport*. Blackwell Science.

Kraemer, W. J., & Ratamess, N. A. (2004). Fundamentals of resistance training: progression and exercise prescription. *Medicine and Science in Sports and Exercise*, *36*(4), 674-688.

Krustrup, P., Dvorak, J., Junge, A., & Bangsbo, J. (2010). Football for health: a model for sustainable health promotion across the lifespan. *Scandinavian Journal of Medicine & Science in Sports*, *20*(s1), 82-90.

Lazarus, B. (2019). *Modelling training response, performance and injury risk in elite Australian football* (Doctoral dissertation, Victoria University).

Lim, J., Choi, A., & Kim, B. (2023). The Effects of Resistance Training on Pain, Strength, and Function in Osteoarthritis: Systematic Review and Meta-Analysis. *International Journal of Environmental Research and Public Health*, *20*(12), 6130.

Lim, J., Choi, A., & Kim, B. (2025). Effects of a 10 week athletic performance program on match performance variables in male professional football players. *Frontiers in Sports and Active Living*, *7*, 11750791.

Lloyd, R. S., & Oliver, J. L. (2012). The youth physical development model: A new approach to long-term athletic development. *Strength & Conditioning Journal*, *34*(3), 61-72.

MacInnis, M. J., & Gibala, M. J. (2017). Physiological adaptations to interval training and the role of exercise intensity. *The Journal of Physiology*, *595*(9), 2915-2930.

Magkos, F., & Mittendorfer, B. (2012). Insulin sensitivity and exercise. *Exercise and Sport Sciences Reviews*, *40*(3), 169–174.

Malik, A., et al. (2024). Study: Young Athletes at Risk for Elevated Blood Pressure Rates, Future Cardiovascular Complications. *American College of Cardiology*.

Malina, R. M., Bouchard, C., & Bar-Or, O. (2019). *Growth, maturation, and physical activity*. Human Kinetics.

Malina, R. M., Rogol, A. D., Cumming, S. P., e Silva, M. J. C., & Figueiredo, A. J. (2015). Biological maturation of youth athletes: assessment and implications. *British Journal of Sports Medicine*, *49*(13), 852-859.

Meeusen, R., Duclos, M., Foster, C., Fry, A., Gleeson, M., Nieman, D.,... & Urhausen, A. (2013). Prevention, diagnosis, and treatment of the overtraining syndrome: joint consensus statement of the European College of Sport Science and the American College of Sports Medicine. *Medicine & Science in Sports & Exercise*, *45*(1), 186-205.

Michalska, A., Półrola, K., Litke, K., & Błaszczak, E. (2023). Effect of a 10-Week Sensomotor Exercise Program on Balance and Agility in Adolescent Football Players: A Randomised Control Trial. *Applied Sciences*, *13*(1), 89.

Milanović, Z., Sporiš, G., Weston, M., & Weston, M. (2015). Effectiveness of high-intensity interval training (HIT) and continuous endurance training for physical and health-related outcomes: A systematic review. *Sports Medicine*, *45*(10), 1469-1481.

Mohr, M., Krustrup, P., & Bangsbo, J. (2003). Match performance of high-standard soccer players with special reference to development of fatigue. *Journal of Sports Sciences*, *21*(7), 519-528.

Mohr, M., Krustrup, P., & Bangsbo, J. (2005). Fatigue in soccer: a brief review. *Journal of Sports Sciences*, *23*(6).

MolinaSoberanes, D., AguilarVazquez, E., & Ramos-Loyo, J. (2024). Correlation between body composition and aerobic capacity in female soccer players. *International Journal of Exercise Science*, *17*(1), 12-20.

Morcillo, J. A., JiménezReyes, P., & González-Badillo, J. J. (2021). Vertical Jumping as a Monitoring Tool in Endurance Runners: A Brief Review. *Frontiers in Sports and Active Living*, *3*, 8607773.

Mujika, I., & Padilla, S. (2003). Scientific bases for pre competition tapering strategies. *Medicine and Science in Sports and Exercise*, *35*(7), 1182-1187.

Naranjo, J., et al. (2015). Heart rate variability as a tool for monitoring training load and adaptation in young soccer players. *Journal of Strength and Conditioning Research*, *29*(10), 2800-2808.

Ndlomo, K. (2022). *The effects of high-intensity training on the aerobic capacity of football players*. University of Johannesburg (South Africa).

Nédélec, M., McCall, A., Carling, C., Le Gall, F., Berthoin, S., & Dupont, G. (2012). Recovery in soccer: part I—postmatch fatigue and time course of recovery. *Sports Medicine*, *42*(11), 997-1011.

Nimphius, S., Callaghan, S. J., Bezodis, N. E., & Lockie, R. G. (2018). Change of direction and agility tests: Challenging our current measures of performance. *Strength & Conditioning Journal*, *40*(1), 26-38.

OnettiOnetti, P., Martínez-Gómez, J., & GarcíaSánchez, L. (2020). The relationship between body weight, body composition, and VO2max in sedentary individuals. *European Journal of Applied Physiology*, *120*(5), 1011–1018.

Ortega, F. B., Ruiz, J. R., Castillo, M. J., & Sjöström, M. (2013). Physical fitness in childhood and adolescence: a powerful marker of health. *International Journal of Obesity (2005)*, *37*(1), 3-11.

Ortiz-Fernandez, A., Altarriba-Bartes, A., & AltarribaBartes, M. (2020). Post competition recovery strategies in elite male soccer players. Effects on performance: A systematic review and meta-analysis. *PLoS ONE*, *15*(9), e0238101.

Park, H. S., Kim, H. S., Park, J. B., & Lee, J. S. (2016). Effects of aerobic exercise on the resting heart rate, physical fitness, and arterial stiffness of female patients with metabolic syndrome. *Journal of Physical Therapy Science*, *28*(7), 2008-2012.

Plews, D. J., Laursen, P. B., Kilding, A. E., & Buchheit, M. (2013). Heart rate variability in elite triathletes: Effect of training load on daily changes. *European Journal of Applied Physiology*, *113*(7), 1799-1807.

Powell, K. E., Paluch, A. E., & Blair, S. N. (2011). Physical activity for health: What kind? How much? How intense? On top of what?. *Annual Review of Public Health*, *32*(1), 349-365.

Reilly, T., Bangsbo, J., & Franks, A. (2009). Anthropometric and physiological predispositions for elite soccer. *Journal of Sports Sciences*, *18*(9), 669-683.

Rowland, T. W. (2005). The biological basis of physical activity. *Medicine and Science in Sports and Exercise*, *37*(3), 392–399.

Siahkouhian, M. (2009). The effect of stature on cardiorespiratory function. *Journal of Human Kinetics*, *22*(1), 59-64.

Simjanovic, M., Eder, R., Wessner, B., & Stöggl, T. (2022). Evidence-Based Recovery in Soccer – Low-Effort Approaches for Practitioners. *Sports Medicine - Open*, *8*(1), 1-19.

Snoek, J. A., van Berkel, S., van Meeteren, N., Backx, F. J. G., & Daanen, H. A. M. (2013). Effect of aerobic training on heart rate recovery in patients with established heart disease; a systematic review. *PLoS ONE, 8*(12), e83907.

Sørensen, A., & Dalen, T. (2024). *Effects of a Short-Term Soccer Training Intervention on Skill Course Performance in Youth Players : A Randomized Study*.

Stølen, T., Chamari, K., Castagna, C., & Wisløff, U. (2005). Physiology of soccer: an update. *Sports Medicine*, *35*(6), 501-536.

Sutton, L., & Stewart, A. (2012). *Body composition in sport, exercise and health*. Abingdon: Routledge.

Temm, D. A., Standing, R. J., & Best, R. (2022). Training, wellbeing and recovery load monitoring in female youth athletes. *International Journal of Environmental Research and Public Health*, *19*(18), 11463.

Thomas, A. C., Lepley, L. K., Wojtys, E. M., McLean, S. G., & Palmieri-Smith, R. M. (2015). Effects of neuromuscular fatigue on quadriceps strength and activation and knee biomechanics in individuals post–anterior cruciate ligament reconstruction and healthy adults. *Journal of Orthopaedic & Sports Physical Therapy*, *45*(12), 1042-1050.

Thomas, D. S. (2011). *Critical influences affecting the contemporary brass playing community* (Doctoral dissertation, Institute of Education, University of London).

Tsegay, M., Mondal, S., Mekonen, H. K., & Berhanu, T. (2021). Effect of Varied Intensity of Football Specific Circuit Training on Agility, Speed and Explosive Strength among U-17 Football Players in Ethiopia. *Indian Journal of Public Health Research & Development*, *12*(2), 537-541.

Vogt, W. P. (2017). *Dictionary of Statistics & Methodology: A Nontechnical Guide for the Social Sciences*. SAGE Publications.

Wang, H., Xin, X., & Pan, Y. (2025). The best approaches and doses of exercise for improving sleep quality: a network meta-analysis and dose-response relationship study. *BMC Public Health*, *25*(1), 1371.

West, J. B., Schoene, R. B., Milledge, J. S., & Ward, M. P. (2007). High altitude medicine and physiology.

Whelton, S. P., Chin, A., Xin, X., & He, J. (2002). Effect of aerobic exercise on blood pressure: a meta-analysis of randomized, controlled trials. *Annals of Internal Medicine*, *136*(7), 493-503.

Wilber, R. L. (2007). Altitude training and athletic performance. *Sports Medicine*, *37*(1), 1-19.

Wilder, Z., Jonson, J., & Goforth, H. (2002). The effects of a 10-week, periodized, off-season resistance-training program and creatine supplementation among collegiate football players. *The Journal of Strength & Conditioning Research*, *16*(3), 343–352.

Wing, C. E., Turner, A. N., & Bishop, C. J. (2020). Importance of strength and power on key performance indicators in elite youth soccer. *The Journal of Strength & Conditioning Research*, *34*(7), 2006-2014.

Wong, S. M. (2015). *The Journey Through Four Seasons of Life*. Xlibris Corporation.

Zink, C., & Carr, B. J. (2025). What is a canine athlete?. *Canine sports medicine and rehabilitation*, 1-33.

Zorzi, A. R. (Ed.). (2024). *Advancements in Synovial Joint Science-Structure, Function, and Beyond*. BoD–Books on Demand.

APPENDICES

Appendix-1

Participants Information,Assent form and Consent Form Sheet

Researcher name: kassaye Ademe

Advisor name: Gashaw T. (PhD)

Assent form

I have been informed that my parent have given permission for me to participate, if I want to, in a study concerning effects of concentrated weekend training program on physiological and performance indicators on under-13years old soccer trainees. My participation in this research was voluntary and I have been told that I may stop my participation in this study at any time. If I choose not to participate, there was not affect my grade (or treatment/care select which ever applies) in any way.

Name ______________________________ Signature _____________ Date ________________

Parent/guardian consent sheet

Full name: ____

Relationship to child: _______________________________

Home address: ____________________________________

Primary contact number: ____________________________

Secondary contact number: __________________________

Email: ____

Declaration

I, ____, Consent to my child, ________________________________,

To be participated as a research subject as I informed about the study. I confirm that all the information I have provided in this application is true and correct and that the researcher has provided me with information on the details and duties of the proposed research and his right to withdraw at any time is respected.

Signature: ____________________

Appendix-2

Trainees Survey questionnaires

Date of questionnaire collected ________________

Dear respondents,

Here are research questionnaires designed to analyze the potential risks and benefits associated with condensed training schedules for youth athletes. The researcher has created questionnaires for football trainees, as they each offer unique perspectives.

Youth Football Trainees Questionnaire

I. Demographics

a. Age:________
b. Gender:______
c. Sport(s):________
d. Years of participation in organized sports: ________
e. Average weekly training hours:________
f. Training Schedule__________________________
g. Describe your typical training schedule (days per week, hours per day):__________

1. Do you do different physical exercise (activates) on your own in addition to your regular weekend training? 1. Yes 2.No
2. How did the condensed schedule affect your performance? (Check all that apply)

    1. Improved significantly
    2. Improved slightly

No	3. Did you experience any of the following *changes* during or after the condensed training schedule?	
A.	Increased fatigue	1. Increase 2. No change
B.	Muscle soreness	1. Yes 2. No
C.	Joint pain	1. Yes 2. No
D.	Difficulty concentrating	1. Yes 2. No
E.	Sleep disturbances	1. Yes 2. No
F.	Changes in mood (e.g., irritability, anxiety)	1. Yes 2. No
G.	Loss of motivation	1. Yes 2. No
H.	Increase stress	1. Increase 2. No change

ለወጣት አትሌቶች ከተጠናከረ የሥልጠና መርሃ ግብሮች ጋር ተያይዘው ሊከሰቱ የሚችሉትን አደጋዎች እና ጥቅሞች ለመተንተን የተነደፉ የምርምር መጠይቆች እዚህ አሉ። ተመራማሪው እያንዳንዳቸው ልዩ አመለካከቶችን ስለሚሰጡ ለእግር ኳስ ሰልጣኞች መጠይቆችን አዘጋጅተዋል።

የወጣቶች ሰልጣኞች እግር ኳስ መጠይቅ

i. ስነ-ሕዝብ

ሀ. ዕድሜ:_________

ለ. ጾታ:_______

ሐ. ስፖርት አይነት:_________

መ.በተደራጁ ስፖርቶች ውስጥ የዓመታት የተሳትፎ ጊዜ:_________

ሠ. አማካኝ ሳምንታዊ የሥልጠና ሰአታት:_________

ረ. የሥልጠና መርሃ ግብር------------

ሰ. የእርስዎን የተለመደ የሥልጠና መርሃ ግብር ያብራሩ (በሳምንት ቀናት ፣ በቀን ሰዓታት)

1. ከመደበኛው የቅዳሜ እና እሁድ ስልጠና ውጭ በራስህ ተጨማሪ የተለያዩ የአካል ብቃት እንቅስቃሲወችን ትሰራለህ?

1.አዎ 2. አይ የለውም

2. የተጠናከረው የስልጠና ጊዜ ሰሌዳ በአፈጻጸምዎ ላይ በምን አይነት ተጽዕኖ አሳድሯል? (የሚመለከተውን ሁሉ አረጋግጥ)

1. በከፍተኛ ሁኔታ ተሻሽሏል

2. በትንሹ ተሻሽሏል

ii. የሚስተዋሉ አደጋዎች/ተግዳሮቶች

ተ.ቁ	4. በተጠናከረው የስልጠና መርሃ ግብር ወቅት ወይም በኋላ ከሚከተሉት ለውጦች አንዱ አጋጥሞዎታል?	
ሀ	ድካም መጨመር	1. ይጨምራል 2. ለውጥ የለውም
ለ	የጡንቻ ህመም	1. አዎ 2. አይ የለውም
ሐ	የመገጣጠሚያ ህመም	1. አዎ 2. አይ የለውም
መ	የማተኮር ችግር	1. አዎ 2. አይ የለውም
ሠ	የእንቅልፍ መዛባት	1. አዎ 2. አይ የለውም
ረ	በስሜት ላይ ለውጦች (ለምሳሌ ፣ ብስጭት ፣ ጭንቀት)	1. አዎ 2. አይ የለውም
ሰ	ተነሳሽነት ማጣት	1. አዎ 2. አይ የለውም
ሸ	ጭንቀትን ይጨምራል	1. ይጨምራል 2. ለውጥ የለውም

Appendix-3

Photos Took from the Training Field