EFFICACY OF EIGHT WEEK SOCCER TRAINING PROGRAMME ON MUSCULAR FITNESS AND CARDIOVASCULAR ENDURANCE: CASE OF STRATHMORE SCHOOL, NAIROBI CITY COUNTY, KENYA

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DECLARATION

This thesis is my original work and has not been presented for a degree in any other University.

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DEDICATION

To the many athletes and sports enthusiast in Kenya and around the world, I dedicate this masterpiece to you. The mind shift that you help to create in people in matters pertaining health and wellness is so profound and has in turn led to the world viewing the extent to which the human body can be pushed from a different perspective. I also dedicate this work to everyone who supported me along this path especially the late Ryan Kigo who passed away after a short illness. Finally, I dedicate this work to my family for always having my back, giving me support and the extra inspiration when I needed it.

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I am grateful that God Almighty enabled me to come to this point of completing my thesis. His grace has sustained me and kept me safe. He has blessed me with good health and also the zeal and determination to push on without getting tired in the process.

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ABBREVIATIONS AND ACRONYMS

ACSM	-	American College of Sports Medicine
CE	-	Cardiovascular endurance
CF	-	Cardiovascular Fitness
CS	-	Cross-Sectional
HIT	-	High Intensity Training
MS	-	Muscular Strength
PHV	-	Peak Height Velocity
PT	-	Plyometric Training
SS	-	Sport Specific
SST	-	Sport Specific Training
SV	-	Stroke Volume
YS	-	Youth Soccer

OPERATIONAL DEFINITION OF TERMS

Aerobic Exercise - Physical activities of low to high intensity that depends primarily on the use of oxygen to adequately meet energy demands during exercise via metabolism.

Anaerobic Exercise - Short lasting high-intensity activity, where the body's demand for oxygen exceeds the oxygen supply available.

Cardiovascular Fitness -How well the body takes in oxygen and delivers it to the muscles and organs during prolonged periods of exercise.

Case Study - A process or record of research into the development of a particular person, group or situation over a period of time.

Efficacy - The ability to produce the desired or intended result.

High School Soccer Team Players - Players representing a particular team in soccer but are in high school.

Muscular Strength - Amount of force a muscle can produce with a single maximal effort.

Muscular Endurance - Ability of a muscle to perform an activity for a prolonged time without undue fatigue.

Muscular Fitness - An individual's combination of muscular strength, muscular endurance, and power.

Strength and Conditioning - The use of exercise prescription to improve the performance of competitive athletes. This is achieved through the combination of strength training and aerobic conditioning.

ABSTRACT

Muscular fitness and cardiovascular endurance training plays a key role in adding value to the overall performance of soccer players. However very few soccer players especially those of high school going age have embraced muscular fitness and cardiovascular endurance training. The study assessed the efficacy of an eight-week soccer training programme on the muscular and cardiovascular fitness of Kenyan high school soccer team. The Strathmore school student's soccer team was the target population. The sample size consisted of 30 male respondents who underwent a before and after test. The programme involved their normal skill work plus the muscular fitness and cardiovascular endurance training routine. STATA version 16 (IBM limited, UK, 2016) was used for processing data. To obtain means, percentages, standard deviations and frequencies, descriptive statistics was calculated to analyze the status of the athletes after the training period. A paired T-test was used to test the hypotheses. The results of the study indicated that a substantial portion of the participants experienced significant change after the duration of the strength and conditioning program. All the parameters that were being tested showed a significant improvement (power; broad jump $t(29)= 8.70$, $P < 0.05$; cardiovascular endurance; shuttle run $t(29)= 4.093$, $P < 0.05$; muscular strength; push-ups $t(29)= 21.49$, p = p-value; pull-ups $t(29)= 16.38$, $P < 0.05$; muscular endurance sit-ups $t(29)= 8.7$,$P < 0.05$, side bridge $t(29)= 11.34$, $P < 0.05$). The research findings act as a future point of reference in the field of strength and conditioning with the findings contributing to the body of knowledge on muscular and cardiovascular fitness training in Kenyan soccer. The study recommended that sports coaches in youth soccer teams should in-cooperate strength and conditioning in their training routine. The study also recommended that the fitness status of the athletes should be determined in a bid to make informed decisions when creating programmes for the athlete.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

As one of the most widely played sports in the world, success in soccer requires players to be physically, tactically, and technically fit. Ideally, a well-conditioned soccer player should have the ability to maintain an intensity of high level throughout the whole game (Helgerud, Engen, Eislf & Hoff, 2015). The intermittent exercise associated with soccer requires both anaerobic and aerobic energy systems (Morgans, Orme, Anderson & Drust, 2014). There is a need to improve players' performance. Globally, the sport of soccer is rapidly being changed by the diverse and different training modes (Ramirez et al., 2014).

Training should be molded to represent soccer's technical and tactical aspects (Gaetano, 2015). High aerobic capacity contributes to one’s ability to produce a variety of decisive actions during a 90-minute game. In addition, the capacity to produce an explosive single-bout effort is equally as crucial as aerobic power for succeeding in soccer. This includes frequently occurring movements in soccer, such as kicking, throwing, changing direction, jumping, and sprinting (Ramirez et al., 2014). Therefore, muscular strength (MS), muscular endurance (ME), and cardiovascular endurance (CE) are components of fitness that should be emphasized in considering the nature of the sport and how the different fitness demands come into play during soccer matches. In developed countries, there are coaches whose work deals explicitly with the athletes' muscular fitness and cardiovascular endurance needs for sports performance (Coursehero, 2019).

In the efforts to develop soccer in Africa, various administrative and management structures have been set up for the sport at national, regional, and continental levels (Njororai, 2017). Furthermore, the sport's popularity has seen many African countries investing heavily in soccer to enhance its success. However, in Kenya, the pace at which strength and conditioning is being embraced at the grassroots level in soccer is relatively slow (Njororai, 2017). In the Kenyan high school scene, factors such as the motivation status of the athlete greatly influence an athlete's performance (Nancy, 2020). It is also imperative that coaches handling soccer players at the high school level should use diverse motivation techniques and strength and conditioning can be one of the techniques that can be used (Nancy, 2020).

The national team of Kenya already faces various challenges due to the failure to invest in youth programs and weak financial management and leadership (Njororai, 2017). These factors affect the training programs offered in football clubs and, more so leave the clubs without strength and conditioning coaches (Njororai, 2017). This is in contrast to developed countries where strength and conditioning programs are well established from the high school level, such that the junior varsity teams engage in strength and conditioning programs (Neal, Stasinos, 2017). This leads to the physical attributes of the athletes being developed at an early age, and these same traits are carried by the athletes when they become adults and engage in pro-competitions (Neal, Stasinos, 2017). Recruitment for the national team will thus be made easy because of the increase in the pool of players who can play at a high capacity due to in-cooperating strength and conditioning to skill training. Other professional football clubs can also do their scouting

and talent identification due to the increase in the pool of players who can play at a high capacity.

This study, therefore, set to determine the efficacy of an eight-week strength and conditioning program on the muscular fitness and cardiovascular endurance of a selected high school soccer team in Kenya.

1.2 Statement of the Problem

Traditionally, in sports development, youth have been exposed to more of the regular drills that are done every day with the expectation that the player's performance will improve (Aloui et al., 2021). There is a need to incorporate strength and conditioning training, especially in youth soccer development, so that the athletes can carry the correct attributes and effects of training into adulthood (Aloui et al., 2021). In Kenya, there is a lack of focus on strength and conditioning in Kenyan high school football. Limited studies have been done about strength and conditioning at the high school level in Kenya.

Research by Christou et al. (2016) indicates that adding resistance training to ball work training in soccer enhances the maximal strength of the lower and the upper body, jumping vertical height and 30-meter speed more than soccer-specific training alone. Thus, combining resistance and soccer training could be used in the overall development of the physical abilities of young players.

Due to the demands of sports-specific performance, technical skill development has become the main area of focus in training (Christou et al., 2016). This leads to less concentration on physical fitness during training. Strathmore School has not been performing well in soccer over the past ten years despite the emphasis on skill training. The study thus added a strength and conditioning program to complement the skill program of the athletes and set out the program's effect on the muscular fitness and cardiovascular endurance of a selected high school soccer team in Kenya.

1.3 The Purpose of the Study

The study aimed to assess the efficacy of an eight-week strength and conditioning program on the muscular strength, muscular endurance, and cardiovascular endurance of a select high school soccer team.

1.4 Objectives of the Study

1. To determine the muscular fitness and cardiovascular endurance status of the Strathmore school soccer players.
2. To assess the effect of an eight-week strength and conditioning program on the muscular strength of Strathmore school soccer players.
3. To determine the effect of an eight-week strength and conditioning program on the muscular endurance of Strathmore school soccer players.
4. To assess the effect of an eight-week strength and conditioning program on the muscular power of Strathmore school soccer players.

5. To ascertain the effect of an eight-week strength and conditioning program on the cardiovascular endurance of Strathmore school soccer players.

1.5 Study Hypotheses

H_{01}- There is no significant difference in the muscular strength of Strathmore school soccer team players before and after the strength and conditioning program.

H_{02}- There is no significant difference in the muscular endurance of Strathmore school soccer team players before and after the strength and conditioning program.

H_{03}- There is no significant difference in the muscular power of Strathmore school soccer team players before and after the strength and conditioning program.

H_{04}- There is no significant difference in the cardiovascular endurance of Strathmore school soccer team players before and after the strength and conditioning program.

1.6 Significance of the Study

The study's findings may provide information on the specific possible benefits of a strength and conditioning programme. Coaches can use this program in tailor-making their routines, thus improving the athletes' performance in the long run. The study also provides data for future studies in the area of strength and conditioning for Kenyan secondary school students engaging in soccer.

1.7 Delimitations of the Study

The study was delimited to the players in the Strathmore school soccer team. This is attributed to the unique trait of the school, which enables it to participate in both the

public and international school games. This trait enables the study to be of influence to both leagues due to the exchange of information that happens within the sports departments and the students of the various schools.

1.8 Limitations of the Study

Since the study was done in a school setup, it was influenced by the school-related calendar and its activities flow. There was also a possibility of students dropping out of the study because of academic issues. The researcher mitigated these limitations by planning his activities in strict compliance with the school calendar and also added eight extra players to the study, hence had a number of 30 participants, in case some players were to drop out of the study due to academic issues.

1.9 Assumption of the Study

The study was carried out on the assumption that the school administration would allow the study to be conducted to completion. Secondly, all the students who made up the soccer team would be willing to participate to the completion of the study.

1.10 Conceptual Framework

The conceptual framework was adapted from the model by Bauman et al., 2016, illustrating the benefits of physical activity. The framework from the original model reinforced that physical activity improves an individual's physiology (Bauman, Merom, Bull & Singh, 2016).

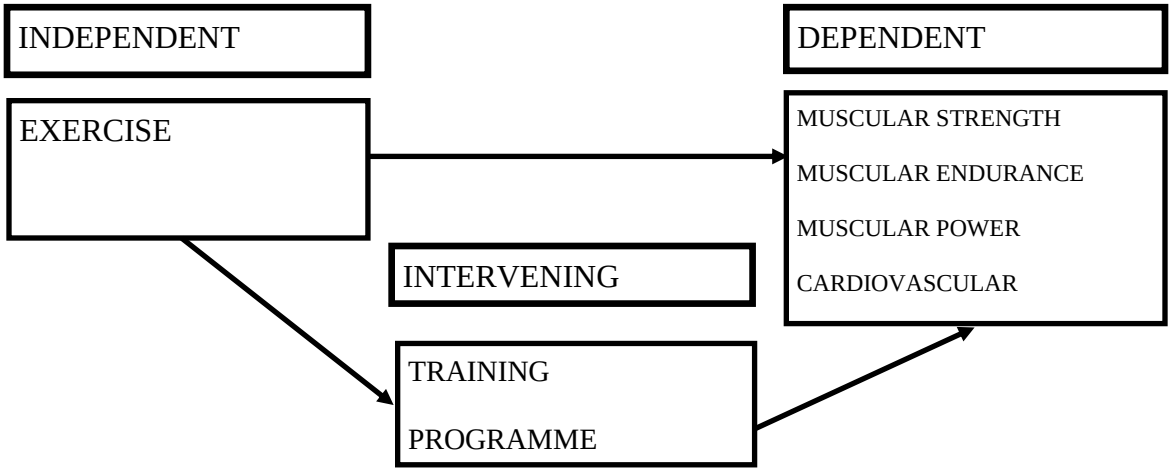

Figure 1.1: Conceptual Framework on the Effect of an Exercise Routine on the Cardiovascular Endurance and Muscular Fitness of Youth Soccer Players Adapted from the Model by Bauman et al., 2016)

In the model, (Figure 1) the specially designed programme is linked to the athletes' muscular fitness and cardiovascular endurance. Adherence to the physical activities regimen brings about an improvement to both the muscular fitness and cardiovascular endurance of the athletes. Physical activities can increase muscle and bone strength, strengthen the cardiovascular system, and improve an individual's general wellness (Mohammed et al., 2016). Since exercise has been shown to bring about a physiological adaptation of the cardiovascular system to meet the metabolic needs of exercising

muscles (Opondo, Sarma & Levine., 2015), and improve muscular strength and endurance (Kaukab et al., 2016). It can therefore be inferred that a combination of both the muscular fitness and cardiovascular training regimen can benefit young soccer players' physical ability.

CHAPTER TWO

LITERATURE REVIEW

2.1 Muscular and Cardiovascular Fitness Programme

Muscular and cardiovascular fitness is an integral part of soccer due to the nature of the game, which entails efforts of high intensity performed intermittently (Aloui et al., 2021). Furthermore, these efforts considerably require power, strength, speed, agility, and endurance as they are brought about by plyometrics training for one to perform successfully in a competition (Ramirez-Campillo et al., 2018).

Research done in Chile on the specific changes in young soccer players after a strength and conditioning program that lasted for 8 weeks showed substantial improvement in the athletes' muscular strength and muscular power (Ramirez et al.,2018). In another study by Aloui et al., (2021) on the effects of the plyometric and short sprint with the change of direction training in male under 17 soccer players, which was done over 8 weeks, there was an improvement in the sprint performance of the athletes, their ability to change directions and also their balance. A study was also done on the effects of an enrichment training program for youth football attackers (Coutinho et al., 2018). The experimental group participated in a 10-week program to improve their physical literacy. After the participants engaged in the training program, they recorded improvements in variables such as their vertical jump, repeated change of direction, and also their speed.

This study took 8 weeks, engaging the participants through the strength and conditioning program. The duration of the training was informed by the current literature, which took

the same duration, and an improvement was noted in the variables that were being targeted. The study aimed to create a customized workout program that would significantly improve youth athletes' muscular and cardiovascular fitness. Most of the studies (Aloui et al., 2021; Ramirez-Campillo et al., 2018; Coutinho et al., 2018) were capital-intensive. This program was unique as it utilized the available resources, which were easily accessible and affordable. This aimed to motivate muscular and cardiovascular fitness training in clubs facing financial constraints.

2.2 Muscular Strength

Muscular strength is the amount of force a muscle can produce. It is measured by the maximum amount of force a muscle can produce in a single effort (Buranarugsa et al., 2014). Muscular strength is developed through strength training. It is a component of physical fitness conditioning achieved by overloading the skeletal muscles through different training modalities, encompassing different types of resistance and muscle actions, which can be used in isolation or combination (Buranarugsa et al., 2014). Most sporting activities require high accelerations of an external resistance such as the body mass of the player, the opponent's body mass, or the mass of an object as shown in Newton's Law of motion (force = mass *acceleration) hence showing that the ability to produce maximal force voluntarily is essential for sports performance (Granacher et al., 2016).

Muscles take some time to develop and adapt, as shown by Abe (2013), who investigated the time course of skeletal muscle adaptations and found that strength increased

significantly at weeks four and six for women and men respectively. This was confirmed in a study by (Styles, Mathews, and Comfort, 2016) on the impact of a simple in-season strength training program where professional soccer players (n= 17, age = 18 years, height = 1.8 m, body mass [BM] = 75.6 kg) completed 1 repetition maximum (1RM) back squat and sprint tests (5m, 10m, and 20 m) before and after a 6-week in-season strength training (85–90% 1RM) intervention. Results indicated increased maximal squat strength and short sprint performance in professional soccer players.

Another study by Anderson and Kearney (2014) on the effects of three resistance training programs on muscular strength was done on forty-three male college athletes randomly assigned training protocols. Those in the high resistance-low repetition group (3 sets of 6-12 repetitions) as per the ACSM guidelines, recorded an improvement. This case study has adopted the ACSM guidelines. However, another review by Turner and Stewart (2014) states that the best method of improving strength is through combining heavy resistance training and power exercises. It further suggests that training at loads of 5 sets of 3 reps with a 1-minute rest between sets will bring about the recommended change. Although these studies share insight on how to go about strength training, they tend to have a biased approach as they put more focus on heavy resistance training and have focused mainly on pro athletes.

The study used the push-up test (Cooper Institute for Aerobics Research, 1992) with norms of very poor being 1 and excellent being >35 and pull-up tests (Robert et al., 2008) with norms of < 3 being poor and >13 being excellent. Push-ups are performed by

keeping the back and knees straight, the subject lowers the body to a pre-determined point to touch some other object, or until there is a 90-degree angle at the elbows, then returns to the starting position with the arms extended (Cooper Institute for Aerobics Research, 1992). These tests targeted the participants' upper body muscles and measured the athletes' muscular strength. Successful push-ups were counted and recorded in the datasheet.

The study also used the pull-up test with norms of >13 for excellent and < 3 for poor to gauge the athlete's muscular strength (Robert, 2012). The athlete hangs from the bar with the palms of their hands facing them and arms straight (start position). Using the arms, the athlete pulls the body up until the chin is above the bar and then lowers the body to the start position (Robert, 2012). The athlete continues with the pull-ups until they cannot continue or let go of the bar (Robert, 2012).

Many studies on strength training (Turner and Wikstrom, 2014; Anderson and Kearney, 2013; Abe, 2013; Styles, Mathews, and Comfort, 2016) have focused on pro athletes who are generally adults. The study focused on a different age group consisting of high school youth who are still amateurs. This was in a bid to get more insight into how to approach such a population when it comes to their prescription and administration of exercise routines.

2.3 Muscular Endurance

Muscular endurance is the ability of a muscle to repeatedly exert force against resistance (Brown, Xu, Q., Fan, 2019), enabling an individual to engage in physical activity without undue fatigue. It is one of the key components of good physical performance (Mackenzie, 2016). The adaptations associated with engaging in muscular endurance exercises include increases in the muscle fibers' mitochondrial content and respiratory capacity (Constable, Holloszy, John, Coyle, 2015). The profound metabolic changes in muscle adaptations to endurance exercise are a slower utilization of muscle glycogen and blood glucose, a higher reliance on fat oxidation, and a decreased lactate production during exercise of a given intensity (Holloszy et al., 2015).

Studies have diverse approaches when it comes to muscular endurance training. Each approach tends to be guided by philosophies concerning performance-related power enhancement (Kraemer, Heleniak, Tryniecki, Okazaki, and Castracane 2015). Nevertheless, muscular endurance takes time to develop as shown in a study by Amtmann et al. (2007) where it took six weeks for a group of participants of a muscular endurance program to exhibit 45.5% improvement with an average increase of five repetitions and three sets.

Muscular endurance training tends to be effective as a result of the routine that is being used, as shown in a review by Gorostiaga, Isquierdo, Ruesta, and Banez (2015) where eight experimental and eleven control soccer players, aged 17.2 (0.6) years, were tested before and after an 11-week training period. The experimental group exhibited an

increase in lower body strength, whereas no changes were observed in sprint performance.

In another study by Mota, Castardeli, and Gomes (2010) muscular endurance was used as a means of injury prevention where there was a decreased incidence of injuries in soccer after players did proprioception and muscular endurance exercises before training. The exercises were, however more geared towards injury prevention.

This study used the sit-up test with norms of <17 being poor and greater than >30 being excellent (Mackenzie, 2016) and the side bridge test with norms of< 60 being poor and > 90 being excellent (Robert, 2012). The athlete sits up, touching the knees with their elbows, then returns to the floor and performs as many sit-ups as possible in 30 seconds (Mackenzie, 2016). While on the other hand when performing the side bridge test, the subject lays on their side. The upper part of their body is supported off the ground by the elbow and forearm until they can't hold their back straight and their hip is lowered (Robert, 2012). These tests were used to gauge the abdominal endurance and also the endurance of the lateral core stabilizing muscles of the participants. Both tests used a stopwatch to determine how long the participants could perform the test (Robert, 2012).

The studies by (Gorostiaga, Isquierdo, Ruesta, and Banez 2015; Mota, Castardeli, and Gomes, 2017) have emphasized general muscular endurance training, not sports-specific training. This study had a more sports-specific approach toward its muscular endurance

program. It tried to simulate the activities in soccer games, like short running bouts, as part of the muscular endurance training program.

2.4 Muscular Power

Muscular power refers to the force applied multiplied by the movement velocity (Knuttgen & Kraemer, 2015). It can also be expressed as work done per unit of time (Garhammer, J. 2016). Power output is the determinant of performance in activities that require one movement to produce a high velocity at release or impact. Muscular power is shown in throwing a punch, jumping, or striking activities (Kraemer & Newton 2000). Muscular power is achieved with force and speed in the equation (power = force*speed). To enhance power, plyometric training is considered the suitable choice (Saez, Suarez, Requena, Haff & Ferrete., 2015).

Muscular power is a significant contributor to the overall performance of an athlete. It has a variety of factors that tend to affect it such as muscular strength (Hoff & Helgerud, 2014). Various exercises improve muscular power, such as squat training with heavy resistance, which has been shown to increase maximum isometric strength (Hakkinen et al., 2018). In another review by Lockie, Murphy, and Schultz (2017), participants went through a six-week training program where they engaged in; short sub-maximal interval running to a maximum distance of 120 meters with four repetitions and weight training predominantly targeting their lower body (4 exercises, 3 sets, and 12-14 repetitions). General improvements of up to 40% in the athlete's muscular power were recorded. The preferred resistance to be used needed to be clarified in these studies.

Another review by Kawamori and Haff (2016) shows concern about which range of training loads (percentage of maximum isometric strength or 1RM) bring about the most favorable adaptations in power development during resistance training. Schmidtbleicher and Garalambie (2018) have suggested the use of heavy loads of up to 80% of 1RM to induce the recruitment of high-threshold fast-twitch motor units, which produce more power output than do low-threshold slow-twitch motor units, based on the size principle. The study used the standing broad jump test with norms of <1.98m being poor and >2.44 being excellent to gauge the lower body power generated by the athlete's leg muscles (Van, Pragh, Dore, 2010). This test starts when the athlete places their feet over the edge of the sandpit, crouches down, and using the arms and legs jumps horizontally as far as possible landing with both feet in the sandpit (Van, Pragh, Dore, 2010). The distance that the athlete covers is measured using a field tape measure

These studies (Hoff & Helgerud, 2014; Hakkinen et al., 2003; Lockie, Murphy & Schultz, 2012; Kawamori and Haff, 2016 and Schmidtbleicher and Haralambie, 2018) focused on trying to find the optimal resistance that brings about muscular power. This study, however, focused on designing a combination of workouts that can bring about an optimal improvement in the muscular power of the athletes.

2.5 Cardiovascular Endurance

Cardiovascular endurance is the ability of the body to work continuously for an extended period (Patil, O'Keefe, Lavie, Vogel, 2015). Cardiovascular endurance is considered an important fitness component as it gives the body stamina to generate energy and ensure

oxygen delivery to working muscles (Patil et al., 2015). Physiological adaptations occur in the body to ensure this takes place. Such adaptations include enlarged left and right ventricle volumes, increased ventricular wall thickness, cardiac mass, and atrial size (Pellicia et al., 2014).

Due to its importance, fitness for a game should be assessed regularly to monitor and determine the players' preparedness (Castagna, Manzi, Impellizzeri, Mathew, Alvarez 2010). In a study by Chamari, (2016) Yoyo test endurance level 2 and Intermittent level 1 were used on soccer players to determine their physiological determinants of the test. The Yoyo test comprises stages. The more stages an athlete can sustain are crucial as they enable the strength and conditioning coaches to gauge the physical state of the athletes. The current study also used the same concept to gauge the cardiovascular endurance of its participants. A shuttle run test was administered to assess the participants' cardiovascular fitness with test norms of <3/1 being very poor and > 12/1 being excellent (Brewer et al., 1989). The participants aim to continue running between the two lines marked 20m apart, turning when signaled by the recorded beeps (Brewer et al., 1989).

Soccer relies on endurance training programmes to build on cardiovascular endurance. Some trainers have embraced small-sided games to build on players' cardiovascular endurance (Castagna, Imperilezzi, Belardinelli, 2017). In a study by McMillan, Helgerud, Macdonald, and Hoff (2014) soccer specific endurance training was used to improve the cardiorespiratory capacity of the athletes where eleven youth soccer players with a mean (SD) age of 16.9 (0.4) years performed high-intensity aerobic interval training sessions

twice per week for 10 weeks in addition to normal soccer technical training. The specific aerobic training consisted of four sets of 4-minute work periods dribbling a soccer ball around a specially designed track at 90–95% of maximal heart frequency, with a 3-minute recovery jog at 70% of maximal heart frequency between intervals. Their mean $V0_{2max}$ improved significantly from 63.4 (5.6) to 69.8 (6.6) ml kg^{1} min^{1}.

Several studies (Castagna et al., 2017; Edwards, Macfadyen, and Clark, 2015) preferred using small-sided games to help improve soccer players' cardiovascular endurance and have embraced using the ball in their routines. The study specifically used off-the-ball workouts to train for the cardiovascular endurance of athletes in a bid to see if the rate of improvement may differ from what has become a standard norm in cardiovascular endurance training in soccer.

2.6 Exercise Prescription

Workout routines in soccer require keen and intentional planning to be effective. Furthermore, the sessions should be devised so that they bring about a simultaneous development of a player's tactical, physical, technical, and mental aspects (Ryland, Patrick, Liam, and Barry, 2014). When creating a workout routine for the players, there is a need to include a variety of components of fitness into the program as the prescription of the workout should be multi-dimensional (Ryland et al., 2014).

Due to soccer's intensity and cyclical nature, it is identified as a high-intensity sport that is intermittent (McMillan et al., 2005). There is, therefore, a need for an ideal

optimization process for one to target all these aspects of fitness. A training routine that has been embraced is high-intensity functional training (Carvutto, Damasco, De Candia, 2021). This technique has proven effective due to its incorporation of functional exercises into the workout. These functional workouts mainly entail multiple planes of movement, universal motor recruitment patterns, and generally, an individual's whole body (Roberto et al., 2021).

This study employed a comprehensive workout program that targeted multiple fitness components (Falk, Kennedy, 2019). The exercise prescription targeted both the upper body and lower body of the athletes as informed by current literature. This required smart optimization for the program to be effective (Carvutto et al., 2021). Periodization of the activities significantly contributed to the exercise prescription of the athletes with two specific training days (Carvutto et al., 2021). Load management was quite prudent as the athletes' training had to be weighed in such a way that they would not get burnout and that the training would achieve its purpose (Carvutto et al., 2021). The training lasted eight weeks, and it was broken down into a one-week micro cycle with two specific training days, specific workout routines, and the skill programme (Ryland et al., 2014).

The exercises that were adapted in this study were functional workouts such as push-ups squats, chin-ups, burpees, box jumps, dips and calf raises. These were done in two sessions, whereby in one week, the routine for session one differed from that for session two (Jussim, 2022). This is due to the need for load management by ensuring that specific muscles are not overloaded (Jussim, 2022). Lower body workouts such as squats have

been shown to greatly build the strength of an individual's lower body, develop calves, quadriceps, and hamstrings, and improve an individual's hip flexibility (Jussim, 2022). Others such as burpees were also a part of the workout routine due to the aspects of high-intensity functional training which is important in the game of soccer (Roberto et al., 2021). The exercise prescription was made ideal and realistic so that schools in the country can easily embrace it. The training had aspects of free body exercises and using equipment that are easily accessible equipment such as tires to create a simplistic routine that is safe, effective, and adhere to scientific principles such as the principle of progression (Carvutto et al., 2021).

2.7 Strength and Conditioning for Youth in Developed Countries

Developed countries have over time embraced strength and conditioning for their youthful population. This is quite prudent as it is widely known that engaging in physical activity is vital as it promotes good health (Pedersen, Saltin, 2015). Physical activity should be embraced irrespective of one's sex, maturation status, and also their age. The World Health Organization (WHO) advises that youth aged 5-17 years should engage in a minimum of 60 minutes of physical activity (WHO, 2010). These activities should be moderate to vigorous and should be performed daily for the youth to attain optimal health benefits. Furthermore, WHO recommends that the youth engage in strength training at least three times a week as this has been shown to strengthen their muscle and bones (WHO, 2010).

Research done in Germany compared how strength and conditioning was viewed back in the 1970s-1980s to the current time. Resistance training was not embraced previously by many coaches as it was postulated that it would damage the growth plate of the athletes (Chaabene et al., 2020). Currently, literature shows that resistance training positively affects the performance and health of the youth (Feigenbaum, Myer, 2012). Furthermore, it is advocated that strength and conditioning be integrated into all stages of development to improve athletes' movement skills and muscular fitness (Chaabene et al., 2020).

On the other hand, the Australian Strength and Conditioning Association advocates for resistance training for children and youth to engage in strength training (Stephen, Greg, Dona, 2008). However, the association's concern is that adolescents should always train under the close supervision of a certified and qualified trainer (Stephen et al., 2008). The Australian legal system has handled several legal issues regarding negligence on the part of instructors due to injuries caused by unsupervised training by the youth (Stephen et al., 2008). Nonetheless, another factor that has made strength and conditioning popular in Australia among the youth is its ability to prevent sports-related injuries. Research has shown that when performed well, strength and conditioning improve the strength of the musculoskeletal system, a factor that significantly reduces sports-related injuries (Stephen et al., 2008).

Ann-Christin et al. (2017) study showed how physical educators in the US have learned to capitalize on the critical window that lies between one's childhood and the adolescence period. It is at this stage that physical educators use to develop optimal physical literacy.

Furthermore, the fundamental aspect of movement skills brought about by strength and conditioning should be embraced during childhood, facilitating an individual's long-duration engagement in physical activity (Ann-Christin et al., 2017). It also builds up their confidence. Most studies done in developed countries (Pedersen, Saltin, 2015; Chaabene et al., 2020; Stephen, Greg, Dona, 2008; Ann-Christin et al., 2017) promote strength and conditioning among the youth. In Kenya, there is a need for baseline research on strength and conditioning among the youth in sports settings. This will mainly impact the strength and conditioning scene among the Kenyan youth and propagate better practices when preparing for sporting activities.

2.8 Summary of Literature Review

The knowledge of strength and conditioning is being embraced in various sports. However, there is a gap in implementing the benefits of strength and conditioning especially in youth athletes of high school-going age in Kenya. There has been a great focus on pro athletes or other sporting activities, and not soccer. The studies that were done by (Turner and Wikstrom, 2014; Anderson and Kearney, 2013; Abe, 2013; Styles, Mathews and Comfort, 2016) ideally focused on workout routines that were custom made for pro athletes. Most of their load management and techniques of training may be viable to an adult who may want to perform at such a high capacity. The current study however focused on youth athletes who are still in high school with an aim to custom make and prescribe a workout routine that suites such a population.

Research in developed countries has focused on using weights and machines in their capital-intensive training routines. Most of the studies (Aloui et al., 2021; Ramirez-Campillo et al., 2018; Coutinho et al., 2018) were capital intensive. The current study embraced a callisthenic workout routine which is appealing to a developing country like Kenya, as it is less capital intensive and can be easily embraced with the hope of promoting muscular fitness and cardiovascular endurance training among the high school soccer players in the sporting scene in Kenya.

The modalities of training of the current study differed from what has been implemented by other researchers. Most researchers have put more emphasis on general muscular training and they did not have a sports specific approach towards their muscular training (Gorostiaga, Isquierdo, Ruesta, Banez 2015; Mota, Castardeli, Gomes, 2017). The current study had a sports specific approach towards its muscular endurance training as it in-corporates most actions that take place in the soccer game.

CHAPTER THREE

METHODOLOGY

3.1 Research Design

The study used a quasi-experimental design (William, 2006) to assess the efficacy of an exercise training regimen on the fitness components of a Kenyan high school soccer team, with pre and post-tests being employed. The results to be collected in the pre-test were to act as the point of reference. The players were also to remain in the same school environment from pre-test, participation in the exercise programme, up to post-test time. The research aimed at looking at the efficacy of a workout routine on a specific group, hence a case study served the purpose of the research in carrying out an in-depth investigation of the group (Robert et al., 2003).

3.2 Measurement of Variables

The dependent variables were the participants' cardiovascular endurance, muscular strength, muscular endurance, and muscular power. The independent variable was the exercise program participants engaged in during the training sessions.

3.3 Study Location

The study was conducted at Strathmore School in Nairobi County, Kenya in Westland's constituency. The school was ideal as it has a sports program that runs throughout the year while soccer is one of the highly esteemed sports in the school. The school also participates in the Nairobi County High School Games and the Kenya Association of Independent Schools Sports Association (KAISSO) (Kaisso, 2019). Strathmore School is

the only school in the county that participates in both leagues, and is also among the best performing schools in both leagues. This study's results can thus influence the other schools due to Strathmore's ability to interact with both the high-end international schools and the public schools in Kenya. This information exchange can occur at the coaching level between Strathmore and other schools during the sports interschool meetings and when the students interact.

3.4 Target Population

The target population was the Strathmore School's under-19 soccer team which comprised the form three students. This is because the school administration only allows the form three students to join the main soccer team. The team had a total of 30 players. The eight extra players are normally alternates in case some of the students drop out of the programme. The focus of the study was on a specific team thus was limited to the number of players who were on the team.

3.5 Inclusion Criteria

The study included respondents were those who had been accepted to be part of the Strathmore School U 19 soccer team after the tryouts.

3.6 Exclusion Criteria

The study excluded athletes who were engaged in any other soccer program aside from the Strathmore School soccer program and also those who had Injuries.

3.7 Sampling Technique and Sample Size

The soccer team consisted of 30 players, hence (N=30). The study used the census method, where data was collected from each unit of the population relating to the study. All players underwent the pre-test and participated in the training and post-test programs. This being a case study the sample size was sufficient to get a statistically significant results (Mugenda and Mugenda, 2003).

3.8 Research Instruments

The study used a fitness test battery that included a Shuttle run, Broad jump, Push-up, Side Bridge, Pull-up, and Sit-up tests for data collection (Appendix V).

Instrument Pre-Testing

The pre-test was done on team C of the Strathmore school soccer team**.** The test was administered to the team and re-administered after two weeks. The instrument's dependability was established using the test-retest technique, and the results correlated. A reliability coefficient of r=0.7 was accepted as high enough (Williams et al., 2016).

3.9 Validity and Reliability

3.9.1 Validity of the Instrument

To ensure item validity, the instrument was discussed with the subject experts in the Departments of Physical Education, Exercise, and Sports Science and Recreation and Sports Management of Kenyatta University. Related literature was also analyzed to ensure that all the areas under investigation were covered. The researcher calibrated the

tape measure for measuring the distance covered in the broad jump test as the researcher ensured the units of measurement in the tape were indeed in meters by comparing it with a standardized tape. The bleep test was also calibrated as the researcher used a timer to ensure the time difference between the bleeps as the intensity increased.

3.9.2 Reliability of the Instrument

3.9.2.1 Shuttle Run Test

The shuttle run test assessed the soccer team's cardiovascular fitness (CF). The test produces reliable results and has been widely used to assess the endurance capacities of all sports participants. The participants aim to continue running between the two lines marked 20 meters apart, turning when signaled by the recorded beeps (Brewer et al., 1988).

According to Mayorga, Aguilar, and Viciana, 2015, they found a reliability coefficient that ranged between 0.66-0.84 when they performed the 20 m shuttle run validity test with their participants r=0.73.

3.9.2.2 Standing Broad Jump Test

The standing broad jump test has been suggested as an effective and reliable way of measuring lower body strength and power. The athlete places their feet over the edge of the sandpit, crouches down, and using the arms and legs jumps horizontally as far as possible landing with both feet in the sandpit (Dialo, Pragh, Dore, 2010). The distance

covered after the jump is measured using the field tape measure. Reid, Dolan, and Debeliso, 2017 found a reliability co-efficient of r=0.99.

3.9.2.3 Push-up Test

Ran et al., (2017) state the importance of using push-ups to measure upper body endurance, as seen in fitness test batteries like Fitness Gram. It is performed by keeping the back and knees straight, the subject lowering the body to a pre-determined point to touch some other object, or until there is a 90-degree angle at the elbows, then returning to the starting position with the arms extended (Ran et al., 2017). The number of successful push-ups is counted and recorded in the datasheet. According to Hashim, Ariffin, and Hashim (2018) participants relayed a reliability coefficient of r=0.93 after passing the push test-retest protocol. This is similar to the reliability coefficient of the current study which r=0.91.

3.9.2.4 Pull-Up Test

The pull-up test (also called the chin-up test) is widely used as a measure of upper body strength. Using the arms, the athlete pulls the body up until the chin is above the bar and then lowers the body to the start position. The athlete continues with the pull-ups until they are unable to continue. This test measures upper-body muscle strength and endurance (Robert et al., 2017). The number of successful pull-ups is counted and recorded in the datasheet.

3.9.2.4 Sit-Up Test

The objective of the sit-up test is to monitor an athlete's abdominal endurance. The athlete sits up, touching the knees with their elbows, then returns to the floor and performs as many sit-ups as possible in 30 seconds (Mackenzie, 2016). In a similar study by More et al., 2015 participants went through the pull-up test with a test and retest being performed. After this was done, the reliability coefficient was r=0.62. This was slightly lower than the current study, which has a reliability coefficient of r=0.79.

3.9.2.5 Side Bridge Test

The side bridge test measures the control and endurance of the lateral core stabilizing muscles (Appendix IV). The amount of time an individual can perform the side bridge test while maintaining the correct form is taken. The subject lays on their side, the upper body supported off the ground by the elbow and forearm until they can't hold their back straight and the hip is lowered (Robert et al., 2017). The study has a reliability co-efficient of r=0.89, which is slightly lower when compared to a similar study that targeted youth aged twenty years whose reliability co-efficient was r=0.91

3.10 Data Collection Procedure

Upon receiving approval to conduct the study from the Graduate School, Kenyatta University Ethics Review Committee (KU-ERC), and National Commission for Science Technology and Innovation (NACOSTI) a visit was made to the school with a letter of introduction (Appendix III). The researcher communicated with the principal, who in turn informed the sports director. With permission from both the principal and the sports

director, the researcher talked with the coach and the athletes to introduce himself and make the athletes and the coach informed about the study. The athletes were also briefed on what was expected from them regarding their dressing during training, the need to keep time, and the training dates. After consultation with the coach, the training dates were set: Tuesdays and Thursdays. The exercise prescription was comprehensive and covered the components of fitness comprising muscular fitness and cardiovascular endurance as shown in Appendix vii.

A pre-test was done to collect data on the initial physical state of the participants. The researcher was dealing with a team comprising of 30 players and 2 research assistants who helped in the process of data collection during the pre-test and post-test. The researcher trained them on how to collect data, and training was done a month before the start of the data collection. The training entailed making the research assistants conversant with the correct data collection techniques as they used the various tools. The data collection process took place in an indoor setup. The pre-tests occurred during the first week of the term, during the evening soccer training hours.

On the data collecting day, the researcher and the research assistants met the team in the field. The first test to be done was the shuttle run test. When performing the shuttle run test, cones are normally used to mark out two lines 20 meters apart. The subjects start with their foot behind one of the lines and begin running when instructed. They continue running between the two lines, turning when signaled by the recorded beeps. The pace gets quicker after approximately every minute. If the line is not reached in time, the

subject must run to the line and try to catch up with the pace within the two beeps. Here, the respondents were divided into three groups. Each group did their shuttles, and the records were taken, one after the other.

After that, they went through the broad jump test. During this test, an athlete is required to warm up for at least 10 minutes. The athlete places their feet over the edge of the sandpit, crouches down, and, using the arms and legs, jumps horizontally as far as possible, landing with both feet in the sandpit. One thus measures and records the distance from the edge of the sandpit to the nearest mark made by the athlete. The athlete repeats the test 3 times. The longest distance is recorded. This was done on day one.

On day two, they first went through the push-up tests. A standard push-up begins with hands and toes touching the floor, the body and the legs in a straight line, feet slightly apart, the arms at shoulder width apart, extended, and at a right angle with the body. Keeping the back and knees straight, the subject lowers the body to a pre-determined point, to touch some other object, or until there is a 90-degree angle at the elbows then returns to the starting position with the arms extended. This action is repeated, and the test continues until exhaustion or until they can't do more in rhythm or have reached the target number of push-ups. As the respondents were doing the push-ups, the researcher/research assistants were helping to ensure they kept the proper technique, and at the end, they recorded the final scores.

During the sit-up test the athlete warms up for 10 minutes. The athlete lies on the mat with their knees bent, feet flat on the floor, and their hands on their ears, where they must stay throughout the test. The assistant holds the athlete's feet on the ground. The assistant gives the command “GO” and starts the stopwatch. The athlete sits up, touching the knees with their elbows, then returns to the floor and performs as many sit-ups as possible in 30 seconds. The assistant keeps the athlete informed of the time remaining. The assistant counts and records the number of correct sit-ups completed in the 30 seconds and uses this recorded value to assess the athlete's performance.

On day three, they first went through the side bridge test. The subject lays on their right side, the upper body supported off the ground by the right elbow and forearm. The legs are straight, with the left foot (top) in front of the right foot. The hip is lifted off the floor so that the elbow and feet support the body, creating a straight line from head to toe. The left hand is placed on the supporting shoulder. The stopwatch starts as soon as the subject is in the correct position. The test is over when the subject is unable to hold the back straight, and the hip is lowered. After five minutes of rest, the other side is tested. The researchers focused on ensuring that the participants maintained their form.

The last test to be done was the pull-up test. The athlete warms up for 10 minutes. The athlete hangs from the bar with the palms of their hands facing them and arms straight (start position). The athlete, using the arms, pulls the body up until the chin is above the bar and then lowers the body to the start position. The athlete continues with the pull-ups

until they cannot continue or let go of the bar. The assistant counts and records the number of completed pull-ups.

After the collection of their baseline information, the 30 participants went through an eight-week exercise program (Appendix VII). The researcher was present during all the training sessions; the researcher ensured that they followed the workout routine. The researcher used the same protocol that was used in the pre-test to do the post-test. The data collected was recorded on an Excel form (Appendix V).

3.11 Data Analysis and Presentation

Data was analyzed using Stata version 16 (IBM Limited, UK, 2016) and Microsoft Excel 2013 for Windows. Data collected was summarized in frequency tables, graphs, and bar charts. Descriptive statistics mean, mode, median, variance, and standard deviation were used to determine the occurrences in the variables. The paired t-test was used to determine if there were changes between the two tests (the pre-test and post-test of the same group of participants). This test is appropriate because it compares two means on a given attribute to test the hypotheses at alpha level p=0.05 (Hinton, 2012).

3.12 Logistical and Ethical Consideration

The researcher established a rapport with the school and participants, explained the study's purpose and significance to them and the large soccer fraternity, and sought consent from the school before the study. Ethical clearance was obtained from the Kenyatta University Ethics and Research Committee (Appendix X) after the Kenyatta

University Graduate School's approval of the research proposal. The National Council for Science and Technology granted the research permit (Appendix VIII). The participants who were willing to participate in the study were given consent forms to take to their respective guardians. All respondents submitted the signed consent and assent forms and were allowed to participate (Appendix I and II, respectively). All the information collected by the researcher was kept confidential by storing it in the researcher's Excel and PDF form and also by giving participants coded numbers and not using their names. The participants were also guided through a workout routine under the supervision of the researcher.

CHAPTER FOUR

FINDINGS

4.1 Introduction

The data collected was analyzed using the STATA 16 software package. The results were provided in both descriptive tables and t-test scores. The dependent variables in this study were cardiovascular endurance, muscular strength, muscular endurance, and muscular power. The independent variable in this study was the 8-week conditioning programme that Strathmore students were subjected to. A paired sample t-test was run to determine if statistical differences existed in the means of the measured variables before and after the programme. The results of this analysis are presented in the sections that follow.

4.2 Demographic Details of the Study Respondents

Table 4.1: Demographic Details of the Study Respondents

Participants	Mean
Age	17.21±1.34
Weight (Kgs)	60.12±0.21
Height (Cm)	168.47±0.97
BMI (Kg/m^2)	35.68±2.65

The team comprised the Strathmore school team players (N=30) who went through pre-test fitness testing for cardiovascular endurance, muscular strength, muscular endurance, and muscular power, then participated in an eight-week strength and conditioning program (Appendix VII) and a post–test fitness testing for cardiovascular endurance, muscular strength, abdominal endurance, and muscular power.

4.3 Muscular Fitness and Cardiovascular Endurance Status of the Respondents

Respondents went through pre- and post-tests in muscular endurance, cardiovascular endurance, muscular power, and muscular strength. The summary of the pre-test and post-test measurements of the respondents is shown in Table 4.2.

Table 4.2: Muscular Fitness and Cardiovascular Endurance Status of the Respondents

Component	Test	Measurement	Pre	Post
Muscular endurance	Side bridge	Seconds	77.69 ± 20.15	84.46 ± 19.71
	Sit-ups	Repetitions counts	27.63 ± 8.60	30.97 ± 8.31
Cardiovascular endurance	Shuttle-Run test	$V0_{2max}$	38.91±5.73	41.66 ±5.34
Muscular Power	Broad-Jumps	Meters	2.23 ± 0.31	2.31 ± 0.32
Muscular Strength	Pull-Ups	Repetition counts	8.97 ± 4.15	11.53 ± 4.43
	Push-Ups	Repetition counts	24.67 ± 7.70	27.13 ± 7.61

The study found the participants' abdominal endurance status to be at 77.69 ± 20.15 seconds after the side bridge test was done and 27.63 ± 8.60 repetitions after the sit-up test was done. The status of the cardiovascular endurance of the participants was at 62.13± 18.06 $V0_{2max}$ after performing the shuttle-run test. Nonetheless, the status of the

muscular power of the participants was at 2.23 ± 0.31 metres after performing the broad jump test. Lastly, the muscular strength of the participants was at 8.97 ± 4.15 repetitions after doing the pull-up test and 24.67 ± 7.70 repetitions after doing the push–up test.

4.4 Muscular Endurance of the Respondents

The study tested muscular endurance using both the Side Bridge and sit-ups.

4.4.1 Side Bridge Test

The respondents did a side bridge test that measured the control and endurance of their lateral core stabilizing muscles. The results are shown in Table 4.3.

A paired-sample t-test was used to determine whether there was a statistically significant mean difference between the participants' average abdominal endurance before and after the conditioning programme. Data are mean ± standard deviation unless otherwise stated. There were no outliers detected. The assumption of normality was not violated, as assessed by Shapiro-Wilk's test (= .24005).

Table 4.3: Side Bridge Scores in Seconds before and after the Conditioning Programme

Variable	Observation	Pre-test (Seconds)	Post-test (Seconds)	Difference (Seconds)	P-Value	T-test
Side bridge test	30	77.69±20.15	84.46±19.71	6.78±0.44	< 0.05	11.34

Participants displayed more abdominal endurance after the programme - (84.456 ± 19.713) seconds as opposed to before the programme (77.691 ± 20.152) seconds, a statistically significant increase of 6.765 at t (29) = 11.3416 and effect size d = 2.070691, P < 0.05. The hypothesis that there would not be any significant increase in abdominal endurance was thus rejected.

4.4.2 Sit Up Test

The respondents did the sit-up test that measured the endurance of their core stabilizing muscles. The results are shown in Table 4.4.

A paired-sample t-test was used to determine whether there was a statistically significant mean difference between the participants' sit-up repetitions before and after the conditioning programme. There were no outliers detected. The assumption of normality was violated, as assessed by Shapiro-Wilk's test (= .0474).

Table 4.4: Sit-up Test Results before and after the Conditioning Programme

Variable	Observation	Pre-test	Post-test	Difference	P-Value	T-test
Sit-ups	30	27.63±8.60	30.97±8.31	3.33±0.29	< 0.05	8.7

Participants performed more sit-ups after the programme - (30.967 ± 8.307) repetitions as opposed to before the programme (27.633 ± 8.604) repetitions, a statistically significant increase of 3.333 at t (29) = 8.7 and effect size d = 2.63, P < 0.05. The hypothesis that there would not be any significant increase in abdominal endurance was thus rejected.

4.5 Cardiovascular Endurance of the Respondents

The respondents did the shuttle run test that measured their cardiovascular endurance. The results are shown in Table 4.5.

A paired-sample t-test was used to determine whether there was a statistically significant mean difference between the respondents' shuttle-run VO2 max scores before and after the conditioning programme. There were no outliers detected. The assumption of normality was not violated, as assessed by Shapiro-Wilk's test (= .1378).

Table 4.5: Results of the Shuttle Run V02 max before and after the Conditioning Programme

Variable	Observation	Pre-test	Post-test	Difference	P-Value	T-test
$V0_{2max2}$	30	38.91±5.73	41.66±5.34	2.75±0.39	< 0.05	4.09

The shuttle run test starts with the participants standing behind a line and starts running after being instructed. The concept behind this is that the runner always strives to reach in time as guided by the signal. The test ends when the participant cannot keep up. The shuttle run norms (Woods, 2021) indicate a value of (38.9133 ±5.73102) $V0_{2\ max}$ to be in the fair category. However, this study found that the soccer players scaled up from fair to good after passing through the workout program.

Participants scored more after the programme with an average of (41.663 ±5.34199)$V0_{2\ max}$ as opposed to before the programme (38.9133 ±5.73102) $V0_{2\ max}$, a statistically significant increase as shown by the t-test; 2.75 t(29) =4.093, and effect size d = 0.741, P

< 0.05. The hypothesis that there would not be any significant increase in cardiovascular endurance was thus rejected.

4.6 Muscular Power of the Respondents

The respondents did the broad jump test that measured their lower body muscular power. The results are shown in Table 4.6.

A paired-sample t-test was used to determine whether there was a statistically significant mean difference between the Pre and post-test broad jump scores. There were no outliers detected as assessed by Shapiro-Wilk's test (p = .01378).

Table 4.6: Broad Jump Scores Before and after the Conditioning Programme

Variable	Observation	Pre-test	Post-test	Difference	P-Value	T-test
Broad Jump	30	2.23±0.31	2.31±0.32	0.08±0.01	< 0.05	8.70

Participants performed broader jumps after the programme - (2.308 ± 0.3153) metre as opposed to before the programme (2.2263 ± 0.3135) metre, a statistically significant increase of 0.08167, t (29) = 8.70 and effect size d = 1.588849, P < 0.05. The hypothesis that there would not be any significant increase in muscular power was thus rejected.

4.7 Muscular Strength of the Respondents

4.7.1 Pull-Up Test

The respondents did the push-up and pull-up tests that measured their upper body muscular power. The results are shown in Table 4.7.

A paired-sample t-test was used to determine whether there was a statistically significant mean difference between the participant's pull-up repetitions before and after the conditioning programme. There were no outliers detected. The assumption of normality was not violated, as assessed by Shapiro-Wilk's test (p = .856).

Table 4.7: Pull-Up Scores Before and after the Conditioning Programme

Variable	Observation	Pre-test	Post-test	Difference	P-Value	T-test
Pull_Up	30	8.97±4.15	11.53±4.43	2.57±0.28	< 0.05	16.38

Participants performed more pull-ups after the programme- (11.5333 ± 4.4313) repetitions as opposed to before the programme (8.9667 ± 4.1480) repetitions, a statistically significant increase of 2.57, t (29) = 16.3780 and effect size d = 2.990199, P < 0.05. The hypothesis that there would not be any significant increase in muscular strength was thus rejected.

4.7.2 Push-Up Test

The respondents did the push-up test that measured their lower limb muscular power. The results are shown in Table 4.8.

A paired-sample t-test was used to determine whether there was a statistically significant mean difference between the participant's Push-up repetitions before and after the conditioning programme. There were no outliers detected. The assumption of normality was not violated, as assessed by Shapiro-Wilk's test (p = 1.000).

Table 4.8: Push-Up Scores Before and after the Conditioning Programme

Variable	Observation	Pre-test	Post-test	Difference	P-Value	T-test
Push-Up	30	24.67±7.70	27.13±7.61	2.47 ±0.09	< 0.05	21.49

Participants performed more push-ups after the programme- (27.1333 ± 7.61417) repetitions as opposed to before the programme (24.6667 ± 7.7028) repetitions, a statistically significant increase of 2.4667, $t(29) = 21.4858$ and effect size $d = 3.922753$, $P < 0.05$. The hypothesis that there would not be any significant increase in muscular strength was thus rejected.

CHAPTER FIVE

DISCUSSION, SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 Discussion

5.1.1 Muscular Fitness and Cardiovascular Endurance Status of the Respondents

The first objective the study analyzed was the athletes' muscular and cardiovascular fitness status. The sit-up and side bridge test tested the respondents' muscular endurance. The side bridge norms (Wood, 2021) indicate a value of 77.69 ± 20 seconds to be in the good category. This study found that soccer players are good in the good category. The respondents also had a score of 27.63±8.60 sit-ups before the workout program. These side bridge results are similar to the Kaneoka and Imai (2016) study, which found the average results of participants' side bridge scores to be at 89.8 ± 24.4 seconds. The soccer players' abdominal endurance is good when the results are compared to the test score norms (Robert Wood, 2022).

Kuriu, Jarani, and Spahiu (2015), in their study comparing speed and strength in youth soccer players, found that the initial status of the participant's broad jump means before going through the fitness routine was 2.28 m, 2.19 m, 2.26 m, and 2.38 m. Similarly, the current study found that the distance covered was at 2.2263 ± 0.3135 metres after performing the first broad jump test.

The muscular power of the respondents was measured using the broad jump test at 2.23±0.31 metres. The broad jump test norms (Wood, 2021) indicate this value as good. The respondents also performed the pull-up and push-up tests to gauge their muscular

strength, with scores at 8.97 ± 4.15 repetitions which is considered average when compared to the pull-up test norms. In the push-up tests, the respondents had a baseline of 24.67 ± 7.70 repetitions, which is considered above average compared to the push-up test norms.

The baseline, pull-up, and push-up test scores, are prudent as supported by Marques et al., 2017. The study affirmed this by embracing trunk stability push-ups in their functional movement screen. Compared to the current study, the mean score for the push-up was 24.667 ± 7.70 repetitions, and Marques's 2017 study had a lower score with a mean of 11.60 ± 0.77 repetitions.

Finally, on cardiorespiratory endurance, respondents' scores on the shuttle run test were at $V0_{2max}$ (38.91 ± 5.73) before the program. The shuttle run norms (Woods, 2021) indicate this value to be in the fair category.

The overall high test scores in the current study can be attributed to several factors such as the target population that the study focused on. The respondents were also engaged in soccer training sessions thrice a week during the school calendar.

5.1.2 Muscular Endurance of Soccer Players

The study assessed the effect of an eight-week strength and conditioning program on the muscular strength of Strathmore school soccer players. Results indicated a significant increase in the respondents’ muscular endurance after the strength and conditioning

program. This was a statistically significant increase of 6.765 seconds at t (19) = 11.34 with an SD of 3.27, 95% CI, and $P < 0.05$. Before the training, the side bridge score of the participants was (77.69 ± 20.15) seconds. This is considered as good when compared to the test score norms (Appendix V). After the training routine, the participants had an increased score of (84.46 ± 19.72) seconds. This value is rated as good when compared to the test score norms (Appendix V).

While on the other hand, the sit-up scores before the programme were (27.63 ± 8.60) repetitions, and after the programme was (30.97 ± 8.31) repetitions. Before going through the training program, the score was considered above average, but after the training program, the sit-up score was considered excellent according to the test norms. There was a statistically significant increase of 3.33±0.29, SD 1.27, CI 95%, meaning the respondents would perform at least 20 sit-ups at the end of the training program.

According to Beth (2021), there was an improvement in the participant's ability to continuously contract a muscle or a group of muscles against a form of resistance after passing through moderate-intensity training. Beth's (2021) findings indicated that increased muscular endurance allows an individual to perform more repetitions of various exercises. Similarly, Hollerbach, (2021) also experienced an improvement in the participant's results after they passed different fitness classes. Hollerbach's findings further suggested that improving one's muscular endurance such as the abdominal endurance enables one to improve their muscles' aerobic capacity and increase their capacity to carry out actions such as repeated sprints (Hollerbach, 2021). Likewise,

Tibana et al., (2021) in their study on local muscular endurance, found that the athletes exhibited improved results after engaging in muscular endurance training. This concept is in concurrence with the results that the study portrayed due to the significant increase in the muscular endurance performance of the players. There was a significant increase of 6.78 ±0.44 seconds for the side bridge scores and 3.33±0.29 repetitions for the sit-ups. Hoppe et al., (2020) also experienced a similar increase in core strength endurance in their study

The improvements experienced by the respondents in the current study may be attributed to the moderate to high-intensity nature of the programme. One other factor that may have contributed to the increased muscular endurance is the body's ability to adapt to the physiological strain being placed on it (Hughes, 2021), and in the process, the respondents were able to perform more sit-ups and posted higher side bridge scores. The sport-specific aspects of the training programme may also have significantly contributed to the athletes' improved muscular endurance.

5.1.3 Muscular Power of Soccer Players

The study assessed the effect of an eight-week strength and conditioning program on the muscular power of Strathmore school soccer players. Results indicated a significant increase of 0.08167 meters in the respondents' broad jump scores with $P < 0.05$. The study found a statistically significant mean difference between the participants' broad jumps. Before the training, the participants scored (2.23 ± 0.31) metres. This is viewed as average compared to the broad jump test norms (Robert Wood, 2022). The post-test

scores of the participants were (2.31 ± 0.32) metres. Compared to the test norms, this is viewed as above average (Robert Wood, 2022).

This study's results concurred with Meylan and Malatesa's (2009) study whereby after eight weeks of training, with two weekly training sessions, a significant improvement in the muscular power of the participants was observed. Similarly, Granacher et al., (2016) findings showed an improvement in the muscular power of the participants after training and the study findings further lead to the conclusion that the components that make up the power equation, namely force and velocity, should be trained to increase an athletes' muscular power.

However, Sander et al., (2013) on the influence of a two-year programme on the power performance of elite youth soccer players found out that the strength training group displayed a significant improvement of up to 6% when the pre and post-test were compared. Sanders's study focused on testing the front and back squats and the athletes' linear sprinting abilities. There was an improvement ($p<0.001$) in the front and back squats while the sprints also displayed improvement ($p<0.001$).

Likewise, (Thomas et al., 2009) investigated the effect of two plyometric training techniques on the muscular power of youths engaging in soccer. The respondents underwent a six-week programme that engaged in-depth and counter-movement jumps. The post-test score of the depth jump group after doing the 20m sprint was 3.10±0.11 seconds, while the pre-test score was 3.07±0.22 seconds, showing a slightly lower

improvement when compared to the current study, which had a post-test of 2.31±0.32 and a pre-test of 2.23±0.31.

Research in Spain by Lopez et al. (2014) showed that the repeated sprint index of players was associated with power output. Furthermore, this was associated with the athlete's body mass, such as the full squat they performed and the counter-movement jump (Lopez et al., 2014). A study by Fischerova et al., 2021 focused on female athletes' strength and power parameters. The workout took six weeks and involved female athletes. A significant improvement $p<0.05$ and an 11% significant increase was displayed in the counter-movement jump.

Similarly, the current study significantly increased by 0.08±0.01 in its broad jump test. This was slightly higher than the Fischerova et al. (2021) study. One of the factors that can be attributed to this was that Fischerova's study had female respondents while the current study had male respondents. This also shows that male respondents build more muscle power due to strength training than females. The current study also improved after the strength training program ($p<0.05$). The current study concur with Sander et al., 2013 on how strength training positively influences muscular power production. The increase in the standing broad jump scores suggests a positive correlation between the respondent's training and overall scores. Similarly, the current study may have posted higher test scores than (Thomas et al., 2009) mainly because the current study took 8 weeks and the study done by Thomas took six weeks thus alluding to the fact that the

more one engages in a strength training programme, the more gains they do tend to have in regards to their muscular power generation.

5.1.4 Muscular Strength of Soccer Players

The study purposed to determine the efficacy of an eight-week strength and conditioning program on the muscular strength of Strathmore school soccer players. Results indicated a significant increase in the respondents' muscular strength. In the study, the participants performed more pull-ups after the program with 11.53 ± 4.43 repetitions as compared to 8.97 ± 4.15 repetitions before the programme. This is considered above average when compared to the pull-up test norms (Robert, 2012). This led to a statistical increase in mean of 2.5667, SD = 0.8584 at 95 % CI.

On the other hand, the push-up was at 24.67 ± 7.70 repetitions before the programme and consequently, a significant increase was achieved at 27.13 ± 7.61 repetitions after the training programme. This is considered reasonable compared to the push-up test norms (Robert, 2012). This was a significant increase in mean of 2.47, SD = 0.11 at 95 % CI. These findings were similar to a study by Sander et al., (2013) in which the effects of long-term strength training on youth soccer players were conducted. The group conducted four soccer training sessions and two additional strength training sessions similar to the current study’s two training sessions in a week.

In a study by Hammami et al. 2019, the effects on explosive muscular performance were examined after junior soccer players underwent an eight-week strength and conditioning

program. The group that engaged in strength training significantly improved their leg peak power, standing jump, and counter-movement jump. The vertical jump height had an improvement of 18.7% $p<0.001$ while the counter movement jumps and the standing jumps had an improvement of 15.7% $p\leq0.01$. The study findings inclined to the fact that including strength training in the routine goes a long way in improving the performance of the athletes.

Similarly, Christoum et al. (2006) in their study on the effects of resistance training and how they influence an individual's physical performance, found that adding resistance training to skill training tends to improve the maximal strength of the upper and lower body. It also improves the vertical jumping height and sprint capacity. The respondents in Christoum et al (2006) study followed a program twice weekly for sixteen weeks. After sixteen weeks of training the post-tests of the standing broad jump, counter-movement jumps and bench press were higher $p<0.05$. Sander et al., (2013) study also found a significant increase in relative percentages, with differences ranging from 230% to 250% after the muscular strength training period. Nonetheless, the study also had two other slightly older cohorts, and they posted a lower improvement that ranged between 56% and 80%.

The current study also observed improvement in the muscular power of the participants. It also embraced a similar technique of adding strength training to skill training but the post-test results of its standing broad jump were slightly lower but still had a statistically significant increase at $P < 0.05$. This may have been attributed to the fact the current

study took eight weeks while Christou et al took sixteen weeks. During that period the respondents might have developed more strength gains. The results displayed by the current study were also in concurrence with Hammami (2019). One factor that is however unique is how significant the improvements of the studies were. One contributor to this may be the athletes' youthful age as all of them were eighteen years and below.

The current study did not have a mixture of older and younger respondents. Although the significant increase of the respondents' pre-test and post-test are compared, the current study shows higher improvement compared to Sander's older cohort. In the current study, the athletes exhibited a significant change in the mean of 2.47±0.09 repetitions in push-ups and 2.57±0.28 repetitions in pull-ups. This was an enhanced adaptive potential after the athletes went through the training program. This can be attributed to the athletes' tremendous relative percentage strength gains and the youth athletes' increased neural plasticity (Pfeiffer & Francis, 1986). The study pointed out that the increased neural plasticity was higher in youth athletes.

5.1.5 Cardiovascular Endurance of Soccer Players

The study ascertained the effect of an eight-week strength and conditioning program on the cardiovascular endurance of Strathmore school soccer players. Results indicated a significant increase in the respondents' cardiovascular endurance. In the present study, the shuttle run test scores were in $V0_{2\ max.}$ The mean score for the participants before the training was at (38.91 ± 5.73) $V0_{2\ max}$, after the training, the mean went higher to (41.66 ± 5.34) $V0_{2\ max}$. These results were similar to (Wisløff et al., 2001) where players had an

improved VO_2 max after the training. A statistically significant mean increase of 2.75±0.39 was recorded SD = 3.68 at 95 % CI. This improvement shows that an increase in the level of cardiovascular training and normal skill training brings about a positive change in the cardiovascular endurance of youth athletes.

The physical status of the athletes before engaging in the workout routine shows the physical capacity of the athlete. The baseline score of the athletes before engaging in the training programme was (38.91± 5.73) $V0_{2\ max.}$ This was regarded as fair when compared to the test score norms (Robert, 2012). In a similar study by Straus et al. (2020), the respondents exhibited a baseline score of (14.01±0.81). This shows that the respondents were in the poor category. Similarly, Wisløff et al, (2001) in their study on how aerobic endurance training improves sports performance created a programme in which the respondents went through an interval training routine. The respondents did the programme twice a week. The group that engaged in the training routine had an increased $V0_{2\ max}$ from 58.1 ± 4.5 to 64.3 ± 3.9 ($P<0.01$). This is quite a huge improvement as compared to its pre-test. The study results portrayed the effectiveness of the interval training that the respondents went through.

Further, small-sided training was incorporated in Helgerud's study whose main aim was to gauge the physiological adaptation to soccer-specific endurance. Helgerud's study also used interval training as its technique of training the players. A significant improvement was noted as the scores went up from $V02_{max}$ 63.4(5.6) to 69.8 (6.6), $p<0.0$. The findings of the study showed the significant impact of interval training in building the

cardiovascular endurance of athletes. The current study also experienced a significant change with a mean increase in $V02_{max}$ of 2.75±0.39. The significant increase in both studies can also be attributed to the incorporation of skill training and cardiovascular training. Such a model of training also ensures that soccer-specific endurance is achieved.

Similarly, the current study's respondents posted higher scores compared with Straus et al. (2020) study. Several factors may contribute to this. One of them could be the frequency of their fitness training before engaging in the workout routine. This may have contributed to the respondents in the current study having higher scores. The other factor may be how often the participants engaged in the skill training. Frequently engaging in the skill training may also increase the participants' scores. The current study observed similar results to Helgerud et al. (2001) study on how aerobic endurance training can have beneficial effects on an athlete's aerobic endurance. The $V02_{max}$ improved from (38.91±5.73) to (41.66 ±5.34). This can be attributed to the combination of moderate to high-intensity training with the load in skill training.

5.2 Summary of the Findings

The study aimed to assess the efficacy of an eight-week soccer programme on the muscular and cardiovascular fitness training of the Strathmore school soccer team. The study assessed the muscular and cardiovascular fitness status of the Strathmore School Soccer team and further assessed the workout's effectiveness on the student-athletes. A pre-test and post-test were done to ascertain the changes that took place. The results of

the study indicated that the participants experienced significant change after the duration of the strength and conditioning program.

5.2.1 Muscular Fitness and Cardiovascular Endurance Status

The participants who participated in the study had good scores in the initial test that was taken before the strength and conditioning program. The muscular endurance measure was 77.69± 20.15 (side bridge), 27.63 ± 8.60 (sit-ups), cardiovascular endurance 62.13 ± 18.07 (Shuttle run), muscular power 2.23 ± 0.35 (broad jumps), muscular strength 8.97 ± 4.15 (pull–ups) and 24.67 ± 7.71 (push-ups). Compared to the test norms, the muscular and cardiovascular fitness of the athletes was above average.

5.2.2 Efficacy of the Strength and Conditioning Programme

Several tests were used to gauge the efficacy of the strength and conditioning programme. The comparison of the pre-test and post-test indicates the efficacy of the programme on the participants. Findings indicated statistically significant differences between the pre and post-tests, as follows: Muscular Endurance of the Respondents; Side Bridge Test; $t(29) = 11.3416$ and effect size $d = 2.070691$, $P < 0.05$ plus Sit Up Test; $t(29) = 8.7$ and effect size $d = 2.63$, $P < 0.05$. Cardiovascular Endurance of the Respondents; $t(29) = 4.093$, and effect size $d = 0.741$, $P < 0.05$. Muscular Power of the Respondents; $t(29) = 8.70$ and effect size $d = 1.588849$, $P < 0.05$. Muscular Strength of the Respondents; Pull-Up Test; $t(29) = 16.3780$ and effect size $d = 2.990199$, $P < 0.05$ plus Push-Up Test; $t(29) = 21.4858$ and effect size $d = 3.922753$, $P < 0.05$ The abdominal endurance, cardiovascular endurance, muscular strength, and muscular power of the

athletes significantly improved. These implied the efficacy of the training programme. The study confirmed that callisthenic training combined with skill training can improve athletes' performance.

5.3 Conclusions

Based on the findings of the study, the following conclusions are made:

1. The participants' fitness level in the study was relatively high as shown by the initial score they posted before training. The participants could engage in the strength and conditioning and also in the skill work training, thus indicating that they could handle the added training session.
2. Muscular strength training (45 mins, 2 times a week) is an effective way of boosting the muscular strength of the student-athletes.
3. Aerobic training (45 mins, 2 times a week) combined with the strength and conditioning routine targeting other fitness components improves the participant's cardiovascular endurance.
4. The muscular power training, in combination with muscular training targeting all the other fitness components (45 mins, 2 times a week), causes the soccer team to experience a significant change in their muscular power.
5. Muscular endurance training in combination with cardiovascular endurance and other muscular fitness exercise (1 hour, 2 times a week) brings about a significant change in the muscular power of the athletes.

5.4 Recommendations for Policy and Practice

1. Sports coaches in youth soccer teams should understand the importance of cooperating in strength training in their routine. The strength training can be combined with the skill training.

2. The aerobic capacity of the athletes should be determined as this will enable the trainer to know about the athletes' baseline. With this in mind, the trainer can make informed decisions when creating the cardiovascular endurance programme for the athletes.

3. The strength and conditioning programme of the athletes should incorporate muscular power training. This is important as the training should accommodate the nature of the sport that the athletes will play. This enhances the performance of the athletes due to the program targeting muscular power actions that the athlete may undertake in a real game situation.

4. Youth athletes should be advised to embrace muscular endurance training early. This will go a long way in building the athletes' muscular endurance level and enhance their performance in competition. Furthermore, it will make it easier for them to transition into pro-competition as they will be able to embrace that level of training.

5.5 Recommendations for Further Research

1. The study was quasi-experimental, but longitudinal studies can be done in combination with the quasi-experimental study to gauge how aspects such as nutrition and sleep patterns affect the physiological adaptation of the participants after the training duration.

2. Further studies should be done to ascertain the impact of high-intensity small-sided games without the strength and conditioning programme on the participants' cardiovascular endurance and muscular fitness.

3. Further studies should be done on the different types of exercise, such as high-intensity training and slow to moderate-intensity training, to gauge the efficacy of the different strength and conditioning program models.

4. Further research should also be done to gauge how strength and conditioning among youth soccer athletes help prevent and reduce the rate of injuries among athletes who engage in such sports and also in strength and conditioning training.

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APPENDICES

Appendix I: Consent form

The efficacy of an 8 week muscular strength and cardiovascular endurance program on Kenyan high school soccer team players: A case study of Strathmore School.

KENYATTA UNIVERSITY

OFFICE OF THE CHAIRMAN ETHICS REVIEW COMMITTEE

Informed Consent

My name is_____Brian Ochieng' Abuto_____(Masters student from Kenyatta University). I am conducting a study titled "_____Efficacy of an Eight Week Soccer Programme on Muscular and Cardiovascular Fitness Training: Case of Strathmore School, Nairobi City County, Kenya

_____

_____

_____

The information will be used (indicate the purpose of the study and significance).

Procedures to be followed

Participation in this study will require that I ask you some questions and I also examine you in order to screen you for muscular and cardiovascular fitness

Some specimen (indicate type of specimen, amount and from where) will be taken from you for further tests. I will record the information you provide in a questionnaire.

Voluntarism

You have the right to refuse participation in this study. You will get the same services and care whether you agree to join the study or not and your decision will not change the care you will receive. Please remember the participation in this study is voluntarily. You may ask questions related to the study at any time.

You may refuse to respond to any questions and you may stop an interview at any time. You may also stop being in the study at any time without any consequences to the services you receive here or any other organization now or in the future.

Discomforts and Risks

Some of the questions you will be asked are on intimate subject and may be embarrassing or make you uncomfortable. If this happens, you may refuse to answer these questions if you so choose. You may also stop the interview at any time. The interview may add approximately half an hour to the time you wait before you receive your routine services. During the removal of blood there will be some pain or discomfort but we will try our best to minimize this by being gentle.

Benefits

If you participate in this study, you will help us to learn how to provide effective screening services that can improve muscular and cardiovascular fitness: You will also benefit from being screened for muscular and cardiovascular fitness and if you are found to have a problem you will be advised on the treatment.

Reward

If you agree to participate in this study, lunch will be provided and transport expenses will be reimbursed at 200/- per visit.

Confidentiality

The interviews and examinations will be conducted in a private setting within the clinic. Your name will not be recorded on the questionnaire. The questionnaires will be kept in a locked cabinet for safe keeping at Kenyatta University. Everything will be kept private and only shared with the study team.

Contact Information

If you have questions about the study call the department number +254028701901 or the Supervisor Dr. Hellen Muthomi 0720862113 /Investigators Tel Nos: 0729719899

However, if you have questions about your rights as a study participant: You may contact Kenyatta University Ethical Review Committee Secretariat on chairman.kuerc@ku.ac.ke,

Participant's statement

The above information regarding my participation in the study is clear to me. The study has been explained to me and I have been given a chance to ask questions and my questions have been answered to my satisfaction. My participation in this study is entirely voluntary. I understand that my records will be kept private and that I can leave the study at any time. I understand that I will still get the same care and medical treatment whether I decide to leave the study or not and my decision will not change the care that I will receive from the clinic today or that I will get from any other clinic at any other time.

Name of Participant: _____

Signature or Thumbprint_____Date_____

Name of Representative/Witness (where necessary) Relationship to Subject

Investigators statement

I, the undersigned, have explained to the volunteer in a language s/he understands, the procedures to be followed in the study and the risks and benefits involved

Name of Interviewer_____

Signature_____Date_____

Appendix II: Student's Ascent Form

I (write name) _____ hereby consent to participating in the physiological assessment on the following terms: I have been informed about the physiological assessment procedures and understand what I will be required to do. I understand that I will be partaking in physical exercise, some of which is at maximal intensity. I understand that there is always a risk of injury associated with high-intensity exercise. I understand that I can withdraw my consent, freely and without prejudice, at any time. I have told the testing personnel about any illness or physical defect I have that may contribute to the level of risk. I understand that the information obtained from the test will be treated confidentially, with my right to privacy assured. However, the information obtained may be used for statistical analysis or scientific purpose with my right to privacy retained. I release the testing personnel from any liability for any injury or illness that I may suffer while undertaking the physical assessment, or subsequently occurring in connection with the assessment or that is to any extent contributed to buy it. I accept however that the testing personnel will take every precaution to ensure that no incidents will occur.

Participant Signature_____Date_____

Witness_____Date_____

Appendix III: Letter of Introduction and Consent to the Strathmore School Management

Kenyatta University,
Department of Physical Education and Exercise Science.
P.O Box 43844-00100,
Nairobi.

The Principal,
Strathmore School,
P.O Box
Nairobi.

Dear Sir

RE: REQUEST FOR RESEARCH DATA COLLECTION

I am a postgraduate student taking a Master of Science degree in Exercise and Sports Science in the department of Physical Education and Exercise Science. My M.Sc. research topic is, "The Efficacy of an Eight Week Muscular Fitness and Cardiovascular Endurance Program on Kenyan High school Soccer Players". It is through this letter that I am kindly requesting you to allow me to use your Institution and have access to your students to enable me collect data by passing the students through a training routine with a pre and post test administered in order to get the relevant information. The results of this study will purely be for academic purpose and will be treated in confidence. The findings of the study will assist towards development of the necessary strategies to promote strength and conditioning among youth athletes in the country.
Thank you.

Yours Sincerely,

Brian Ochieng' Abuto.

Appendix IV: Map of Nairobi County & Strathmore School

Appendix V: Testing Battery Sample Sheet for Each Participant (Description)

Testing battery						
Code number	Shuttle run test	Broad Jump test (cm)	Push up test	Pull up test	Side bridge test	Sit Up test
					R= L=	

Shuttle run test – Cardiorespiratory endurance test

The Yoyo Endurance test is a variation of the beep test developed by the Danish soccer physiologist Jens Bangsbo. Its main aim is to test an individual's cardiovascular endurance.

Cones are normally used to mark out two lines 20 metres apart.

The subjects start with their foot behind one the lines and begin running when instructed.

They continue running between the two lines, turning when signaled by the recorded beeps

The pace gets quicker after approximately every one minute.

If the line is not reached in time the subject must run to the line and try to catch up with the pace within the two beeps

Shuttle Run Test Norms

Age	very poor	Poor	Fair	Average	Good	very good	Excellent
17 < 3/1	3/1-5/2	5/3-6/8	6/9-8/3	8/4-9/9	9/10-12/1	> 12/1	

Standing Broad Jump test – P….

The aim of the test is to measure an individual's leg ***Strength (Lower body Strength).

The athlete is required to warm up for at least 10mins.

The athlete places there feet over the edge of the sandpit, crouches down and using the arms and legs jumps horizontally as far as possible landing with both feet in the sandpit.

One thus measures and records the distance from the edge of the sandpit to the nearest mark made by the athlete.

The athlete repeats the test 3 times.

The longest distance recorded is used to record an athlete's leg strength

Broad Jump Test Norms

Age	Excellent	Above average	Average	Below average	Poor
>16	>2.44	2.44-2.99m	2.28-2.16 m	2.15-1.98m	<1.98

Muscular strength tests

Push up test

It measures the upper body strength

A standard pushup begins with hands and toes touching the floor, the body and the legs in a straight line, feet slightly apart, the arms at shoulder width apart, extended and at right angle with the body.

Keeping the back and knees straight, the subject lowers the body to a pre-determined point, to touch some other object, or until there is a 90 degree angle at the elbows then returns back to starting position with the arms extended.

This action is repeated, and the test continuous until exhaustion or until they can't do more in rhythm or have reached the target number of pushups.

Push Up test norms

Age	17-19
Excellent	> 35
Good	27-35
Above Average	21-27
Average	11-20
Below average	6-10
Poor	2-5
Very Poor	0-1

Pull up test

The athlete warms up for 10 minutes

The athlete hangs from the bar with the palms of their hands facing them and arms straight (start position)

The athlete, using the arms, pulls the body up until the chin is above the bar and then lowers the body to the start position

The athlete continues with the pull-ups until they are unable to continue or let go of the bar

The assistant counts and records the number of successfully completed pull ups

Pull up test norms

The following are national norms for ages 16 to 19.

Gender	Excellent	Above Average	Average	Below Average	Poor
Male	>13	9-13	6-8	3-5	<3
Female	>6	5-6	3-4	1-2	0

Muscular endurance Tests

Origin, development, use, performance, recreation, fitness, norms, how useful

Sit up test

The athlete warms up for 10 minutes

The athlete lies on the mat with the knees bent, feet flat on the floor and their hands on their ears where they must stay throughout the test

The assistant holds the athlete's feet on the ground

The assistant gives the command “GO” and starts the stopwatch

The athlete sits up touching the knees with their elbows, then returns back to the floor and continues to perform as many sit-ups as possible in 30 seconds

The assistant keeps the athlete informed of the time remaining

The assistant counts and records the number of correct sit-ups completed in the 30 seconds and uses this recorded value to assess the athlete's performance

Sit up test norms

Sit up test norms for 16 to 19-year-olds.

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

Side bridge test

The aim of this test is to hold an elevated position for as long as possible.

The subject lays on their right side, the upper body supported off the ground by the right elbow and forearm.

The legs are straight, with the left foot (top) in front of your right foot. The hip is lifted off the floor so that the elbow and feet support the body, creating a straight line from head to toe.

The left hand is placed on the supporting shoulder. As soon as the subject is in the correct position, the stopwatch is started.

The test is over when the subject is unable to hold the back straight and the hip is lowered. After five minutes rest, the other side is tested.

Rating	Time (seconds)
Excellent	> 90
Good	75 to 90
Average	60 to 75
Poor	< 60

Appendix VI: Specific Exercises Description

Aerobic endurance exercises

Laps

Continuous running around the field for 15-20 mins.

Shuttle run

Place a marker at 10m, 20m and 30m.

Run to the 10m mark first, touching the floor and running back to the start line.

Then run to the 20 m line and back .Finally to the 30m line and back.

Start the routine again and repeat four times.

20m repeat sprints

Place a marker at 20 m

Sprint to the 20m marker then come back jogging to the starting line.

Start the routine again and repeat the process five times.

Muscular strength

Push ups

A standard pushup begins with hands and toes touching the floor, the body and the legs in a straight line, feet slightly apart, the arms at shoulder width apart, extended and at right angle with the body.

Keeping the back and knees straight, the subject lowers the body to a pre-determined point, to touch some other object, or until there is a 90 degree angle at the elbows then returns back to starting position with the arms extended.

This action is repeated up to the completion of the required repetitions.

Tyre flips

The tyre is first placed lying flat on the ground.

One then places their hands underneath the tyre and flips it.

The tyre will be flipped for the given distance in our case up to the 20 m mark and back to the starting point.

Tyre Pull

Start by placing a marker at 20m

A strap is then attached to the tyre and then placed on the subjects back like a back pack

The tyre is then pulled as it trails behind the subject for the given distance.

The tyre is then pulled back to the starting point and repeated for the recommended amount of repetitions.

Dips

The exercise will be done on a raised step which will be perpendicular to the subject's body, while looking away from it they will hold on to the step with hands fully extended, separated at the shoulder width. The legs will be extended forward, bent at the waist and perpendicular to the torso. This will be starting position.

Slowly lower your body as you inhale by bending at the elbows until you lower yourself far enough to where there is an angle slightly smaller than 90 degrees between the upper arm and the fore arm.

The elbows should be kept as close as possible throughout the movement and the forearms should always be pointing down.

Using your triceps to bring your torso up again, lift yourself back to the starting point.

Repeat for the recommended amount of repetitions.

Chin ups

It is done on a chin up bar.

Put your hands on the bar with your palms facing your body.

Grip the bar comfortably but firmly, with your hands spaced shoulder width apart.

Raise your body until your chin is above the bar.

Use you upper arm strength to lift your body toward the bar, stopping when your chin is above the bar. Your elbows should be fully bent.

The knees should also be bent or crossed to distribute one's weight more evenly.

Using a slow controlled motion, lower yourself until your arms are straight. This the full range of motion.

Repeat the process for the recommended amount of reps.

Squats

Stand with feet a little wider than shoulder -width apart, hips stalked over knees and knees over ankles.

Roll the shoulders back and down away from the ears.

Initiate the movement by inhaling and unlocking the hips, slightly bringing them back. Keep sending hips backwards as the knees begin to bend.

While the butt begins to stick out make sure the chest and shoulders stay upright, and the back stays straight. Keep the head facing forward with eyes straight ahead at a neutral spine.

The best squats are the deep ones with hips sinking below the knees.

Engage core with body weight in the heels, explode back up to standing, driving through heels.

Calf raises (Standing)

Start by standing on the edge of a step or something raised.

Stand tall with your abdominals pulled in, the balls of your feet firmly planted on the step, and your heels hanging over the edge .Hands can be rested on a wall or sturdy object.

Raise your heels a few inches above the edge of the step so that you are on your tiptoes

Hold the position for a moment and then lower your heels below the platform feeling a stretch in your calf muscle.

The process should continue for the recommended amount of reps.

Box Jumps

It will be done a raised step of about 50 cm high.

One will stand in front of the step with their feet shoulder width apart.

Bend into a quarter squat and swing your arms back, then swing them forward and explode up and off the ground.

Land on the box as softly as possible.

You are aiming to mimic your take-off position on landing-feet flat and knees slightly bent.

Then jump back down again, you are aiming to land as softly as possible.

You can also opt to step down slowly one leg at a time.

Repeat the process for the recommended amount of repetitions.

Burpees

The standard starting position for the burpee is standing erect with the arms by the side.

From the standing position, squat down and place the hands on the floor in front of the feet.

Putting the bodyweight on the hands, the legs are thrust back to a push-up position with a straight line from the shoulders to the heels.

Next pull the legs back and return to the squatting position, then up back to the starting standing position.

One complete burpee is from the standing back to the standing position.

Appendix VII: Program

Workout one

Aerobic endurance

Laps around the field (15mins)

Strength training

Exercise	Sets	Reps	Distance
1. Push Ups	3	10-12	
2. Tyre Flips	3		100 m
3. Tyre Pulls	3		100 m
4. Squats	3	10-12	
5. Chin Ups	3	10-12	
6. Burpees	3	10-12	
Stretches	(10 mins)		

Workout Two

Aerobic Endurance

Shuttle run (10 rounds)

Strength Training

Exercise	Sets	Reps	Distance
1. Dips	3	10-12	
2. Calf raises	3	10-12	
3. Tyre Pulls	3		100m
4. Box Jumps	3	10-12	

5. Tyre flips	3		100m
6. Burpees	3	10-12	
Stretches	(10 mins)		

Program Details

Training will last 1 hour. 15 minutes aerobic endurance and 45 minutes strength training.

Intensity will be maintained at 80 % Rpm & VO2 max.

Individuals will spend at least 6 minutes at each station.

The training will be on Tuesdays and Thursdays.

Appendix VIII: NACOSTI Research License

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: 285023

Date of Issue: 27/May/2021

RESEARCH LICENSE

This is to Certify that Mr., Brian Ochieng' Abuto of Kenyatta University, has been licensed to conduct research in Nairobi on the topic: CASE OF AN EIGHT WEEK SOCCER PROGRAM ON MUSCULAR AND CARDIOVASCULAR FITNESS TRAINING AT STRATHMORE SCHOOL ,NAIROBI CITY COUNTY KENYA for the period ending : 27/May/2022.

License No: NACOSTI/P/21/10831

285023

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

NOTE: This is a computer generated License. To verify the authenticity of this document, Scan the QR Code using QR scanner application.

Appendix IX: Graduate School Approval Letter

KENYATTA UNIVERSITY
GRADUATE SCHOOL

E-mail: dean-graduate@ku.ac.ke
Website: www.ku.ac.ke

P.O. Box 43844, 00100
NAIROBI, KENYA
Tel. 020-8704150

Internal Memo

FROM: Dean, Graduate School **DATE:** 18th February, 2021

TO: **Mr. Brian Ochieng' Abuto**
C/o Department of Physical Education, Exercise & Sports Science

REF: H108/38649/2016

SUBJECT: APPROVAL OF RESEARCH PROPOSAL

We acknowledge receipt of your Research Proposal after fulfilling recommendations raised by the Graduate School Board of 27th January, 2021.

You may now proceed with your Data collection, subject to clearance with the Director General, National Commission for Science, Technology & Innovation.

As you embark on your data collection, please note that you will be required to submit to Graduate School completed Supervision Tracking and Progress Report Forms per semester. The forms are available at the University's Website under Graduate School webpage downloads.

Thank you.

REUBEN MURIUKI
FOR: DEAN, GRADUATE SCHOOL

CC. Chairman, Department of Physical Education, Exercise & Sports Science

Supervisors:

1. Dr. Gitahi Theuri
   C/o Department of Physical Education, Exercise & Sports Science
   Kenyatta University

2. Dr. Nkatha Muthomi
   C/o Department of Recreation & Sports Management
   Kenyatta University

RJM/eww

Appendix X: Kenyatta University Directorate of Ethics Review Committee Letter

KENYATTA UNIVERSITY
DIRECTORATE OF ETHICS REVIEW COMMITTEE

Fax: 8711242/8711575
Email: chairman.kuerc@ku.ac.ke
Nairobi, 00100

P. O. Box 43844,

Tel: 8710901/12

Website: www.ku.ac.ke
Our Ref: **KU/ERC/APPROVAL/VOL.1**

Date: 18th May, 2021

Brian Abuto
P.O Box 43844, 00100
Nairobi.

Dear Mr. Abuto,

APPLICATION NUMBER: PKU/2247/I1391 CASE OF AN EIGHT WEEK SOCCER PROGRAM ON MUSCULAR FITNESS TRAINING AT STRATHMORE SCHOOL, NAIROBI CITY COUNTY, KENYA

This is to inform you that ***KENYATTA UNIVERSITY DIRECTORATE OF ETHICS REVIEW COMMITTEE*** has approved version 4 of the study protocol together with the attached consent forms dated 12.09.2020. Your application approval number is **PKU/2247/I1391.** The approval period is ***18th May, 2021 TO 18th May, 2022.***

This approval is subject to compliance with the following requirements;

i. Only approved documents including (informed consents, study instruments, MTA) will be used
ii. All changes including (amendments, deviations, and violations) are submitted for review and approval by ***KENYATTA UNIVERSITY DIRECTORATE OF ETHICS REVIEW COMMITTEE***.
iii. Death and life threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to ***KENYATTA UNIVERSITY DIRECTORATE OF ETHICS REVIEW COMMITTEE*** within 72 hours of notification
iv. Any changes, anticipated or otherwise that may increase the risks or affected safety or welfare of study participants and others or affect the integrity of the research must be

reported to ***KENYATTA UNIVERSITY DIRECTORATE OF ETHICS REVIEW COMMITTEE*** within 72 hours

v. Clearance for export of biological specimens must be obtained from relevant institutions.
vi. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal.
vii. Submission of an executive summary report within 90 days upon completion of the study to ***KENYATTA UNIVERSITY DIRECTORATE OF ETHICS REVIEW COMMITTEE***.

Prior to commencing your study, you will be expected to obtain a research license from National Commission for Science, Technology and Innovation (NACOSTI) https://oris.nacosti.go.ke and also obtain other clearances needed.

To serve you better, researchers are kindly requested to access and complete a customer feedback form and sent it back online as you continue with research and upon completion of data collection found on the following websitelink;(https://docs.google.com/forms/d/1ytWefDwvyz5h1oz_Vln0xbxg3uGdlDzMXFWNDsMrRPQ/edit?usp=sharing

Yours sincerely

Prof. Judith Kimiywe

DIRECTOR- KENYATTA UNIVERSITY ETHICS REVIEW COMMITTEE.

Appendix XI: Kenyatta University Research Authorization

Republic of Kenya

MINISTRY OF EDUCATION

STATE DEPARTMENT OF EARLY LEARNING AND BASIC EDUCATION

Telegrams: "SCHOOLING", Nairobi
Telephone; Nairobi 020 2453699
Email: rcenairobi@gmail.com
cdenairobi@gmail.com

When replying please quote

REGIONAL DIRECTOR OF EDUCATION
NAIROBI REGION
NYAYO HOUSE
P.O. Box 74629 – 00200
NAIROBI

Ref: RDE/NRB/RESEARCH/1/65 Vol.1 DATE: 29th October, 2021

Mr. Brian Ochieng' Abuto
Kenyatta University.

RE: RESEARCH AUTHORIZATION

We are in receipt of a letter from the National Commission for Science, Technology and Innovation regarding research authorization in Nairobi County on the topic: *" CASE OF AN EIGHT WEEK SOCCER PROGRAM ON MUSCULAR AND CARDIOVASCULAR FITNESS TRAINING AT STRATHMORE SCHOOL, NAIROBI CITY COUNTY KENYA".*

This office has no objection and authority is hereby granted for a period, ending **27th May , 2022** as indicated in the request letter.

Kindly inform the Sub County Director of Education of the County you intend to visit.

REGIONAL DIRECTOR OF EDUCATION NAIROBI
29 OCT 2021
MINISTRY OF EDUCATION P. O. Box 74629, NAIROBI

JAMES KIMOTHO
FOR: REGIONAL DIRECTOR OF EDUCATION
NAIROBI.

Copy to: Director General/CEO
National Commission for Science, Technology and Innovation
NAIROBI.