COMPARATIVE STUDY OF PHYSICAL FITNESS AND ANTHROPOMETRIC CHARACTERISTICS OF NIGERIAN FEMALE DEFENSIVE AND OFFENSIVE SOCCER PLAYERS IN ABUJA-FCT, NIGERIA

BY

Dilichukwu, ONYEDINMA
MSC/EDUC/07634/2008-2009/ P13EDPE8048

DEPARTMENT OF PHYSICAL AND HEALTH EDUCATION
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A THESIS SUBMITTED TO THE SCHOOL POSTGRADUATE STUDIES, AHMADU BELLO UNIVERSITY ZARIA IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF SCIENCE (M.Sc) DEGREE IN EXERCISE AND SPORTS SCIENCE

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ZARIA, NIGERIA

AUGUST, 2015

DECLARATION

I hereby declare that this research work was written by me and that it is a record of my own research work. That it has not been presented in any previous application for a higher degree. All sources have been dully acknowledged in the reference section.

Dili Onyedinma

APPROVAL PAGE

This thesis entitled **"The Comparative Study of Physical Fitness and Anthropometric Characteristics of Nigerian Female Defensive and Offensive Soccer Players in Abuja-FCT Nigeria"** has been read and approved as meeting the required standard for the award of Master of Science (M.Sc.) degree in Exercise and Sports Science in Department of Physical and Health Education, Ahmadu Bello University, Zaria and for its contribution to knowledge and literacy presentation.

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Prof. C.E. Dikki Date
Chairman, Supervisory Committee

_____________________________ _______________

Prof. J.A. Gwani Date
Member, Supervisory Committee

_____________________________ _______________

Prof. T.N. Ogwu Date
Head of Department

_____________________________ _______________

Prof. A.Z. Hassan Date
Dean, Postgraduate School

DEDICATION

To God Almighty, my Saviour and protector. My loving and understanding kids Ada, Enkay, Dilinna and Chizzy

I owe my success to all of you. May the good Lord reward you wherever you are now Amen.

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ABSTRACT

The purpose of this study was to compare the physical fitness and anthropometric characteristics of Nigerian female defensive and offensive soccer players. To achieve the purpose of this study, we used stratified sampling technique to obtain a representative sample of thirty (30) female defensive players and thirty (30) female offensive players from five female soccer teams participating in National Competition in Federal Capital Territory (FCT). Female defensive players included those playing as goal keeper, right full back, left fullback and centre half back positions whereas female offensive soccer players included those playing in right forward, left forward and centre forward positions, including outside right and outside left. The instruments used were stop watch, whittles, 400 meter running track, calibrated stool, weighing scales, cross bars, horizontal broad wooden blade, etc. Age, height, weight, total arm length and total leg length of these players were recorded using standard, validated and reliable methods to represent anthropometric characteristics. Similarly, cardiorespiratory endurance, muscular strength and endurance, flexibility and explosive strength of the lower limbs were determined by administering valid and reliable field tests to represent physical fitness characteristics. The results indicated that (1) female offensive players demonstrated greater flexibility and explosive strength than female defensive players. (2) female defensive soccer players were significantly taller and heavier than the female offensive players, depending on their playing experience. It was recommended that: (1) taller and heavier female soccer players should be selected for defensive positions. (2) female soccer players with height and weight but greater flexibility and explosive strength should be selected for offensive positions in soccer.

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Definition of Terms

The technical terms used in research report are defined below in the operation sense.

1. Anthropometric characteristics for the purpose of the study include body mass (weight) total leg and arm lengths and body mass index.
2. Physical fitness – In this study the term physical fitness was used to include such component as cardio-respiratory endurance, muscular strength, lower limb explosive power and flexibility.
3. Defensives players – For the purpose of this study defensive players included right full back left full back, goal keeper, centre half eight left.
4. Offensive players – Offensive players included centre forward inside left, inside right, outside left, outside right.

CHAPTER ONE

INTRODUCTION

1.0 Background of the Study

Football is the most popular sport globally (Witvrouw, Danneels, Asselman, D'Have & Cambier, 2003) and its growing interest has been on the increase in Nigeria. The national team Super Eagle's ranking has been up and down in Federation International de Football Association (FIFA) currently ranked 46 and third in the continent of Africa in male football. While in the female category both in Africa and globally Nigeria is a force to be reckoned with. The ranking suggests that our playing standards need to be improved in line with three key areas previously reported to be related to successful football performance, namely physical, technical and tactical skills, (Hoff & Helgerud, 2004)

The advent of female football in the continent was through the organisation of African Women's Cup in 1988 by Confederation of Africa Football (CAF) (Complete Football, 1998). This stirred up the development of female football in the nation, though proper female league did not start until 1990 and by 1991 Nigeria Football Federation organised the first female challenge cup competition for female footballs registered with the federation, (Ayodele, 1992).

There was a rapid growth of female clubs in the country an indication that the country is blessed with potential female players. The swift rise of Nigeria into dominance in the African continental female football, a mecca of female players and a confirmed force to be reckoned with in the world female football. The national senior female team Super Falcon having participated in almost all the FIFA female competitions having won the African Women Cup six times since its inception in 1988.

Historically physical fitness was concerned in a simple term as consisting of strength, endurance, speed agility, coordination and balance in 1950s. But with the passage of time it becomes more complex in computing level of strengths, endurance and flexibility. The present concept of physical fitness emphasizes two broad areas of fitness which includes health-related fitness and skill or performance related fitness. Health related fitness is made up of cardiorespiratory, endurance, muscular endurance, body agility.

Physiological characteristics that have been reported as essential for football players are aerobic fitness, agility, muscle strength, speed, and explosive jumping power, (Polman, Walsh, Bloomfield & Nesti, 2004). While aerobic fitness contributes up to 90% of energy utilization during football matches (McMllian, Helgerud, Macdonard & Hoff, 2005), typically high intensity bouts of sprinting are necessary to score goals. These efforts may be complemented by jumping used by footballers when controlling the ball in the air and to score or defend goals by way of heading. Sprinting accounts for approximately only five per cent of the duration; with each sprint covering up to 30 meters and most efforts not completed in a straight line. Thus, acceleration, speed, and agility are determined by the athletes muscle strength and power (Wisloff, Catagna, Helgerud, Jones & Hoff, 2004) and can be effectively trained through a well-developed and structured program. These key components have been shown to differentiate performance of players independent of their football specific skills such as ball control, dribbling, and tackling.

Success in sports has been associated with specific anthropometric characteristics, body composition and somatotype (Duquet & Carter, 2001). During a soccer match (90 minutes), the player’s movements are characterized by high intensity, short-term actions and pauses of varying length. To be successful in such a team sport, soccer players need an optimal combination of technical, tactical, physical characteristics (e.g. somatotype), and mental motivation (Bangsbo, 1994), among other sports characteristics. Hence, for soccer coaches, managers, sports physiotherapists, and scientists, an in-depth understanding of the determinants of success, such as the specific anthropometric characteristics of players may be important. Some studies showed evidence for position-specific anthropometric characteristics in soccer players (Rienzi, Drust, Reilly, Carter, & Martin, 2000; Gil, Gil, Ruiz, Irazusta & Irazusta, 2007). Goalkeepers are taller than central position players, Tahara, Moji, Tsunawake, Fukwda, Nakayama & Nakagaichi, 2006; Gil et al., 2007). Similar studies on position-specific anthropometric profiles have been reported for Australian football (Young, Newton, Doyle, Chapman, Cormack & Stewart, 2005; Pyne et al., 2006), Gaelic soccer (McIntyre, 2005; McIntyre & Hall, 2005) and American football (McGee & Burkett, 2003; Garstecki, Latin, & Cuppett, 2004).

It is well-known fact that there is a growing interest in improving the performance of players (Popovic, Bjelica, Petkovic & Muratovic, 2012) as well as identifying talent, strengths and weaknesses, assigning player positions and helping in the design of optimal training programmes all over the world. (Hadzic, Bjelica, & Popovic, 2012) However, in many places much more time is spent on increasing the physical fitness of athletes without taking into consideration the assessment of their body composition and their nutritional status (Triki, Rebaih, Abroug, Masmoudi, Fellmann, Zour & Tabka, 2012). Contemporary sport science is designed to improve the performance of players and to discover talents as precisely as possible. However, this process is very demanding, as various games/sport events require different body types to achieve maximum performance. Therefore, understanding the body composition of players, and then assigning corresponding competitive weights for the athletes, has been done for decades and is considered an essential part of the total management process. It is widely addressed in the scientific literature that adequate profiles are primarily important in various sports, mostly due to the reason that absolute size contributes a significant percentage of total variance associated with athletic success (Carvajal, Betancourt, Leon, Deturnel, Martins, Echeverria, Eugenia & Serviat, 2012). Therefore, scientists all over the world are looking for a standard formula that can improve the performance of players and discover talents as efficiently as possible.

The anthropometrical characteristics and body compositions of athletes have been the subject of many investigations as many researchers have hypothesized that practicing athletes might be expected to exhibit structural and functional characteristics that are specifically favourable for their specific sport (Singh, Singh &Singh 2010, Matic, & Bjelica, 2013). Since each sport has its own specific demands, every athlete should have specific anthropometrical characteristics and body composition figures for his or her own sports discipline. Some sports, such as martial arts, require much more knowledge regarding this topic than others, because of its weight limits. However, this fact does not decrease the need to investigate the anthropometrical characteristics and body composition numbers of soccer and basketball players, as adequate body composition and body mass figures, among other factors, contribute to optimal exercise routines and performance (Massuça & Fragoso, 2011). According to these two authors, body mass can influence an athlete’s speed, endurance, and power, whereas body composition can affect strength and agility. In other words, successful participation in both soccer and basketball games, next to the high level of technical and tactical skills, also requires from each athlete suitable anthropometrical characteristics and body composition.

This study aims to examine this in respect of Nigerian female soccer player. Hence, many previous studies have evaluated ideal anthropometric profiles of successful soccer player (Milanovic, Vuleta & Sisic, 2012; Reilly *et al.*, 2000; Veale, 2010) as well as basketball player (Gualdi-Russo & Zaccagni, 2001; Bayios, Bergeles, Apostolidis, Noutsos & Koskolou, 2006) that provides insight into the requirements for competing in the zenith of their particular sports. Indeed, soccer is a team sport that is played in an outdoor field and requires a high standard of preparation through the development of physical performance skills, as well as tactical and technical expertise, in order to complete for 90 minutes of competitive play.

In football, physical, physiological and anthropometrics characteristics such height, weight, body mass, maximal oxygen uptake etc play important role in providing district advantage of specific playing position. According to Triki and his collaborators, soccer training is mainly based on movement implementing the endurance qualities consisting of moderate activity alternating with periods of intermittent high intensity, leading to a significant production of metabolic heat, mostly due to the reason that the average work intensity during a soccer match is usually about 75–90% of maximum heart rate, respectively 70–85% of VO2max (Rexhepi & Brestovci, 2010b). Hence, the purpose of this study was to describe anthropometric characteristics and physical fitness of Nigerian female defensive and offensive soccer.

Several studies have reported on anthropometric and physical fitness characteristics of athletes from different sports. The findings of most of these studies indicate significant differences in terms of anthropometric and physical fitness components, like speed, explosive strength, aerobic power, agility and flexibility not only between different athletic groups, but also between athletes with different positional roles in different sports (Tsolakis and Vagenas, 2010). On the contrary, recent studies have shown insignificant differences in vertical jump and velocity of movement between highly skilled and less skilled rugby players (Gabbet, 2009), in anthropometric data, strength and vertical jump, although winners tended to be more powerful in bench press and squat exercises (Roschel, Batista, Bamoso, Laturco, Ugrinowtsch, Trieoli, Franchini, 2009).

The importance of acquiring sports specific skills, developing anthropometric and physical fitness characteristics and performance in different sports is vital to understand athletic performance, as the importance of anthropometric and physical fitness qualities is not always measured in planning to improve performance (Gabbet, Georgieff & Domrow, 2007).

In this regard, studies have shown that performance of elite athletes could not be differentiated from that of novice athletes and athletes with different positional roles on the basis of physical fitness components alone. Recent studies found significant differences in ball velocity between first and second division handball players (Bayios, Anastasopoulus, Svoudus & Bordolos, 2007). Gabbett (2009, reported insignificant differences in anthropometric and physical fitness qualities among individual playing positions in junior rugby league players, although props were taller, heavier and lower in speed, agility and maximal oxygen uptake compared to other positional playing groups. These studies thus suggest that certain anthropometric characteristics and physical fitness levels must be taken into consideration while designing programmes to enhance performance in any sports. For example, body weight, height, body composition, limb length, speed, flexibility, agility and cardio-respiratory endurance are essential requirements for better performance in high intensity, intermittent sports like football (Janessens, Van Rentergham & Vrigen, 2004). In addition, this physical fitness qualities and anthropometric qualities seem to defer among athletes playing in different positions in team sports. Although, several studies have been reported from other countries as stated earlier on the differences among positional players of different team sports in their anthropometric characteristics and physical fitness qualities, this investigator has not come across any studies on the differences any positional players in team sports in Nigeria. This is specially so in football, which is the most popular sport in Nigeria. Although coaches as well as players are very much aware that certain body types, anthropometric characteristic and physical fitness qualities are more important for some positional players, like defense players, than other positional players, like offensive players. No research evidence has been reported to support these common believes in Nigeria. This is especially so in the case of female football players. This study was therefore conducted to compare anthropometric characteristics and physical fitness of Nigerian female defensive and offensive soccer players.

1.1 Statement of the Problem

Soccer is one of the most popular sports in the world. This game consists of two equal periods of 45 minutes, with a 15 minutes interval. There are 11 players from each team on the field. The players may be divided into four groups, which include goalkeepers, defenders, midfielders, and forwards. For the purpose of this study, goalkeepers and defenders are considered as defensive players, while midfielders and forwards are considered as offensive players. During the game, players are required to perform activities involving jogging, running forward and backward, kicking, turning, heading and throw-in. Several anthropometric characteristics, like body stature, weight, leg length and stride length, and fitness qualities, like speed, flexibility, endurance and strength are very important for high performance in soccer.

Fitness is important at all levels of the game, while it is being essential for top level players, it is beneficial for beginners who will improve their performances through good standards of fitness. Soccer is one of those rare games which demands not only speed but also agility, strength, power, flexibility and endurance. It is characterized by short sprints, rapid acceleration or deceleration, turning, jumping, kicking, and tackling, (Bangsbo & Michalsik 2002).

Soccer is a high intensive but intermittent sport. Intense bursts of activity last less than 15 seconds each. These are interspersed with periods of less intense activity (Svensson & Drust, 2005). Thus, the game poses several physical and physiological demands on different components of physical fitness and metabolic pathways (Plateinou & Geladas, 2006). Very few studies on female soccer players have been reported on the anthropometric characteristics and physical fitness of soccer players. (Reilly *et al*; 2000).

Taiana et al (1993), have reported that with maximal strength of lower limbs of Soccer players' speed in kicking performance was increased. Though it is widely accepted that speed and accuracy in kicking for goal shooting and passing are depend upon explosive strength, which is also known as power of lower extremities. Bjoern Ekblom in his book Football (Soccer) has reported that Strength in the lower limbs is of obvious concern in football, the Quadriceps, hamstrings and triceps groups must generate high forces for jumping, kicking, tackling, turning, and changing pace. It is evident from the review of literature that the performance in football is dependent on the skills, which is dependent on the physical fitness abilities of the players.

Some of these studies compared physical fitness profiles of male and female soccer players (Helgerud *et al;* 2002). This investigator has not come across any study on anthropometric characteristics and physical fitness levels of female soccer players with different positional roles in Nigeria. It was therefore the purpose of this study to compare the anthropometric characteristics and physical fitness levels of Nigerian female defensive and offensive soccer players.

1.2 Research Questions

The study was to answer the following specific research questions.

1. Do Nigerian female defensive and offensive soccer players differ in their anthropometric characteristics?
2. Do Nigerian female soccer offensive and defensive players differ in their physical fitness components?

1.3 Basic Assumptions

For the purpose of this study, the following assumptions were made.

1. Anthropometric characteristics significantly suggest individuals for performance of specific tasks.
2. Physical fitness is a necessary requirement for successful performance of different movements in soccer.
3. There are individual differences in anthropometric characteristics of female soccer players.
4. There are individual differences in physical fitness of female soccer players.

1.4 Hypotheses

On the basis of the research questions, the following hypotheses were made for the purpose of the study.

Major Hypothesis

There are no significant differences between Nigerian female defensive and offensive soccer players in their anthropometric characteristics and physical fitness performance.

Sub- Hypotheses

1. There are no significant differences between Nigerian female defensive and offensive soccer players in their stature, body weight, leg and arm lengths.
2. There are no significant differences between Nigerian female defensive and offensive soccer players in their cardiorespiratory endurance and muscular strength.
3. There are no significant differences between Nigerian female defensive and offensive soccer players in their muscular strength
4. There are no significant differences between Nigerian female defensive and offensive soccer players in their flexibility.
5. There are no significant differences between Nigerian female defensive and offensive soccer players in their lower limb explosive strength.

1.5 Significance of the Study

This study is justified on the following basis.

1. Certain anthropometric characteristics predispose individuals for performance in certain tasks. Although anthropometric characteristics of male soccer players have been reported in previous studies, no studies seem to have been conducted on the anthropometric characteristics of female soccer players, especially Nigerian soccer players. The results of this study would reveal the anthropometric characteristics of Nigerian female soccer players, which would be helpful in their selection and training.
2. Several studies have been reported on the differences among players of different positional roles in such sports like handball, rugby, water polo, swimming and fencing. Similar studies on female soccer players have not been available. The findings of the study would show the differences between Nigerian female defensive and offensive

soccer players in the selected anthropometric characteristics, which would help in the selection and training of female soccer players for defensive and offensive positions.

3. Several studies have shown that speed, cardio-respiratory endurance and muscular strength and endurance are very necessary for performance in team sports, like handball, rugby and football. Although, a few studies have shown the importance of these components of physical fitness for performance among male soccer players, no similar studies have been available on female soccer players. The results of this study would reveal the standards of Nigerian female soccer players in there components of physical fitness, which would be helpful in their selection and training.

4. Lower limb explosive strength and flexibility are essential requirements for performance in different sports. The level of female soccer players in these components of physical fitness is not well established. The results of this study would show the level of Nigerian female soccer players in these components of physical fitness which may be used in selection.

5. The standards of female soccer players in their lower limb explosive straight and flexibility vary according to positions they play. This view, however, has not been verified by any scientific evidence. The findings of this study would reveal the direction and magnitude of differences between Nigerian female defensive and offensive soccer players, which would be helpful in their selection and training for different positions.

6. Findings from this study will add to the existing data in the area of exercise and sports science.

The importance of the specific physical fitness profile of different playing positions is already recognized in team sports (Abdelkrim, Chaouachi, Chamari, Chtara & Castagna, 2010; Markovic & Mikulic, 2011; Pyne, Gardner, Sheehan & Hopkins, 2006), but such studies are evidently scarce in female soccer players. Therefore, the results of the specific physical fitness tests we presented in this study are hardly comparable to previous findings.

1.6 Delimitation of the study

This study is delimited to the following;

1. This investigation was only on anthropometric characteristics and physical fitness level of Nigerian female soccer player in defensive and offensive roles.
2. All the subjects were female soccer players of clubs participating in Federal Capital Territory female soccer league, Abuja.
3. Anthropometric measurements included stature, body weight, leg and arm lengths. Physical fitness components included cardio-respiratory endurance, muscular strength, lower limb explosive power and flexibility.

1.7 Limitation of the study

This study was limited in the following respects which would be considered while interpreting the results. Intra and inter tester variability had been reported in the measurement of anthropometric characteristics. To minimize this variability, anthropometric measurements were taken only after all the testers produced evidence of reporting the same measurements within acceptable limit (0.02 millimeters).

As most of the equipment was not available to carry out the measurements, the variables in this study were measured by standard field tests. These tests were used in previous study.

CHAPTER TWO

2.0 REVIEW OF RELATED LITERATURE

2.1 Introduction

The purpose of this study is to find out and compare anthropometric characteristics and physical fitness of Nigerian females defensive and offensive soccer players to achieve this purpose, available related literature has been critically reviewed and presented in this chapter under the following sub-titles. The fitness components are qualities that athletes must develop to physically prepare for sport competition. They are not skills, but the building blocks of exercise and physical activity. Sports training programs are designed to integrate them in the proper proportions to match the requirements of each sport.

Concepts of physical fitness

Health related physical fitness

Performance related physical fitness

A. Anthropometric characteristics of soccer players.

B. Physical fitness of soccer players.

Concept of Anthropometric Characteristics

Recent studies highlighted the need for a position-specific approach to the study of water polo. Melchiorri, Castagna, Sorge & Bonifazi (2010), investigated and analyzed blood lactate and game activity among elite male water polo players and found 7.7±1.0 mmol/l of blood lactate concentration, but with enormous differences among playing positions. In short, the mean match blood-lactate concentrations for Center Forwards (Centers), Center Defenders (Points), and Field Players (Drivers and Wings) were (in mmol /l) 11.2 ± 1.0, 6.7 ± 0.9, and 5.3 ± 0.9, respectively, indicating the different physiological backgrounds of the water polo game for each playing position.

Authors have evidently recognized the need for a position-specific approach to the study of water polo and therefore most of the recent studies have employed such an experimental approach. Ferragut, Abraldes, Vila, Rodriguez, Argudo & Fernandes (2011), investigated differences between water polo playing positions among 19 elite Spanish players in anthropometry and throwing velocity and found a higher body mass, BMI, and muscle mass of the Center Forwards compared to the Wings, and a longer foot length of the Center Backs compared with the Wings, reflecting a specific physical profile for each playing position. Very similar conclusions were made in earlier studies using similar samples of subjects (Vila, Ferragut, Abraldes, Rodriguez, & Argudo, 2010). A similar approach (i.e. position-specific analysis) is evident when authors described the fitness and/or anthropometric characteristics of water polo athletes of both sexes. (Lozovina, Durovic & Katic,2009; Tan et al., 2009), in studies which developed and validated sport-specific tests (Mujika, McFadden, Hubbard, Royal & Hahn, 2006; Platanou, 2005), investigations which focused on the intensity of the game (Lozovina, Pavicic & Lozovina, 2003), or sport tactics and related statistics of the water polo game (Platanou, 2004). However, most of the studies mentioned so far sampled adult athletes (e.g. senior-age water polo players), while position specifics were mostly analyzed among three or four playing positions (i.e. goalkeepers were frequently not included in the analysis, and/or drivers and wings were observed as a single group – field players). As far as we are aware both problems are understandable. Water polo is not one of the most popular sports in the world (like football or basketball for example) and it is therefore hard to find an appropriate sample of subjects (i.e. adequate number of adequately trained athletes). This is chiefly the case with goalkeepers (one or two in each team). The second problem (e.g. studies not sampling young athletes) is also a logical consequence of the available number of subjects. Most particularly, if the study of adolescent athletes is intended then, due to the process of biological maturation, the subjects have to be near the end of puberty and homogenous in age (one or two years' age difference at the most) and/or biological age must be controlled in the analysis (Faigenbaum, Kraemer, Blimkie, Jeffreys, Micheli & Nitka 2009; Gurd & Klentrou, 2003; Latt, Jurimae, Haljaste, Cicchella, Purge & Jurimae 2009. Since diversity in age is not a factor which can influence anthropometric status and/or motor achievements in adulthood (i.e. senior-age athletes), it is logically more convenient to study adult athletes.

Players were assessed using standard measures of anthropometric and fitness characteristics. The skeletal age of players was also measured to determine maturity status. Multivariate analysis (MANCOVA) identified a significant ($p<0.001$) effect for playing status. Univariate analysis revealed a significant difference in maturity status in amateurs and professionals versus internationals ($p<0.05$), in body mass in professionals versus amateurs ($d=0.56$, $p<0.05$), in height ($d=0.85$, $p<0.01$) and maximal anaerobic power ($d=0.79$, $p<0.01$) in both professionals and internationals versus amateurs. There was also a significant difference in counter-movement jump ($d=0.53$, $p<0.05$) and 40-m sprint time ($d=0.50$, $p<0.05$) in internationals versus amateurs, as well as a significant main effect for age and playing position ($p<0.001$). Significant differences were reported for maturity status, body mass, height, peak concentric torque, maximal anaerobic power, and sprint and jump performance with results dependant on age category and playing position. These results suggest that anthropometric and fitness assessments of elite youth soccer players can play a part in determining their chances of proceeding to higher achievement levels. le Gall, Carling, Williams & Reilly (2010)

The variables included body height, body weight, body mass index, arm span, triceps- and subscapular-skinfold. Specific physical fitness tests comprised: four swimming tests, namely: 25m, 100m, 400m and a specific anaerobic 4x50m test (average result achieved in four 50m sprints with a 30 sec pause), vertical body jump (JUMP; maximal vertical jump from the water starting from a water polo defensive position) and a dynamometric power achieved in front crawl swimming (DYN). The position-specific anthropometric profiles of junior water polo players are in line with previously reported results for senior-age players. However, a comparison of our results with those of senior-age players showed there is a real possibility that in the following period (between junior and senior ages) the sport-selection process will favour tall players. Kondrič, Uljević, Gabrilo, Kontić & Sekulić(2012)

2.2 Concept of Physical Fitness

Physical fitness can be defined and measured in different ways. A basic definition of physical fitness is the ability to complete daily tasks with energy reduce health risks due to inactivity, and be able to participate in a variety of physical activities.

Physical fitness components are currently divided into two groups--health-related and skill-related. Those that are health-related are designated to improve health, wellness, and the quality of life the building of these can also enhance sport performance. The 5 health-related elements are: muscular strength, cardiovascular endurance, muscular endurance, flexibility, and body composition.

Physical fitness is an individual quality that varies from person to person. It is influenced by age, sex, heredity, personal habits, exercise and eating habit practice. Physical fitness is all encompassing; it is a state characterized the degree to which the individual is able to live most and to serve best. The ability to function emotionally, socially and spiritual components of fitness, all of which are related to each other and mutually interdependent (AAPHERD, 1989).

Historically, physical fitness was conceived in simple terms as consisting of strength, endurance, speed agility, coordination and balance. The National Youth fitness testing was started in 1950s around the world on a limited scale, which has become much more complex in 1980s. The health- related fitness test was developed to assess minimum levels of strengths, endurance and flexibility. This test stimulated the American Association of Health, physical Education and Recreation (AAHPERD) to develop a battery of test. The present concept of physical fitness emphasizes two broad areas of fitness, which includes health related fitness and skill or performance - related fitness. Health related fitness comprises cardio respiratory endurance, muscular endurance, muscular strength, body composition and flexibility. Skill or performance - related fitness includes agility, balance, coordination, speed, power and reaction time (AAHPERD, 1984).

Physical fitness can be subjectively measured by determining how much energy one has for doing what is enjoyable in life and for experiencing all the natural adventure possible. Engaging in activities from snow skiing to mountain climbing, cycling, those who are physically fit have the energy and zest to maximize the enjoyment of the natural resources available to them. Gaurav et al. (2011), stated that players were assessed for physical fitness components such as speed, strength and power.

Physical fitness is not easily understood by examining its components or "parts". There is widespread agreement that these four components are basically:

a. Cardio-respiratory endurance is the ability to deliver oxygen and nutrients to tissue, and to remove wastes, over sustained periods of time. Long runs and swims are among the methods employed in measuring these components (United States president's council on physical fitness and sports, 2005).

b. Muscular strength is the ability of a muscle to exert force for a brief period of time. It is the maximum amount of force that one can generate in a specific movement pattern at a specific velocity of contraction. The definition used to be more simple - the ability to lift a maximum weight. The new definition reflects more specificity in the nature of a movement where strength is required. Upper body strength, for example can be measured by various weight-lifting exercises (United States president's council on physical fitness and sports, 2005). When athletes make significant strength gains, muscles fibers (cells) gain size. Weightlifting requires considerable strength, but all sports also require some level of strength fitness.

c. Flexibility - the ability to move joints and use muscles through their full range of motion. It is the ability of a joint to move freely through its range of motion (ROM). Gymnastic events require substantial joint flexibility. Various methods of stretching can increase flexibility. The sit and reach test is a good measure of flexibility of the lower back and backs of the upper legs (United States President's Council on Physical Fitness and Sports; 2005).

The AAHPERD committee adopted the position that physical fitness testing and programme for development of fitness should emphasize the relationship between health and physical activity. Physical fitness is a multiphase continuum extending from birth to death. It is affected by physical activity, ranges from optimal abilities in all aspects of life through high and low levels of different physical fitness, to severely limiting disease and dysfunction.

Since physical fitness can be operationally defined by the test items used for its evaluation, specific criteria were needed for choosing the test items. The criteria selected were as follows:

i. Simple physical fitness can be operationally defined by the test items used for its evaluation, specific criteria were as follow:

   Physical fitness test should measure at range which extends from severely limiting dysfunction to high levels of functional capacity.

   It should accurately reflect an individual's physical fitness status as well as changes in functional capacity by corresponding test scores and changes in these scores (U.S.PC.F.S, 2005).

ii. The following areas of physiological function are related to positive health, one of which is concerned and appeared to meet the above criteria.

   Cardiorespiratory function

   Body composition

   Abdominal and harmstring musculoskeletal function (USPCPFS, 2005)

AAPHERD, (1980), stated that physical fitness is an expression of physical development in a number of discrete areas that can be classified into two major categories. Namely, health related physical fitness and the performance related physical fitness, each with its own specific components as listed below.

Health related physical fitness

Cardiorespiratory endurance

Muscular strength

Body composition

Flexibility

Performance related physical fitness

Balance

Agility

Power

Speed

Reaction time

Coordination

Svensson & Drust 2005), stated that to cope with the physiological demands of soccer players, especially female, must be competent across several fitness components. The use of fitness tests in the laboratory and field assist in examining soccer players' capabilities for performance. Laboratory tests provide a useful indication of players' general fitness. Accurate test results can be obtained with the use of a thorough methodology and reliable equipment to evaluate the effectiveness of specific training interventions. Field tests provide results that are specific to the sport and are therefore more valid than laboratory tests. The reduced cost, use of minimal equipment and the ease with which tests can be conducted make them more convenient for extensive use throughout the season. The field tests provide a good indication of general and soccer-specific fitness, individual test results cannot be used to predict performance in match-play conclusively because of the complex nature of performance in competition. Fitness tests in conjunction with physiological data should be used for monitoring changes in players' fitness and for guiding their training prescription. VO2 max can be determined through a number of physical evaluations. These tests can be direct or indirect. Direct testing requires sophisticated equipment to measure the volume and gas concentrations of inspired and expired air. There are many protocols used on treadmills, cycle ergometers and other exercise equipment to measure VO2 max directly. This necessitated our adoption of field test for this work.

Over the years, various tests were developed to measure V02 Max but most of these tests require laboratory tests. One of the most common is the Bruce protocol often used for testing VO2 max in athletes or for signs of coronary heart disease in high risk individuals. Indirect testing is much more widely used by coaches as it requires little or no expensive equipment. There are many indirect tests used to estimate VO2 max. Some are more reliable and accurate than others but none are as accurate as direct testing. Examples include the multistage shuttle run (bleep test), 12 minute walk test and 1.5 mile run. Such test includes treadmill running/walking, cycle ergometer pedaling and stepping tests. Again, most of these tests cannot be used on large population at the same time because of cost of equipment, time consumption and their technical complexity.

Thus, to overcome these limitations, varied field tests were developed as alternatives to the more complex laboratory tests. These tests were found to be more convenient when large samples are involved. Some of these field tests include the 6-minutes, 9 minutes, 12 minutes and 1Y2 mile run tests. (Cooper, 1968), designed at 12-minutes run/walk test which was not only considered suitable for large sample, but also found reliable when compared with laboratory tests. While Gwani, (1986), reported that the 6-minutes run and the cooper's 12 minutes run tests correlated as high as 778. This suggests that the two tests are reliable measures of cardiorespiratory fitness.

One study followed a group of 12-year-old boys through to the age of 20 - half of which were trained, the other half untrained but active. Relative to bodyweight no differences in VO2 max were found between the groups suggesting that training had no influence on maximal oxygen uptake. However, when VO2 max was expressed relative to body surface area, there was a significant difference between groups and maximal oxygen uptake did indeed increase in proportion to training Sjodin & Svedenhag (1992).

Untrained girls and women typically have a maximal oxygen uptake 20-25% lower than untrained men. However, when comparing elite athletes, the gap tends to close to about 10% (Wilmore & Costill, 2005). Taking it step further, if VO2 max is adjusted to account for fat free mass in elite male and female athletes, the differences disappear in some studies.

2.3 Muscular Strength and Endurance

Strength refers to the maximal force that a muscle or muscle group can generate at a specified velocity (distance¸ time). When an athlete is in contact with an opponent the addition of their opponent's resistance plus their own body weight is the resistance. Research has demonstrated a strong correlation between lower body strength and agility. The more emphasis the sport has on strength and power the greater the need for strength training, particularly the Olympic lifts, where the rate of force development is most similar to that of agility movements on the field or court. Graham, Brown & Ferrigno (2005), Halberg (2001), Harman (2008)

Muscular strength refers to the capacity of a muscle to develop activity tension, irrespective of the specific conditions under which tension is measured. Strength is the ability of the body to apply force, it refers to the amount of force a muscle or group of muscles can exert. Lanshammar & Ribom(2001) Muscular strength can quickly be built up through static - (Isometric) exercise and through dynamic (Isotonic) exercises. The static exercises are carried out by exercising against an unyielding resistance. Static strength training is the preferred method of the so-called body-builders; it can be measured by different binds of dynamometers, while the dynamic strength exercises are carried out against a moveable resistance (Fahs, Thiebaud, Rossow, Loenneke, Kim, Abe & Bemben(2013)

Endurance is the ability of muscle or group of muscles, to sustain repeated contractions or to continue applying force against a fixed object. Pushups are often used to test endurance of arm and shoulder muscles, Pollock et al, (1990). Muscular endurance has been measured in a number of different ways, including the great number of sit ups that can be performed in a fixed period of time (usually 30 seconds or 1 minute) or the maximum number of push ups, pull ups or bad dips/bench press that can be measured continuously in an indefinite period of time. According to Wilmore (1977), many of these tests penalized the participants who have long legs, short arms, or a heavy body weight. He suggested that, to eliminate this bias, a concept has evolved that uses a fixed percentage of the individual's body weight as the resistance.

Joint mobility is the ability of a joint to move through its natural, effective range of motion and is further characterized as the balance of strength and flexibility regulating contrasting motions around a joint (i.e., flexion and extension). In addition, the integrity of the muscle tissue and its ability to relax and contract appropriately during movement is a limiting factor in producing effective joint mobility. For example, when a sprinter comes out of the blocks, proper range of motion during hip extension requires strength of the hip extenders, as well as the ability for the hip flexors to lengthen properly to allow for full hip extension. If there is an imbalance of strength and flexibility about the hip, range of motion will be compromised, which will in turn affect force output and speed of movement. In addition, if the muscle tissue is not responding properly due to injury, adhesions, or other factors, performance will be diminished. This can be improved with flexibility training

There are two types of flexibility according to Jensen and Fisher (1979) one is passive flexibility, which is demonstrated by the range of movement that occurs in a joint when the muscles are relaxed and the body part is moved by another person. The other is the dynamic flexibility, which is demonstrated by the range of movement that can occur in joint as a result of contractions of the muscles, which control the joint. According to Robison et al, (1974), flexibility is developed by stretching the muscles and the connective tissue regulatory. He further stated even though flexibility can be developed by dynamic stretching. (Bobbing type movements) static stretching is a better method; flexibility exercises produce the best results when they are done daily.

2.4 Performance Related Physical Fitness Component of Female Soccer Players

Physiological characteristics that have been reported as essential for football players are aerobic fitness, agility, muscle strength, speed, and explosive jumping power, Polman, et al. (2004). While aerobic fitness contributes up to 90% of energy utilization during football matches McMillan, et al. (2005), typically high intensity bouts of sprinting are necessary to score goals. These efforts may be complemented by jumping used by footballers when controlling the ball in the air and to score or defend goals by way of heading. Sprinting accounts for approximately only five percent of the match duration Bloomfield, et al. (2007) with each sprint covering up to 30 meters Di Salvo, Baron, Tschan, Montero, Bachl, & Pigozzi, (2007) and most efforts not completed in a straight line. Thus, acceleration, speed, and agility are determined by the athletes muscle strength and power Wisloff, et al. (2004), and can be effectively trained through a well-developed and structured program Metaxas, Koutlianos, Kouidi, & Deligiannis, (2005). These key components have been shown to differentiate elite and non-elite players independent of football specific skills such as ball control, dribbling, and tackling Ostojic (2004). However, it remains unknown how elite Indian footballers compare with previously reported physiological results of professional footballers.

Speed, agility, and quickness all involve learned motor skills. Although the magnitude of proficiency will vary with each individual, learning the efficient and effective execution of these skills can improve overall athletic ability. The concept of agility is difficult to precisely define operationally, even though there is general agreement among coaches, athletes and researchers as to what is meant by the term agility (Wilmore, 1977). Agility typically refers to the ability to move and change position or directions, rapidly without loosing balance or sacrificing space.

Generally, agility can be defined by the ability to explosively start, decelerate, change direction, and accelerate again quickly while maintaining body control and minimizing a reduction in speed Arthur & Bailey (1998); Cissik & Barnes(2004); Plisk(2008). Universally, agility can often be described as an athlete's collective coordinative abilities Tittel(1991); Drabik(1996); Plisk(2008). These are the basic elements of technical skills used to perform motor tasks spanning the power spectrum from dynamic gross activities to fine motor control tasks and include adaptive ability, balance, combinatory ability, differentiation, orientation, reactiveness, and rhythm Plisk(2008). Coordinative abilities are often recognized to be most easily developed in preadolescence, which is considered to be an important time period for skill development Viru(1995); Dick(2007); Balyi(2004). This period often changes focus during adolescence when the shift from general to special preparation should begin.

Most athletic activities that utilize agility occur in less than 10 seconds and involve the ability to coordinate a few or several sport specific tasks simultaneously (like catching a football and then making a series of evasive moves and cuts to avoid being tackled in order to advance the ball further down the field Cissik & Barnes(2004). With the exception of skills specific to the sport, agility can be the primary determining factor to predict success in a sport Halberg (2001). Sports inherently require changes of direction in which lateral movements are used in the several planes of movement simultaneously. Sports regularly are played in short bursts of 30 feet (10 yards) or less before a change of direction, acceleration and/or deceleration is required. Because movements can be initiated from various body alignments, athletes need to be able to react with strength, explosiveness and quickness from these different positions.

Wilmore, (1977), stated that “there are no universally accepted tests of agility, although many test batteries exist which uses various shuttle run tests to estimate the agility components. The shuttle run test has been used to measure the agility of students in running and changing direction and reliability coefficient of 0.94 for boys and 0.82 for girls were reported.

Gabbett (2005) evaluated physiological and anthropometric characteristics of specific playing positions and positional playing groups in junior rugby league players. Two hundred and forty junior rugby league players were measured for standard anthropometry, muscular power, speed, agility and estimated maximal aerobic power during the competitive phase of the season were taken, after players had obtained a degree of match fitness. The results of the study demonstrated that few physiological and anthropometric differences were exist among individual playing positions in junior rugby league players, however props were taller, heavier, have greater skinfold thickness, lower speed, agility, and estimated maximal aerobic power than other positional playing groups. Power is the resultant of force multiplied by displacement divided by time (Noffal & Lynn, 2012), the ability to achieve more force over the same distance and time period would increase power.

2.4.1 Components of speed

Speed, agility, and quickness are some of the most significant, and visible, components of athletic success. An improvement in the ability to react quickly, apply significant force rapidly in the appropriate direction, and to redirect that force if needed is the ultimate goal of a program to improve speed, agility, and quickness. A carefully designed program that addresses these factors of athleticism significantly improves overall performance and reduces the risk of injury.

Speed, mostly in the form of acceleration, is an important factor in almost all games and sports, it becomes a determinant in scoring, passing and defending or preventing a goal, in other words, speed makes the difference where one is able to gain an advantage over an opponent.

According to Wilmore, (1977), speed can be accomplished for the individual body segments, such as for the arm or leg, by using an elaborate system or micro switches and electronic timer, total body speed can be measured by timing the athlete over a set distance from 50-100 meters.

2.4.2 Muscular Power

Muscular power, often called explosive strength, is a combination of strength h and speed. This is the ability to realize maximum force in the fastest possible time. Also, it is known as the ability to exert a maximum contraction at one explosive act.

Stability, strength, and power training help shift the force-velocity curve up and to the right. While stability training develops appropriate balance, strength training improves the body's ability to create force, and power training aids in decreasing the amount of time needed to create that force. These all have significant contributions in regards to improving speed. When performing stability, strength, and power drills specific for speed development, it is important to include exercises for contributing areas, such as the feet, anterior and posterior muscles of the shins, the core, and hip flexors/extensors as part of a whole-body program. In addition, movements that emphasize powerful plantar and dorsiflexion of the ankle, as well as extension and flexion of knee and hip are also important components.

Ballistic movement, as found in speed, agility, and quickness training, is created by a forced and rapid lengthening of a muscle immediately followed by a shortening of the muscle, creating an elastic "rubber-band-like" effect of energy release. As mentioned in Chapter 8, this ability to store and release energy is referred to as the stretch-shortening cycle and is affected by the intrinsic qualities of the muscle and the involved musculotendinous junctions. This action is often reflexive, and referred to as the "stretch reflex." Training the muscle and tendon's ability to load eccentrically and rapidly release energy concentrically improves the magnitude and effectiveness of the stretch-shortening cycle. This is achieved through power training and plyometric.

Muscular power according to Jensen and Nelson, (1972), is the ability to applied force rapidly power is typically demonstrated in perfecting the body... (as in jumping) or an object (as in throwing). The muscles must apply great force at a rapid rate in other to give the body of object the momentum necessary to carry it in the desired distance.

Explosive strength is very important to vigorous performances because it determines how hard a person can hit, how far he can throw, how high he can jump and to some extent, how far he can run. Running is a series of body projections, therefore leg power is essential to fast running.

Power is the resultant of force multiplied by displacement divided by time (Wisløff et al., 2004), the ability to achieve more force over the same distance and time period would increase power. Therefore, increasing strength should translate to increased power in professional athletes (Noffal et al., 2012). Nelson & Jensen, (1972), explosive strength can be increased by increasing the strength without sacrificing speed or by increasing the speed movement without sacrificing strength, or by increasing both the speed and strength. According to fisher and Jensen, (1979), increasing strength affords the greatest potential for improving power because strength can usually be increased by a significant amount while speed can be improved with a very limited amount.

Neuromuscular Adaptation – Agility training may be the most effective way to address the neuromuscular system and sport-specific skills necessary for sport performance, since agility training most closely resembles the sport itself Cissik, et al. (2004). Training at sport-specific metabolic training speeds enables athletes to train at a level that most closely resembles the intensity, duration, and recovery time found in sport during the off-season. The use of agility training in an annual training cycle provides a critical link for athletes to apply their strength and conditioning program gains to the competitive athletic arena.

Explosive strength can be assessed very accurately within the laboratory using expensive force transducers and recorders. (Wilmore 1977). Several field tests have been in use but lack objective validation. The sitting shot put and medicine ball throw have been used to estimate upper body power while standing broad jump and vertical jump have been used to estimate lower-body power.

The margaria-kalamen leg power test. (Mathew and Fox 1981), present a more objective measure of lower body power. The subject begins by standing six meters in front of a series of steps. On the command go he runs as quickly as possible up the stairs, stepping on every third step. A micro switch embedded in a rubber mat is placed on the third step while a second micro switch is placed on the ninth step, which stops the timer when hit. The elapsed time represents the time required to move the body weight, the vertical distance between the third and the ninth steps. Power is the calculated by the following formula

power (Kg X meter/sec) =
Body weight (kg) x vertical distance (meters).
Elapsed time (seconds).

Studies have reported a fairly higher reliability and validity of the sergeant jump test as a measure of explosive power (McArdle et at, 1981).

2.4.3 Balance

The human body rest on a base of support defined as area of contact between the body and supporting surface. if the base of support and other factors remain constant, the stability is said to be achieved, when an even adjustment exist between opposing forces of a body, that body experiences a condition known as balance (Ecker, 1971). Technically speaking, a body is said to be in a state of equilibrium when it doest not take a new position with the slightest application of force

2.4.4 Volume of Oxygen Uptake (V02 Max)

VO2max stands for maximal oxygen uptake and refers to the amount of oxygen your body is capable of utilizing in one minute. It is a measure of your capacity for aerobic work and can be a predictor of your potential as an endurance athlete. Although there are many factors that affect your VO2max, it is a commonly accepted measure of cardio respiratory fitness. Cardio-respiratory endurance is the most vital means of determining a person's maximal oxygen uptake (Vo2 max)(Mathew, 1981). Maximal oxygen uptake, according to Verducci (1980), indicates how well various physiological functions can be adjusted to increasing metabolic demand of work.

There are many physiological factors that combine to determine VO2 max but which of these are most important? Two theories have been proposed:

a. Utilization Theory: This theory maintains that aerobic capacity is limited by lack of sufficient oxidative enzymes within the cell's mitochondria Wilmore & Costill, (2005). It is the body's ability to utilize the available oxygen that determines aerobic capacity. Proponents of this theory point to numerous studies that show oxidative enzymes and the number and size of mitochondria increase with training. This is coupled with increased differences between arterial and venous blood oxygen concentrations (a-vO2 difference) accounting for improved oxygen utilization and hence improved VO2max.
b. Presentation Theory: The theory suggests that aerobic capacity is limited not predominantly by utilization, but by the ability of the cardiovascular system to deliver oxygen to active tissues. Proponents of this theory maintain that an increase in blood volume, maximal cardiac output (due to increased stroke volume) and better perfusion of blood into the muscles account for the changes in VO2max with training.

So what plays the greater role in determining an athlete's VO2 max - their body's ability to **utilize** oxygen or **supply** oxygen to the active tissues? Saltin and Rowell (1980), concluded that it is oxygen **supply** that is the major limiter to endurance performance. Studies have shown only a weak relationship between an increase in oxidative enzymes and an increase in

VO2 max Costill, Thomas, Roberg, Pascoe, Lambert, Barr & Fink, (1991). One of these studies measured the effects of a 6-month swim training program on aerobic function. While oxidative enzymes continued to increase until the end, there was no change in VO2 max in the final 6 weeks of the program Costill, et al. (1991); Kemi, Hoff, Engen & Wisloff (2003).

Over the years, various tests were developed to measure Vo2 max, but most of these tests require laboratory settings. Such tests include treadmill running/walking, cycle ergo-meter pedaling and stepping tests. Again, most of these tests cannot be used on large populations at the same time because of cost of equipment, time limitation. To overcome these limitations, varied field tests were developed as alternative tests. These tests are not only reliable when compared to the laboratory tests, but found to be more convenient when large samples are involved. Some of these field tests include 6 minutes, 9 minutes and 12 minutes run and the 72 mile run tests. Cooper (1968), designed a 12-minute run/walk test, which was considered suitable when compared with laboratory test. Pollock, et al., (1990), stated that the widely used tests for measuring Vo2 max and the 12 minute and the 1 mile run tests.

The contributions of metabolic, physique and mechanical variables to athletic performance are functions of distance and intensity. Maximal oxygen uptake (Vo2 max), running economy, and lactate threshold are metabolic variables that increase in performance as distance increases (Brandon, 2000).

Long distance runners (runners that compete in 5000 meters or longer), typically have higher Vo2.max values, use oxygen more efficiently and have lower lactate accumulation than significantly middle distance runners (runners that compete in 8000 meters or 3000 meters) (Berg and Bell, 1992).

Evaluating variables that influenced athletics performance, Ramsbotton, (2001), found strong relations between a five kilometer athletic performance and Vo2 max, relative, running economy in male recreational runners. Daniel, (2000), concluded that middle distance runners are able to work at 90 to 100% of their Vo2 max up to 10 or 11 minutes while accumulating a high blood lactate level, because the variables in the Ramsbolton, (2001), study were not evaluated by a composite statistical analysis and were at distance longer than 3000m. Since middle distance runners are able to work at a high percentage of Vo2 max in the presence of a high lactate accumulation, lactate threshold and running economy do not appear to strongly influence middle distance runners' performance (Cureton, 1992).

At competitive level, football is an endurance sport that incorporates periods of intense exercise interspersed with lower levels of activity over a 9Ominute period (Reilly, 2000). Therefore, a large amount of aerobic ability may be required and assessed by measuring maximal aerobic power (Vo2 max). This is the maximum rate at which energy can be released from the oxidative process exclusively (Bouchard, 1990). For this reason, Vo2 max is an essential measurement in the study of a footballer, since the physiological as well as physical characteristics are important considerations in player's performance (Bell, 1980).

Recent study showed that Vo2 max in basketball players' increased as the playing level increased. The differences between the guards and the forwards were not significantly different for any of the team tested, both senior and junior categories (Gabbet, 2001). Count the pulse beat for ten seconds, multiply the result by 6. This gives the per-minute total.

2.5 Anthropometric Characteristics of Female Soccer Players

2.5.1 Height

The variability in stature was significantly greater in the soccer players compared to the Gaelic footballers ($p<0.01$). Performances in the 10-m and 30-m sprints, and in vertical jump were superior in the soccer group compared to the Gaelic footballers ($p<0.01$). The intra-group variability on the anthropometric and performance measures of the soccer players is likely to be due to the specificity of positional roles. The combined groups could be described as lean and muscular with a reasonably high level of capacity in all areas of physical performance. Anaerobic characteristics of the professional soccer players were superior to those of Gaelic football players. It is concluded that anthropometric and performance assessment of elite footballers using mean values masks the heterogeneity evident within the football codes.

There could be basketball and volleyball competition for tall people. Team games are sports where height, shape and body composition and fitness play an important role in providing distinct advantage of specific playing positions, particularly at the highest level of performance where there is high degree of player specialization (Bale, 1986).

In the game of soccer, goalkeepers are usually the tallest and heaviest players, while the mid fielders are the shortest and lightest (Reiley, 1996). In Rugby, backs are lighter, smaller, less endomorphic, and more ectomorph than their forwards (Bale, 1986), In American football, Cater found that some players had endomorphic ratings as high as nine. In basketball, pitchers are taller and heavier, with more fat than fielders. Short were lightest with lower fat levels (Burke 1976).

Height plays a vital role in most of the track and field events, such as the high jump, long jump, and triple jump and throws that requires standing position. The influence of long arm length and height play a vital role in shot putting, discuss throw and javelin throw. Height as a variable is important when selecting athletes to their various events (Berg, 2000).

2.5.2 **Weight**

Athletic performance is also influenced by body physique. Excessive amount of fat negatively affects soccer player as the excess weight has to be transported by the lower extremities and this requires extra energy. Thus, the excess fat weight causes the runner to be less efficient, since more leg power is needed during play. A large fat free body, especially if the added weight is leg muscle, may affect soccer play. On the other hand, excess fat is detrimental to both long and middle distance runners, as it requires the body to use more energy and makes no useful contribution (Jerome, 1992). Certain body builds are advantageous to certain activities. A heavy build may help a football tackle, but it is a hindrance to a long distance runner (Ramsbotton, 2001). Discovered from the results of a study in anthropometric measurements in adolescent competitions in specific sports that particular proportionality dimension tends to typify proficiency in certain sports.

According to Mueller et al, (1996), skin fold thickness tends to be less in athletes and is related to the amount of endurance activity, whereas the pattering of fat is ethnically based and does not appear to be changed by training. Studies show that for health reasons, weight should not regularly fall below 10% of desirable weight. The upper limit consistent with good health is 20% above the desirable weight somewhere between these boundaries (minimum 10% to plus 20% of desirable weight), lies a level that is best for athletes (Sharkey, 1979).

2.6 Selected Research Studies on Physical Fitness and Anthropometric Characteristics of Athletic Groups

Before the age of 13, junior rugby league players compete under modified rules, with a reduced emphasis on physical collisions and increased emphasis on skill development. After the age of 13, the physiological demands placed on Junior players are increased, with players required to compete under the same rules and regulations as senior players, with only slight variations in the duration of matches between junior (60 minutes) and senior (80 minutes) rugby players (Baker, 2003). This study found a progressive improvement in agility, speed, muscular power, and Vo2 max scores with increasing age and playing level. In addition, playing experience and body mass also progressively increased from junior players through to senior players. It is likely that the improvement in physiological capacities from Junior to senior players reflects a normal adaptation associated with the onset of poorer than previously reported for professional rugby league players. Interestingly, there is a progressive decline in the physiological capacities of professional, semi professional, and amateur rugby league players, with estimated muscular power; speed, and Vo2 max of semi professional rugby league players were superior to amateur players but inferior to professional rugby league players. These findings suggest a relation between physical fitness and the playing level attained (Gabbett, 2001).

Consistent with previous results from amateur, semi professional and professional rugby league players, this study found higher body mass in forwards than backs. In addition, body mass was a significant predicator in correctly classifying players as either a forward or back (Gabbett, 2001). These findings emphasize the importance of large body size in dominating the rock and tolerating the heavy tackles and collisions associated with forward positions. Of interest were the lack of consistent significant differences between forward and backs, for the l0m, 20m, and 40m sprint tests. Previous studies have reported similar l0m sprint times between forwards and backs, with backs having significantly faster 20m and 40m speed than forwards. These findings have been attributed to the rare requirement of forwards to run further than l0m in a single bout of intense puberty and moderate increase in age (Pollock, 1978) it is also possible that the progressive improvement in physiological capacities from under 13 players through to first grade players is due to the greater training load and higher playing intensity at the higher playing level. Indeed, the longer matches and training sessions and higher match intensity experienced by senior players may explain, at least in part, their superior physiological capacities. The recent finding of no significant differences in preseason muscular power, agility, speed and Vo2 max scores between first grade and second grade players, despite considerable (2.7% to 18.4%) differences in these variables during the competitive phase of the season in the study. Lends support to the hypothesis that the duration and intensity of matches have an important effect on the physiological capacities of rugby league players.

According to Ramsbottom, (2001). the physiological characteristic of professional rugby league players are well developed with estimates of maximal aerobic power (Vo2 max) reported to be in the range 48.6 - 62.6 mI/Kg/mm. Mean measurements of l0m and 40m speed of 1.71 seconds and 5.32 seconds respectively have also been reported, conversely Baker, (2003) the physiological characteristics, of amateur rugby league players are poorly developed, with a recent study showing that muscular power, speed, and estimated Vo2 max were 20 - 42% activity. However, recent time and motion studies of rugby league matches played under the l0m defensive rule have shown that forwards were required to run 49 - 50%

further than previously required tinder the 5m defensive rule. These finding may suggest that forwards have adapted to the further running distances required for the modern game, or conditioning. Coaches have, modified training program to develop a greater sprinting ability in forwards. This finding of higher estimated Vo2 max in under-16 backs than forwards is consistent with some, but not all studies of senior rugby league players.

Billat, et al., (2004) compared the training characteristics and the physical profiles of top-class male and female Kenyan long-distance runners, the subjects were 20 elite Kenyan runners, 13.men (10-km performance time of 28mm, 36 seconds ± 18s) and 7 women (32 mm, 32 seconds ± 65s). The male runners were into high speed training runners (HST: N = 6) and low speed training runners (LST: N = 7) depending on whether they train at speeds equal or higher than those associated with the maximal oxygen uptake (Vo2 max). All but one woman were high-speed training runners (female HST: N = 6) subjects performed an incremental test on a 400 meter track to determine Vo2 max, and the velocity at the lactate threshold (VLT) results within each gender among the HST group. 10-Km performance time was inversely correlated with Vo2 max (rho = -0.86. P = 0.05 and rho = -0.95. p = 0.03, for men and women, respectively). HST male runners had a higher Vo2 max, a lower (but not significant) fraction of Vo2 max (F Vo2 max) at the lactate threshold, and a higher energy cost of running (ECR). Among men, the weekly training distance at Vo2 max explained 59% of the variance of Vo2 max explained 59% of variance of Vo_2 max, and Vo2 max explained 52% of the variance of 10-km performance time. Kenyan women had a high Vo_2 max and Vo_2 max at VLT that was lower than their male HST counterparts. ECR was not significantly different between genders. The velocity at the Vo_2 max is the main factor predicting the variance of the 10-km performance both in men and women, and high - intensity training contributes to this higher Vo_2 max among men.

Warrington, (2001) conducted a study to determine the aerobic power (VoAsubA2Amax), body composition, strength, muscular power, flexibility, and biochemical profile of an elite international squad of tug of war athletes. Sixteen male competitors (mean (SEM) age 34(2) years) were evaluated in a laboratory. For comparative purposes, data were analyzed relative to normative data for their centers and to a group of 20 rugby forwards from the Irish international squad. Results showed that the tag of war participants were lighter (83.6 (3.0) V 104.4C1.8) Kg P0.0001) and had less lean body mass (69.4(2.1) V 86.2 (1.2)kg) than the rugby players and had lower than normal body fat (16.7(0.9)%), all values are mean (SEM). Aerobic power measured during a tread mill test was 55.8 (1.6) mi/Kg/mm for the tug of war participants compared with 51.1(1.4) mt/Kg/mm for the rugby forwards (P<0.03). A composted measure of strength derived from (sum of dominant and non-dominant grip strength and back strength) / lean body mass yielded a strength/mass ratio that, was 32% greater (P<0.0001) for the tug of war group that the rugby group.

Dynamic leg power for the tug of war group than the rugby forwards (4659.8(151.6) V 6198.2 (105) W respectively, P0.0001). Leg flexibility was 25,4 (2.0) cm forwards 34.2(1.5) cm. Whereas blood chemistry and hematology were normal, packed cell volume, hemoglobin concentration, and erythrocytes volume were lower in the tug of war group than the rugby players (P0.05). All three hemoglobin measures correlated with muscle mass {packed cell volume, rASup2A = 0.13, P< 0.05, erythrocytes volume, rASup2A.= 0.37, P0.0001, hemoglobin concentration, rASup2A = 0.21, P0.01).(Green.H. J. (2001).

In conclusion, the data indicated that international level tug of war participants had excellent strength and above average endurance relative to body size, but relatively low explosive leg power and back flexibility. The data provided reference standards for the sport and may be useful for monitoring and evaluating current and future participants.

The physiological characteristics of tri athletes have been substantially reviewed (Toole and Douglas 1995, Sleivert and Rowlands 1996). As with other endurance athletes it has been reported that tri athletes possess a high Vo2 max and an elevated ventilator! Threshold, (Sleivert and Rowlands 1996). Other research has shown that the metabolic, responses to sub-maximal exercise are indicative of short distance performance in national level competitors (Schabort, 2000). However, in these studies the athletes assessed have been either of mixed ability level or the event they were training for has not been established. Moreover, none of the previous studies examining the physiological characteristics of triathlon were conducted after the generalization of the drafting rule during the cycling stage of elite short distance triathlon that resulted in different physiological demands; the athletes are required to exert "Stochastic" burst of very high power output interspersed with more sub-maximal exercise (Bentley, 2002). In contrast, the demands of long distance triathlon events involve prolonged steady state exercise of >4h. The training volume and intensity completed by long distances and short distance tri athletes differ dramatically, since the training volume has been previously shown to influence the oxygen cost of sub-maximal exercise (Scrimgeour, 1986), the metabolic adaptations to sub-maximal or incremental exercise task may differ in tri athletes race demands in elite short distance or long distance triathlon events.

Miller, (2000) compared the physiological responses in cycling and running of elite short distance (ShD) and long distance (LD) tri athletes. Fifteen elite male tri athletes participating in the world championships were divided into two groups (SD) and (LD) and performed a laboratory trial that comprised sub-maximal ergbmetry cycling and then an additional sub-maximal run, best short distance triathlon performances were also analyzed for each athlete. Short distance demonstrated a significantly faster swim time than long distance whereas Vo2 max (ml kg' mm'). Cycling economy (w!1 mm'), peak power output (w peak, w) and ventilator threshold (% Vo2 max) were all similar between short distance and long distance.

Moreover, there were no differences between the two groups in the change (%) in running economy from the first to the second running bout. Swimming time was correlated to w peak (r = -0.76, P< 0.05) and economy.fr = -0.89, P< 0.01) in the short distance athletes. Also, cycling time in the triathlon was correlated to w peak (r = -0.83, P< 0.05) in long distance. In conclusion, short distance tri athlete had a faster swimming time but did not exhibit different maximal or sub-maximal physiological characteristics measured in cycling and running than long distance tri athletes.

Gabbett, (2005) compote the physiological and anthropometric characteristics of specific playing positions and positional playing groups in junior rugby league players. Two hundred and forty junior rugby league players underwent measurements of standard anthropometry (body mass, height, sum of four skinfolds), muscular power (vertical jump), speed (10, 20 and 40 m sprint), agility (L run), and estimated maximal aerobic power (multi-stage fitness test) during the competitive phase of the season, after players had obtained a degree of match fitness. Props were significantly (p<0.05) taller, heavier, and had greater skinfold thickness than all other positions. The halfback and centre positions were foster than props over 40 m, Halfbacks had significantly (p<0,05) greater estimated maximal aerobic power than props. When data were analysed according to positional similarities, it was found that the props positional group had lower 20 and 40 m speed, agility, and estimated maximal aerobic power than the hookers and halves and outside backs positional groups Differences in the physiological and anthropometric characteristics of other individual playing positions and positional playing groups were uncommon. The results of this study demonstrate that few physiological and anthropometric difference's exist among individual playing positions in junior rugby league players, although props are taller hero c have greater skinfold thickness, lower 20 and 40 m speed, agility, and estimated maximal aerobic power than other positional playing groups, These findings provide normative data and realistic performance standards for junior rugby league players competing in specific individual positions and positional playing groups.

Latt, (2009) analyze the relationships between 100m front crawl swimming performance and relevant biomechanical, anthropometrical and physiological parameters in male adolescent swimmers. Twenty five male swimmers (mean ± SD: age 15.2 ± 1.9 years, height 1.76 ± 0.09m; body mass 63.3 ± 10.9 kg) performed an all-out 100-rn front crawl swimming test in a 25in pool. A respiratory snorkel and valve system with toss hydrodynamic resistance was as used to collect expired air. Oxygen uptake was measured breath-by-breath by a potable metabolic cart. Swimming velocity, stroke rate (SR), stroke length and stroke index (SI) were assessed during the test by time video analysis. Blood samples for lactate measurement were taken from the fingertip pre exercise and at the third and fifth minute of recovery to estimate net blood lactate accumulation lion (ΔLa). The energy cost of swimming was estimated from oxygen uptake and blood lactate energy equivalent values. Basic anthropometry included body height, body mass and arm span. Body composition parameters were measured using dual-energy X-ray absorptiometry (DXA). Results indicate that biomechanical factors (90.3%) explained most of 100m front crawl swimming performance variability in these adolescent male swimmers, followed by anthropometrical (45.8%) and physiological (45.2%) parameters. SI was the best single predictor of performance, while arm span and ΔLa were the best anthropometrical and physiological indicators, respectively, SI and SR alone explained 92.6% of the variance in competitive performance. These results confirm the importance of considering specific stroke technical parameters when lien predicting success in young swimmers.

Platanou, (2005), suggests secular trends in anthropometric characteristics, physical fitness, physical activity, and biological maturity over the past 25-35 years in Flemish adolescents were investigated. Representative cross-sectional samples of 12-18-year-old secondary school children (11,899 assessments in boys in 1968-1974, 4,899 girls in 1979-1980, 1429 boys and 1,772 girls in 2005) and parent-offspring pairs tested at approximately the same age during adolescence (55 father-son pairs, mean age fathers = 15,47 years, mean age sons = 15.38 years; 62 mother-daughter pairs, mean age mothers = 16.63 years, mean age daughters = 15.01 years) were used. The cross-sectional data were analyzed in 6 yearly age-categories using Wilcoxon rank sum tests. For the parent-offspring data paired t-tests, simple linear regressions to adjust for parent-offspring differences in chronological age and multiple linear regressions to adjust for parent-offspring differences in chronological and skeletal age were conducted. The cross-sectional study generally revealed an increase in weight, stature, BMI, skinfolds and trunk-extremity index, and a decrease in the performance on several physical fitness tests. In the parent-offspring study, only sons were maturational advanced compared to fathers. Even after adjustment for parent-offspring differences in chronological age and in chronological and skeletal age, results for stature trunk-extremity index and physical fitness were generally similar to the cross-sectional study. No secular trend was observed for sports participation, the fact that the positive secular trends in weight. BMI, and skinfolds of the cross-sectional study were not entirely confirmed in the parent-offspring study is probably due to higher similarity in genetic and familial background, higher socio-economic status, and more health-consciousness of the latter.

Zapartidis, (2007) compared physical fitness and selected anthropometric characteristics between selected (SP) and non-selected (NSP) for the Greek preliminary national team male (n88) and female (n73) young handball players. Results revealed that compared to NSP players, male SP players presented higher values in ball velocity (p=.00l) standing long jump (p=.0l6), 30-m sprint (p=.034) and estimated $V0_{2max}$ (p=.0l 8), while female SP players presented higher values only in ball velocity (p=.009) and standing long jump (p=.045). Male SP players were taller (p .042) and had larger arm span (p-.031). Taking into account the different playing positions, significant differences (in favor of SP) were found between SF and NSP male backs in stature (p=.008), hand spread (p=.042), arm span (p .019) and ball velocity (p=.005). Female SP revealed higher values in stature (p.041) and arm span (p=.046). For wings, significant differences were found in ball velocity (p=.007), 30-m sprint (p=.039) and estimated VO_{2max} (p=.002) between SF and NSF male players (in favor of SP) and in estimated VO_{2max} (p=.O 19) between SF and NSF female players. For pivots significant differences were found only in ball velocity (p=.005) between SF and NSP females (in favour of SP). Finally, no statistically significant differences were found between SF and NSP male and female goalkeepers. Current results suggest that physical and anthropometric characteristics should be included in any testing procedure of junior handball players.

Gabbett, (2000) investigated the physiological and anthropometric characteristics of amateur rugby league players. Methods- Thirty five amateur rugby league players (19 forwards and 16 backs) were measured for height, body mass, percentage body fat (sum of four skin- folds), muscular power (vertical jump), speed (10 m and 40 m sprint), and maximal aerobic power (multistage fitness test). Data were also collected on match frequency, training status, playing experience, and employment related physical activity levels. The 10 in and 40 m sprint, vertical jump, percentage body fat, and multistage fitness test results were 20- 42% poorer than previously reported for professional rugby league players. Compared with forwards, backs had significantly (p<0.0l) lower body mass (79.7 (74.7-84.7) kg v 90.8 (86.2-95.4) kg) and significantly (p<0.0l) greater speed during the 40 in sprint (6.45 (6.35-6.55) v 6.79 (6.69-6.89) seconds). Values for percentage body fat, vertical jump, 10 m sprint, and maximal aerobic power were not significantly different (p>0.0S) between forwards and backs. When compared with professional rugby league players, the training status of amateur rugby league players was 30-53% lower, with players devoting less than three hours a week to team training sessions and about 30 minutes a week to individual training sessions. The training time devoted to the development of muscular power (about 13 minutes a week), speed (about eight minutes a week), and aerobic fitness (about 34 minutes a week) did not differ significantly (p>0.05) between forwards and backs. At the time of the field testing, players had participated, on average, in one 60 minute match every eight days. The physiological and anthropometric characteristics of amateur rugby league players are poorly developed. These findings suggest that position specific training does not occur in amateur rugby league. The poor fitness of non-elite players may be due to a low playing intensity, infrequent matches of short duration, and/or an inappropriate training stimulus.

Investigations of professional rugby league players have reported mean 10m and 40m sprint times of 1.71 seconds and 5.32 seconds respectively.'' Estimates of Maximal aerobic power (Vo^{2max}) have been in the range 48.6-67.5 ml kg mm. Despite having contrasting match play activities, the physiological profile of professional rugby league forwards and backs is remarkably similar, suggesting that fitness training or professional rugby league is uniform for all positions. Indeed, most studies hive reported sot ii muscular and aerobic power between professional rugby league forwards and backs. However, backs are reported to the lighter, leaner and have faster 10m, 20m and 40m sprint times than forwards.

It has been shown that first Class rugby union players have superior muscular strength, cit durance, and power to second class players. Significant differences have also been reported between elite and non-elite Gaelic football players for in muscular power, speed, and arid aerobic power. These results suggest that fitness requirements differ according to the level of competition. However, these findings may also be attributed at least in part, to the poorly developed training habits of non-elite football players. While investigators have developed physiological and anthropometric profiles professional rugby league players, similar studies have not been performed in amateur rugby league players. Therefore, the purpose of this study was to investigate the physiological and anthropometric characteristics of amateur rugby league players.

Tsolakis, (2006) investigates the differences in selected anthropometric, strength-power parameters and functional characteristics of fencing performance between elite and sub-elite fencers. Thirty-three fencers (18 females and 15 males) from the Greek National Team, (age

19 ± 3.5yr, body height 175.6 ± 7.6cm, body mass 66.1 ± 9.1 kg, systematic training 8.4 ± 2.9yr) were classified as elite and sub-elite, according to their international experience. Subjects underwent a detailed anthropometric assessment and performed selected leg power and fencing-specific tests. Significant differences were observed between the two groups in sitting height, triceps, sub-scapular and quadriceps dominant skinfold thickness, absolute and body mass-dependent expressions of leg functional power characteristics of fencing performance: "time of lunge" and time of the "shuttle test", Anthropometric traits, such height, body mass, percent fat and limb length were not different among elite and sub-elite fencers. Although technical and tactical factors are good indicators of fencing success, the observed differences in functional fencing performance tests among different levels of fencers are useful for the design of effective talent development and training conditioning programs for competitive fencers.

Kenpen, (1996) focused on anthropometric and physiological characteristics of soccer players with a view to establishing their roles within .t\talent detection, identification and development programmes. Top-class soccer players have to adapt to the physical demands of the game, which are multifactorial. Players may not need to have an extraordinary capacity within any of the areas of physical performance but must possess a reasonably high level within all areas. This explains why there are marked individual differences in anthropometric and physiological characteristics among top players. Various measurements have been used to evaluate specific aspects of the physical performance of both youth and adult soccer players. The positional role of a player is related to his or her physiological capacity Thus midfield players and full-backs have the highest maximal oxygen intakes (>60 mlkg1min1) and perform best in intermittent exercise tests. On the other hand, midfield players tend to have the lowest muscle strength. Although these distinctions are evident in adult and elite youth players, their existence must be interpreted circumspectly in talent identification and development programmes. A range of relevant anthropometric and physiological factors can be considered which are subject to strong genetic influences le g. stature and maximal oxygen intake) or are largely environmentally determined and susceptible to training effects. Consequently, fitness profiling can generate a useful database against which talented groups may be compared No single method allows for a representative assessment of a player's physical capabilities for soccer. We conclude that anthropometric and physiological criteria do have a role as part of a holistic monitoring of talented young players.

Acikada, (1996) evaluate whether players in different positional roles have a different physical and physiologic profile. For the purpose of this study, physiologic measurements were taken of 270 soccer players during the precompetitive period of 2005/06 and the precompetitive period of 2006/07. According to the positional roles, players were categorized as defenders (n = 80), midfielders (n = 80), attackers (n = 80), and goalkeepers (n = 30) Analysis of variance (ANOVA) was use to determinate differences between team positions. Goalkeepers are the tallest and the heaviest players in the team. They are also the slowest players in the team when sprinting ability over 10 and 20 meters is required. Attackers were the quickest players in the team when looking at sprint values over 5, 10, and 20 meters. There were statistically significant differences between attacker and defenders when measuring vertical jump height by squat jump. Goalkeepers were able to perform better on explosive power tests (squat jump and countermovement jump) than players in the field. Midfielders had statistically significant superior values of relative oxygen consumption, maximal heart rate, maximal running speed, and blood lactate than defenders and attackers. Defenders had more body fat than attackers and midfielders ($p < 0.05$). Coaches are able to use this information to determine which type of profile is needed for a specific position. It is obvious that players in different positions have different physical and physiologic profiles. Experienced coaches can use this information in the process of designing a training program to maximize the fitness development of soccer players with one purpose only, to achieve success in soccer.

Vicente-Rodriguez, (2003) determine anthropometric and physical fitness characteristics of Brazilian male children and adolescents at the beginning of soccer training. In this study, 282 male soccer players ranging in age from 10 to 13 years were evaluated. The athletes participated in a formal soccer training program 3 times per week, with each training lasting 3 hours. Anthropometric and physical fitness parameters were obtained. The boys were divided into age classes and prevalence data were analyzed using Pearson's chi-square test. Parametric data were compared by one-way ANOVA or the Kruskal-Wallis test, when necessary. The results are expressed as the mean ± standard deviation and a p value <0.05 was considered to be significant. Growth, development, body adiposity and physical fitness characteristics were adequate and proportional to age among the boys studied ($p<0.05$). it was concluded that anthropometric and physic fitness characteristics of young male elite soccer players improve with and are proportional to age. Children and adolescents greatly benefit from regular physical activity. The present results show that young male soccer players present adequate anthropometric conditions and physical fitness prior to the initiation of formal training at soccer clubs.

2.7 Summary

In this chapter, extensive review of work on related issue concerning the study has been done, literature related to this study was reviewed on the basis of concept, health related physically fitness component, muscular strength and endurance, performance related physically fitness components was also reviewed. The anthropometric measures were also discussed as applied to this study.

In conclusion, Available research evidence has conclusively shown prophylactic and curative benefits of physical fitness. Physical fitness is given high priority in Nigeria football league and also in outside the country, for two important reasons, one is to lead better healthy life, and the other is for competitive purposes.

The various fields measure of physical fitness and anthropometric characteristics of these five groups of clubs were discussed extensively, these fields' tests are accepted as valid and reliable test to measure physical fitness and anthropometric characteristics of the five groups of female soccer teams, James, (2001).

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

3.1 Introduction

The purpose of this study was to compare anthropometric characteristics and physical fitness levels of Nigerian female defensive and offensive soccer players. To achieve this purpose, the research design, population, sample and sampling technique, instrumentation, tests, and statistical analysis to be used in this study are described in this chapter.

3.2 Research Design

The research design adopted for this study was expost facto research design. It was used to collect the required data for the purpose of this study. In this design, anthropometric characteristics and levels of physical fitness in different components of Nigerian female defensive and offensive soccer player were determined and compared. Cohen, Manion & Morison (2000), noted that instead of taking groups that are equivalent and subjecting them to different treatment to determine the difference in the dependent variables, an expost facto experiment begins with groups that are already different in some respect and searches in retrospect for factors that brought about those differences.

Players	**Test**	
	Anthropometric characteristics	Physical fitness test
Defensive players		
Offensive players		

Ex Post Factor Research Design (Causal-Comparative)

3.3 Population

The population for this study consisted of all the Nigerian female defensive and offensive soccer players from the following female soccer clubs in Federal Capital Territory, Abuja.

i. C. I Angels Football Club

ii. Standard Babes FC

iii. FC. Robo

iv. Martins White Doves FC

v. Tokas Queens FC

The total numbers of female defensive soccer player from each of the club were 20 players. Similarly the total number of offensive players from each of these clubs was 20 players. Thus, there were 100 female defensive players and 100 offensive soccer players in selected Clubs in Abuja FCT, Nigeria, (NFF guideline 2013,)

3.4 Sample and Sampling Techniques

The players were stratified into t wo strata. One stratum was defensive players and second stratum was the offensive players then stratified sampling technique is applied so as to obtain a representative sample. Thus, 6 defensive and 6 offensive players from each of the 5 clubs were picked, totaling 30 defensive and 30 offensive players using stratified random sampling. The names of the defensive and offensive players from each club were randomly selected at the rate of 6 slips for defensive players and 6 slips for offensive players of each of the 5 female soccer clubs. Thus, a total of 60 defensive players and offensive players were selected to constitute the sample for this study.

3.5 Instrumentation

The following research instruments were used in this study for data collection.

2.5.1 **Stop watch for 12 Minutes Run Test:** Two stop watches manufactured by Jeweled Sports Company Britain (Sharkey, 1984). The stop watch not used before will be used to measure the 12 minute run/walk test.

Whistles for 12 Minutes Run Test: A whistle not used before will be used to start and stop the subjects at the expiration of the 12 minute run/walk test.

400meter running track: used for the 12 minute run/walk.

3.5.2 **Stadiometer** for Height: The Technical device used for the examination was Stadiometer (Holtain model) made up of two metal planes set at right angles with an adjustable pointed arrow head. It was used to measure the height of each subject standing without hoes against the instrument.

3.5.3 **Weighing Scale for Weight.** Weight Scale: A portable bathroom type Hanson Scale. Model B 1801a made in Ireland was used to measure the subjects weight in kilograms, while lightly dressed without adorning ornaments or wearing shoes (AAHPERD, 1990).

3.5.4 **Field/Tape Ruler for Explosive Strength:** Non-elastic horse brand tape model S1542, made in USA was used to measure the circumference of the upper and lower arm.

3.5.5 **Calibrated box and Stool for Flexibility:** These are the technical devices used for the measurement of flexibility coupled with other instruments.

3.5.6 Measuring Tape is the main instrument **for arm measurement while Deluxe Box** is the technical device used for the measurement of total arm length.

3.6 Sequence of testing

In other to avoid the influence of fatigue on test results, the tests were conducted in the following sequence.

1. 12 minutes run test.
2. Sit and reach
3. Sit ups
4. Push ups
5. Standing Broad Jump

This sequence was arranged in other to ensure that the muscle group involved in one test was not involved in the test that was conducted immediately afterwards.

3.7 Test Items/Research List

The following tests were conducted to measure the physical fitness and anthropometric characteristics of the defensive and offensive female soccer players.

i. 12 minute walk/run test
ii. Pushups
iii. Sit-up
iv. Sit and Reach
v. Standing broad jump
vi. Weight in kilogram - Scale
vii. Height in meter - Stadometer
viii. Total leg length - Tape

ix. Total arm length - Deluxe Box

3.8 Test Procedure

3.8.1 The 12 - Minute Run/Walk Test

The 12 minute run - walk test was used to determine cardiorespiratory endurance. To perform the test, the subjects were given a brief description of the test. They were required to run round 400m track as many times as possible within 12 minutes. The running was done at one's own pace. One could walk or stop when tired. The subjects ran in groups of 12 each. The subjects were asked to run at a constant pace. The research assistants helped to count the number of laps covered by each subject. At the end of 12 minutes, the whistle was blown and all the subjects running/walking immediately stopped. The distance covered during the 12 minutes was the number of laps covered the distance from where each subject stopped from the starting line in meters. The distance each subject covered was used to find out Vo_2 max. The formula for the calculation of Vo2 max from the running is ml/kg/min. It is measured as "milliliters of oxygen used in one minute per kilogram of body weight." (Wilmore & Costill. 2005)

3.8.2 Sit Ups

The sit - up test was used to test the subject's legs muscular strength. The equipment required for this test included mats, a stop watch, whistle, and assistants. Before the test, subjects were allowed one minutes trial.

Procedure: Subjects are laid on their back with fingers clasped behind the neck and elbows touching the floor with the knees straight, with toes pointing upwards, the heel touching the ground. The body was pulled in close to the thigh. The ankles were held firm to the ground by an assistant. The subject returned to the starting position. The exercise was repeated.

Instruction: Subjects must return to the starting position with the elbows touching the floor. Fingers must remain in contact behind the neck throughout the exercise and should not rest between sit - ups. Subjects are expected to do as many sit - ups as they can for 60 seconds.

Scoring: A good sit - up is scored each time an elbow touches the knee. The number of scores is the correct sit - ups performed within 60 seconds. Each research assistant is expected to score his subjects.

3.8.3 M**uscular Flexibility Using Sit and Reach Test**

The hip flexion of the subject was determined by the sit and reach test as described by Corbin, (1984) and Dikki, (1992). The sit - reach box adopted after Wells and Dellons (Mathews, 1978), Young and Pryor (2007) was used.

The apparatus consisted of a box (constructed) with a measuring scale showing 23cm at the level of the feet. The box was placed against the wall. The subjects removed their shoes and assume a sitting position on the floor with legs fully extended forward with the hands placed on top of each other.

The subject sit and reaches directly forward along the measuring scale on the box. In this position, the subject stretches forward, the maximum reach on each trial with the knees fully extended and the feet still in contact with the box. The distance attained was recorded to the nearest cm. For each trial, the maximum distance reached and maintained for ten (10) seconds is the measure of flexibility.

3.8.4 **Standing Broad Jump**

Standing Broad Jump was used to measure the lower limb explosive power. Hopping with Left Foot and Right Foot for assessing Explosive Strength Endurance of legs was administered, and the maximum distance covered by each subject was measured in meter with the accuracy of one hundredth of the meter, as followed by Bala 2000 and Tarlok 2001).

A jump specific warm up of 5 counter movement jumps increasing the intensity of each jump was performed prior to the test. One minute after the warm up, players performed three countermovement jumps conducted on a piezoelectric force platform (KMS, Australia). During the assessment, all the athletes placed both hands on their hips to avoid any upper body influence on the result (Canavan & Vescovi, 2004). A two minute rest period was allowed between each jump to ensure maximal effort Chamari, Hachana, Ahmed, Galy, Sghaier, Chatard & Wisloff, 2004). The highest jump, determined according to flight time, was selected for further analysis.

3.8.5 **Height Measurement:**

The height was measured while standing erect looking straight ahead and bare footed against the stadiometer. A horizontal broad wooden blade was used on the head of each subject against the instrument. Their height was read off the instrument to the nearest 0.0 1mm.

3.8.6 **Weight Measurement:**

Body weight with minimal clothing (0.05kg) was measured with a spring balance. Weight was recorded in kilogram (kg) and height to meters (m). The height and weight measured were used to calculate the body mass index (BMI) dividing weight (in kg) by height (in meters) Squared. (wt / Ht2).

3.9 Research Assistants

10 research assistants were used. They were physical education teachers, coaches drawn from Abuja - FCT, and nearby schools to assist in conducting the test on the subjects. They were

trained and a pre test was conducted to determine their level of understanding of how the test was conducted.

3.10 Statistical Analysis.

The data were analyzed using the following statistical techniques.

i. Descriptive statistics of mean, standard deviation and standard error of estimate to determine the average performance of the subjects.

ii. Correlation coefficient was computed to determine the relationship between component of physical fitness and anthropometric characteristics among the groups or clubs.

iii. t-test was used to find the difference in the selected variables between defensive and offensive soccer players. In any case the decision to reject or retain the null hypothesis was set at 0.05 alpha levels.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Introduction

The purpose of this study was to compare anthropometric characteristics and physical fitness components of female soccer offensive and defensive players. To achieve this purpose, the data collected were statistically analyzed. The results of the tests are presented and discussed according to hypotheses in this chapter.

4.2 Results.

Information regarding the mean scores of the soccer fem ale defensive and offensive players in their physical characteristics is shown in table 4.2.1

Table 4.2.1a:Mean Scores of Females Defensive and Offensive Soccer Players in Their Anthropometric Characteristic

Position Of Player	Age (Yrs)		Height (Meters)		Weight (Kg)		Total leg length (cm)		Total arm length (cm)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Defensive	21.2	2.2	1.6	0.1	61.3	8.0	100.0	18.3	82.4	4.8
Offensive	20.4	1.9	1.5	0.3	60.5	4.9	104.3	4.7	82.8	11.2

Table 4.2.1a shows the mean age, weight, total leg length and the total arm length of both female defensive and offensive pla yers. The mean ages were 21.2 ± 2.2 and 20.4 ± 1.9 years for defensive and offensive players respectively. The mean of height for respectively category of players were 1.6 ± 0.09m and 1.5 ± 0.3m. While the mean for weight were 61.3 ± 8.kg and 60.5 ± 4.9kg., The means for the total leg length 100 ± 18.3 and 104.3 ± 4.7cm

respectively while that of total arm length, 82.4 ± 4.8 and 82.8 ± 11.2 respectively. However, the defensive players were taller (1.6m ± 0.6) than other offensive players.

Table 4.2.1b: Mean Scores of Females Defensive and Offensive Soccer Players in Their Physical Fitness Performance

Position of Player	Cardio-respiratory endurance		Muscular strength (push up)		Muscular strength (sit up)		Flexibility (sit reach)		Standing broad jump	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Defensive	2.0	0.4	22.1	4.8	20.5	5.2	23.3	5.3	1.6	0.3
Offensive	2.3	0.4	21.4	2.1	20.9	2.2	28.0	2.8	1.8	0.2

Examination of table 4.2.1b shows the means scores of Cardio-respiratory endurance, Muscular strength (arm), Muscular strength (leg), Flexibility, Standing broad jump (Lower Limb power) of the defensive and offensive players. The mean cardio-respiratory endurance ages were 2.0 ± 0.4 and 2.3 ± 0.4 for defensive and offensive players respectively. The mean of muscular strength (arm) for respectively category of players were 22.1 ± 4.8 and 21.4 ± 2.1. While the mean for muscular strength (leg) were 20.5 ± 5.2 and 20.9 ± 2.2. The means for flexibility were 23.3 ± 5.3 and 28.0 ± 2.8 respectively while that of lower limb power, 1.6 ± 0.3 and 1.8 ± 0.2 respectively. It was observed that female defensive players had higher mean scores in muscular strength whereas offensive players had greater mean scores in cardiovascular endurance (explosive power strength).

4.3 Hypotheses testing

Major hypothesis:

There is no significant difference between Nigerian female defensive and offensive soccer players in their characteristics and physical fitness performance.

To test the major hypothesis, it was sub divided into 7 sub-hypotheses which are tested below,

Sub hypothesis 1

There are no significant differences between Nigerian female defensive and offensive soccer players in their stature, body weight, leg and arm lengths. The data collected for height, weight, length and arm length were analyzed using sam ple t-test for differences between female defensive and offensive soccer players in the variables, the results of which are shown in the table 4.3.1

Table 4.3.1 Two sample t-test for differences in height, weight, leg and arm length of Defensive and Offensive soccer females in Nigeria.

Variable	Type	Mean	SD	SEE	**t**	DF	P
Height Stature (M)	Defensive	1.6	0.1	0.02	1.1	58	.3
	Offensive	1.5	0.3	0.01			
Weight (Kg)	Defensive	61.3	8.0	1.5	0.4	58	.7
	Offensive	60.5	4.9	1.0			
Leg length (cm)	Defensive	100.0	18.3	3.4	1.2	58	.2
	Offensive	104.3	4.7	0.9			
Arm length (cm)	Defensive	82.4	4.8	0.9	0.2	58	.9s
	Offensive	82.8	11.2	2.1			

$t(58) = 2.0, P < 0.1$

The Table 4.3.2 reveals that the defensive and offensive female soccer players were not significantly different in any of the selected parameters in the test. This was indicated with an observed t-value of 1.1 for height, 0.4 for weight, 1.2 for leg length and 0.9 for arm length respectively. The levels of significance observed for the tests were 0.3 for height, 0.7 for weight, 0.2 of leg length and 0.9 for arm length respectively which are all higher than 0.1 (P >

0.1). This means that the null hypothesis that there is no significant difference between Nigerian female defensive and offensive soccer players in their height, weight, leg length and arm length was retained.

Sub hypothesis II:

There is no significant difference between Nigerian female defensive and offensive soccer players in their cardio-respiratory endurance measured by 12 minute run test.

The sub hypothesis was tested by using two sample t-test for difference between female defensive and offensive soccer players, the results of which are shown in table 4.3.2

Table 4.3.2 Two Sample t-test for Differences on Cardio-respiratory Endurance Test (12 Min Run) of Female Defensive and Offensive Soccer Player in Nigeria.

Position of Player	N	Mean	SD	SEE	t	DF	P
Defensive	30	2.0	0.4	0.1	2.4	58	0.0
Offensive	30	2.3	0.4	0.1			

$t(58) = 2.0, P < 0.0$

Table 4.3.2: shows that the female defensive and offensive soccer players differ significantly in their cardio-respiratory endurance test. The observed t-values (2.4) in the table is higher than the critical value of 2.0 at the same degree of freedom and the observed level of significance is 0.018 ($P < 0.1$). This means that the null hypothesis is that there is no significant difference between Nigerian female defensive and offensive soccer players in their cardio-respiratory endurance measured by 12 minute run was rejected.

Sub-hypothesis III:

There is no significant difference between Nigerian female defensive and offensive soccer players in their muscular strength (arm) measured by push up.

Sub hypothesis 3 was tested by using two t-test for differences between the two groups in their muscular strength and endurance. The results of which are shown in table 4.3.3

Table 4.3.3 Two sample t-test for differences in muscular strength test (push up) of Defensive and Offensive females soccer player in Nigeria.

Position of Player	N	Mean	SD	SEE	T	DF	P
Defensive	30	22.1	4.8	0.9	.8	58	.4
Offensive	30	21.4	2.1	0.4			

$t(58) = 2.0$, $P < 0.1$

Table 4.3.3 does not show significant difference in the muscular strength of the two groups as measured by their push up. The observed t-value (0.8) is lower than the critical value of 2.0 at the same degree of freedom. The observed level of significance in the test is 0.4 ($P > 0.1$.). By these observations the null hypothesis that there is no significant difference between Nigerian female defensive and offensive soccer players in their muscular strength measured by push up was retained.

Sub-hypothesis IV:

There is no significant difference between Nigerian female defensive and offensive soccer players in their flexibility measured by sit reach.

The sub hypothesis was tested by using two sample t-test for differences between the two groups in their flexibility, the results of which are shown in table 4.3.4

Table 4.3.4: Two sample t-test for differences in flexibility (Sit Reach) Test of Defensive and Offensive soccer females in Nigeria.

Position of Player	N	Mean	SD	SEE	T	DF	P
Defensive	30	23.3	5.3	1.0	4.3	58	.0
Offensive	30	28.0	2.8	0.5			

$T(58) = 2.0, P < 0.1$

Table 4.3.4 shows that the offensive female players were significantly difference from their defensive counterpart in their flexibility as indicated in the table. The observed t-value for the test is 4.3 which were higher than the critical value of 2.0 at the same degree of freedom. The level of significance observed for the test is 0.0 ($P < 0.1$). Therefore the null hypothesis that there is no significant difference between Nigerian female defensive and offensive soccer players in their flexibility measured by sit reach was rejected.

Sub-hypothesis V:

There is no significant difference between Nigerian female defensive and offensive soccer players in their lower limb explosive strength measured broad jump.

The sub hypothesis was tested by using two sample t-test for differences between the two groups in their broad jump (explosive strength), the results of which are shown in table 4.3.5

Table 4.3.5: Two sample t-test for differences in explosive strength of females Defensive and Offensive soccer in Nigeria.

Position of Player	N	Mean	SD	SEE	T	DF	P
Defensive	30	1.6	0.3	0.1	-3.2	58	.002
Offensive	30	1.8	.9	.03			

T(58) = 2.0, P < 0.1

Table 4.3.5 shows that the two groups (Defensive and Offensive) were significantly different in broad jump as measured for their explosive strength. This shows that the female offensive players are better than their defensive counterparts on their explosive strength. The observed t-value for the test is 3.2 compared with the critical value of 2.0 at the same degree of freedom. The level of significance for the test is 0.002 (P < 0.1). Therefore the null hypothesis that there is no significant difference between Nigerian female defensive and offensive soccer players in their explosive strength was rejected.

4.4 Discussion

The purpose of this study was to compare physical fitness and anthropometric characteristics of Nigerian female defensive and offensive soccer players. This study was based on the assumption that there are differences not only between sports groups but also within the same sport depending on the positions played. In the psychobiological and physical demands they make. In soccer, like in any other team sport the demands made by different positions in the sport differ and therefore the physical and physiological characteristics with which either the players come to the sport or they develop while practicing the sport significantly differ. The finding of the study reported in this regard relating to soccer is explained in this section.

4.4.1 Anthropometric Characteristics

Anthropometric characteristics of Nigerian female defensive and offensive soccer players, the anthropometric characteristics included in the study are height, weight, total arm length and total leg length.

The results of this study indicated insignificant differences between female soccer defensive and offensive players in their slightly weight, total leg length and total arm length. This finding is contrary to the findings and observations of Kholsa (1983), Bale (1986), Bompa (1999), Burke (1976) and Venkateswarlu (1982), according to which height and weight play very significant role not only in sports like volleyball, basketball and events like throws and jumps in track and field athletics but also in different positions in each of these sports on soccer these authors have shown that defensive players are heavier and taller than the offensive players because these measures are advantageous to perform fast movements for a short period of time that require taller and heavier players. In other words, these positions are advantageous to people who are heavy and tall.

Although the study showed insignificant differences between defensive and offensive female soccer players in their heights and weight, the height of defensive players (1.58m) was slightly greater than the offensive players (1.52m). The absence of significance may be attributed either to the limited sample size involved in this study, to the relatively less professional experience of the players' studied or to both.

As in the case of height and weight, this study showed insignificant differences between defensive and offensive soccer players in their total arm length and leg length, which is contrary to the findings to Gabbett (2001) and observation of Bompa (1999), according to which defensive players have longer limps in rugby and American football, which are close of soccer. The only explanation that can be provided is that the subjects they studied came to positions in the game with longer limbs whereas in this study the subjects did not seem to have come with relatively longer limbs.

4.4.2 Physical Fitness

Differences between defensive and offensive female soccer players in physical fitness characteristics are looked into in this study.

Physical fitness characteristic investigated in the study were cardio respiratory endurance, muscular strength and endurance, flexibility and explosive strength. The findings of the study showed insignificant difference between defensive and offensive female soccer players in cardio- respiratory endurance and muscular strength and endurance. This finding is in agreement with those of Gabbett (2000) on rugby players, Kenpen (1996) on soccer players, Acikada (1996) on soccer players, Bompa (1999) on soccer, rugby and handball players, and Venkateswarlu (1992) on speed and endurance sports, according to which there are no significant differences between defensive and offensive soccer players in the cardiorespiratory endurance and muscular strength and endurance. This was attributed mainly because of the fact that players playing different positions require a certain minimum level of cardio respiratory endurance and muscular strength and endurance, especially in the case of players with limited experience. Therefore, insignificant differences in these two physical fitness characteristics are justified. However, this study showed significant differences between defensive and offensive female soccer players in their flexibility and explosive strength of the lower limbs. This finding is in agreement with the observation of Bompa (1999) and Venkateswarlu (1995), according to which offensive soccer players have greater flexibility and explosive strength, because these positions involve fast movement with intermittent rest periods, the performance of which requires greater flexibility and explosive strength.

The findings of this study clearly indicated significant differences between offensive and defensive female soccer players in flexibility and explosive strength because offensive players had greater amount of this particular characteristics than the defensive players. This finding justifies the assumption that the physical and physiological demands of positional play in soccer, as in many other team sports, are greater for particular physical fitness characteristics like speed, flexibility and strength which are more essential for playing forward position than defensive positions.

CHAPTER FIVE

5.0 SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 Summary

This study was conducted to compare the anthropometric and physical fitness characteristics of Nigerian female soccer players. Anthropometric characteristics included height, weight; total leg length and total arm length, whereas physical fitness characteristics included cardiorespiratory endurance, muscular strength, and endurance flexibility and explosive power of lower limbs.

To achieve the purpose of this study, thirty (30) female defensive players and thirty (30) female offensive players were selected by using random sampling technique from five female soccer teams participating in National Competition in FCT (Federal Capital Territory)

The data collected were statistically analyzed using descriptive statistics of mean and standard deviation and inferential statistics of t-test for differences between female defensive and offensive soccer players in each of these characteristics. The results indicated the following:

1. The observed mean age, weight, total leg length and the total arm length of both female defensive and offensive players were not significant. The mean ages were 21.2 ± 2.8 and 20.3 ± 1.9 years for defensive and offensive players respectively. The mean of height for respectively category of players were 1.58 ± 0.093m and 1.5 ± 0.3m. While the mean for weight were 61.3 ± 8.kg and 60.5 ± 4.9kg., The means for the total leg length 100 ± 18.3 and 104.3 ± 4.7cm respectively while that of total arm length, 82.3 ± 4.75 and 82.8 ± 11.23 respectively.

2. There were no significant differences between the defensive and offensive female soccer players in any of the selected parameters in the test as observed t-value of 1.1 for height, 0.4 for weight, 1.2 for leg length and 0.9 for arm length respectively. The levels of significance observed for the tests were 0.3 for height, 0.7 for weight, 0.2 of leg length and 0.9 for arm length respectively which are all higher than 0.1 ($P > 0.1$). However, the defensive players were taller (1.6m ± 0.6) than other offensive players.
3. The offensive female players were significantly difference from their defensive counterpart in their flexibility as the observed t-value for the test is 4.3 which were higher than the critical value of 2.0 at the same degree of freedom. The level of significance observed for the test is 0.0 ($P < 0.1$).
4. Defensive and Offensive players were significantly different in broad jump as measured for their explosive strength. This shows that the female offensive players are better than their defensive counterparts on their explosive strength. The observed t-value for the test is 3.2 compared with the critical value of 2.0 at the same degree of freedom. The level of significance for the test is 0.0 ($P < 0.1$).
5. The female defensive and offensive soccer players differ significantly in their cardio-respiratory endurance test. The observed t-values (2.4) in the table is higher than the critical value of 2.0 at the same degree of freedom and the observed level of significance is 0.0($P < 0.1$).
6. There was no significant difference in the muscular strength of the defensive and offensive players as measured by their push up. The observed t-value (0.8) is lower than the critical value of 2.0 at the same degree of freedom. The observed level of significance in the test is 0.4($P > 0.1$.).

5.2 Conclusion

Within the limitations of this study, the following conclusions were drawn.

1. Female offensive players demonstrated greater flexibility and explosive strength than female defensive players.
2. Female defensive soccer players were significantly taller and heavier than the female offensive players, depending on their playing experience.
3. There are no significant differences between female defensive and offensive soccer players in the total length of their limbs, cardio- respiratory endurance and muscular strength and endurance.

5.3 Recommendations

On the basis of the findings of the study, we recommended that;

1. taller and heavier female soccer players should be selected for defensive positions,
2. female soccer players with height and weight but greater flexibility and explosive strength should be selected for offensive positions in soccer,
3. training programmes should be designed to develop more speed and cardiorespiratory endurance for offensive female soccer players.
4. more flexibility and explosive strength should be encouraged in offensive players.

5.4 Recommendation for Further Research

On the basis of the findings of this study, the following recommendations are made to improve the quality of training for soccer players and also to conduct further research on problems related to the this study.

1. Studies on physical and physiological characteristics of offensive and defensive soccer players participating in different soccer competitions in Nigeria may be conducted.

2. Training programme should be designed that can emphasize more on the dominant physical and physiological characteristics of defensive and offensive players.
3. Studies may be conducted to find out the relationship between playing experience and physical fitness of defensive and offensive players in soccer.
4. findings for this study will add to the existing data in the area of exercise and sports science.

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