ASSESSMENT OF THE EFFECT OF RESISTANCE TRAINING ON BIOMOTOR ABILITIES OF MALE FOOTBALL PLAYERS IN FEDERAL COLLEGE OF EDUCATION, KONTAGORA, NIGERIA

BY

SHUAIBU MOHAMMED UMAR

DEPARTMENT OF HUMAN KINETICS AND HEALTH EDUCATION,

FACULTY OF EDUCATION,

AHMADU BELLO UNIVERSITY, ZARIA, NIGERIA

OCTOBER, 2018

TITLE PAGE

ASSESSMENT OF THE EFFECT OF RESISTANCE TRAINING ON BIO-MOTOR ABILITIES OF MALE FOOTBALL PLAYERS IN FEDERAL COLLEGE OF EDUCATION, KONTAGORA, NIGERIA

BY

Shuaibu Mohammed UMAR

P14EDPE9013

THESIS SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES, AHMADU BELLO UNIVERSITY, ZARIA, NIGERIA

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF DOCTOR OF PHILOSOPHY DEGREE (PhD) IN EXERCISE AND SPORTS SCIENCE,

DEPARTMENT OF HUMAN KINETICS AND HEALTH EDUCATION,
FACULTY OF EDUCATION,
AHMADU BELLO UNIVERSITY, ZARIA

OCTOBER, 2018

DECLARATION

I hereby declare and affirm that this thesis titled "Assessment of the Effects of Resistance Training on Biomotor Abilities of Male Football Players in Federal College of Education Kontagora, Nigeria" was carried out by me in the Department of Human Kinetics and Health Education. This work has not been submitted in any previous work for a higher degree. The information derived from the literature has been duly acknowledged in the text.

_____ _____

Shuaibu Mohammed UMAR **Date**
P14EDPE9013

CERTIFICATION

This thesis titled: Assessment of the Effects of Resistance Training on the Biomotor Abilities of Male Football Players in Federal College of Education, Kontagora, Nigeria meets the regulations governing the award of Doctor of Philosophy (PhD) degree in Exercise and Sports Science, Department of Human Kinetics and Health Education, Ahmadu Bello University, Zaria, and is approved for its contribution to knowledge and literary presentation.

Prof. E. A. Gunen	**Date**
Chairman, Supervisory Committee	
Prof. J. O. Ayo	**Date**
Member, Supervisory Committee	
Prof. M. A. Chado	**Date**
Member, Supervisory Committee	
Prof. M. A. Suleiman	**Date**
Head, Department of Human Kinetics and Health Education	
Prof. S. Z. Abubakar	**Date**
Dean, School of Postgraduate Studies	

DEDICATION

This research is dedicated to my late father, Mal. Umar; my mother, Madam Ash'au Umar, my wife, Rashidat, children and my uncle, Mal. M.J Unwaha, for their untiring support and prayers.

ACKNOWLEDGEMENTS

The researcher is grateful to the Almighty Allah for his abundant mercies and for the strength, health and wisdom to pursue this study. Words cannot fully express his profound gratitude and indebtedness to the supervisory team: Professor E.A. Gunen, Professor J.O. Ayo, Professor M.A. Chado, for all their efforts and contributions to make this work a success. The researcher is indebted to Professor M.A. Suleiman (Head of Department) for the motherly pieces of advice and cooperation throughout the period of study. Special thanks go to Professors C.E. Dikki, J.A. Gwani, R.O. Okuneye, F.B. Adeyanju, A.I. Kabido, E.J. Chom, T.N Ogwu and V. Dashe. I also thank Drs. Bulus Zamani, Yahaya Abdullahi, Umar Musa, A. Darki and S.U. Omeiza and Mal. S. Suleiman, all of the Department of Human Kinetics and Health Education, Ahmadu Bello University, Zaria, for their support and encouragement.

The researcher cannot forget the management of Federal College of Education (FCE), Kontagora and the College community who facilitated his release for further studies. Special thanks go to the former Provost, Dr. N.O Odediran; the Dean; School of Sciences, Dr. Aliyu Mohammed; and Mr. Emmanuel Igba and Abdul-Malik Onubedo for their assistance, encouragement and prayers. Similarly, the researcher is grateful to many colleagues in the Department of Physical and Health Education, FCE, Kontagora, who served as research assistants; the students, who served as research participants and many others in the College who prayed and assisted him immensely.

Thanks go to all the researcher's classmates, including Timothy Alu (Class Representative), Col. J. Akila, Mrs. Saiwo, E. Omolara, Inalegwu K. Emiene, Ibrahim M. Mbitsa, Y.Y Ibrahim, Mohammed Aliyu, Abdullahi Dahiru, Yusuf Mohammed and all others not mentioned due to space, for the wonderful companionship during the programme.

Finally, the researcher's gratitudes go to his entire family members, for their unflinching support, display of love, for their perseverance and patience; and the typist, Mr. Opeyemi Paul who typed the manuscripts. May the Almighty Allah reward every one for the kindness Ameen.

ABSTRACT

The study assessed the effects of resistance training on selected biomotor abilities of male football players in Federal College of Education (FCE), Kontagora, Nigeria. Twenty (20) male football players within the age range of 18-29 years participated in the study. They comprised all the playing positions of the football game; that is defence, midfield, forward and goalkeeper. For the purpose of this study, the one (1) group repeated-measures research design was adopted. It provided the organized station of the resistance training around six (6) stations of circuit, consisting of hand dips, lateral pull, leg press, leg curl, leg/knee extension and abdominal curl that were used for the training. Four (4) assessments of participants' biomotor abilities of abdominal strength, VO_2 max (endurance), explosive power, flexibility, speed and agility were carried out at base-line, 4^{th}, 8^{th} and 12^{th} week of training respectively. The resistance training programme lasted 12 weeks, on alternate days (Monday, Wednesday and Friday). The data collected were analysed using descriptive and repeated–measures analysis of variance. The findings of the study revealed significant effect of resistance training on abdominal strength ($P < 0.001$), endurance ($P < 0.001$), explosive power ($P < 0.001$), flexibility ($P < 0.001$), speed ($P < 0.001$) and agility ($P < 0.001$) of male football players of FCE Kontagora, Nigeria. Based on the above findings of the study, it was demonstrated, that resistance training programme significantly improved the biomotor abilities of male football players of FCE, Kontagora, Nigeria. The study recommended that biomotor ability training and tests of abdominal strength, endurance (VO_2 max), flexibility, explosive power, speed and agility should be carried out regularly by coaches and trainers of male football players of the College. This would improve the general performance of the team and most desirably win titles for the College, especially the seemingly elusive Nigeria Colleges of Education Games Association (NICEGA) Football Championship Cup. Also, the FCE, Kontagora authorities should fully equip or upgrade to acceptable standards, the existing physical fitness laboratory or gym in the College to meet the training needs of all football players. This would further popularize the use of resistance training as a preferred method of improving many physiological variables of football players in the colleges of education and other tertiary institutions in Nigeria. Moreso, Coaches and trainers should be sponsored for further studies at home and abroad to improve their knowledge in modern scientific training methods, especially resistance training method. This would help to establish standards and produce quality football players in colleges of education and other tertiary institution in Nigeria.

TABLE OF CONTENTS

Cover Page - - - - - - - - - - i

Title Page - - - - - - - - - - ii

Declaration - - - - - - - - - - iii

Certification - - - - - - - - - - iv

Dedication - - - - - - - - - - v

Acknowledgments - - - - - - - - - vi

Abstract - - - - - - - - - - viii

Table of Contents - - - - - - - - - ix

List of Tables - - - - - - - - - - xiii

List of Abbreviations - - - - - - - - - xv

List of Appendices - - - - - - - - - xviii

Operational Definition of Terms - - - - - - - xix

CHAPTER ONE – INTRODUCTION

1.1 Background to the Study - - - - - - - - 1

1.2 Statement of the Problem - - - - - - - 6

1.3 Research Questions - - - - - - - - - 8

1.4 Purpose of the Study - - - - - - - - 8

1.5 Basic Assumptions - - - - - - - - - 9

1.6 Hypotheses - - - - - - - - - - 10

1.7 Significance of the Study - - - - - - - 11

1.8 Delimitations - - - - - - - - - 12

CHAPTER TWO – REVIEW OF RELATED LITERATURE

2.1 Introduction - - - - - - - - - 13

2.2 Football as a Multi-factorial Sport - - - - - - 14

2.3 Bio-Motor Ability Variables - - - - - - 16

2.3.1 Bio-Motor Abilities and Physical Characteristics of Football Players - 27

2.3.2 Endurance and Aerobic Ability in Football - - - - - 28

2.3.3 Impact of Resistance Training on Endurance - - - - - 32

2.3.4 Speed and Sprinting among Football Players - - - - - 33

2.3.5 Explosive Power in Football - - - - - - - 36

2.3.6 Strength in Football - - - - - - - - 38

2.3.7 Agility in Football - - - - - - - - 41

2.3.8 Flexibility among Football Players - - - - - - 43

2.4. Motor and Physical Profiles of Different Playing Positions in Football - 46

2.5 Resistance Training Programme - - - - - - 49

2.5.1 Frequency of Training Programme - - - - - - 52

2.5.2 Duration of Training Programme - - - - - - 52

2.5.3 Intensity of Training Programme - - - - - - 54

2.5.4 Repetitions of Training Programme - - - - - 55

2.5.5 Sets of Resistance Training Programme - - - - - 56

2.6 Summary - - - - - - - - - 57

CHAPTER THREE –METHODOLOGY

3.1 Introduction - - - - - - - - - 60

3.2 Research Design - - - - - - - - 60

3.3 Population of the Study - - - - - - - 60

3.4 Sample and Sampling Technique - - - - - - 61

3.5 Instrumentation - - - - - - - - 62

3.6 Test Item Selection and Testing Procedure - - - - - 62

3.6.1 Informed Consent and Ethic Permission - - - - - 63

3.6.2 Testing Procedure - - - - - - - - 63

3.6.3 Standing Height and Weight - - - - - - - 63

3.6.4 Sit-up Test for Abdominal Strength - - - - - 64

3.6.5 12-Minute Run/Walk Test for Endurance - - - - 65

3.6.6 Sit and Reach Test for Flexibility - - - - - - 67

3.6.7 50-Meter Dash Test for Speed - - - - - - 68

3.6.8 Standing Broad Jump Test for Explosive Leg Power - - - 69

3.6.9 Agility Test (20 – Meter Shuttle Run) - - - - - 70

3.7 Training Protocol - - - - - - - - 71

3.7.1 Inclusion and Exclusion Criteria - - - - - - 71

3.7.2 Resistance Training Programme - - - - - - 71

3.8 Experimental Control - - - - - - - 74

3.8.1 Research Assistants - - - - - - - - 75

3.9 Procedures for Data Analyses - - - - - - 76

CHAPTER FOUR –RESULTS AND DISCUSSION

4.1 Introduction - - - - - - - - - 77

4.2 Results - - - - - - - - - 77

4.3 Discussion - - - - - - - - - 96

CHAPTER FIVE – SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1	Summary - - - - - - - - -	102
5.2	Conclusions - - - - - - - - -	105
5.3	Contribution to Knowledge - - - - - - - -	106
5.4	Limitation of the Study - - - - - - - -	106
5.5	Recommendations - - - - - - - - -	107
5.6	Recommendations for Further Studies - - - -	108
	References - - - - - - - - -	109
	Appendix I - - - - - - - - -	125
	Appendix II - - - - - - - - -	126
	Appendix III - - - - - - - - -	131
	Appendix IV - - - - - - - - -	132
	Appendix V - - - - - - - - -	133

LIST OF TABLES

Table 3.7.2a: Phases of Resistance Training Programme - - - - 73

Table 3.7.2b: Six Station Circuit Resistance Training Programme - - - 74

Table 4.2.1: Physical Characteristics of Male Football Players - - - 77

Table 4.2.2a: Mean, Standard Deviation and Standard Error of Abdominal Strength of Male Football Players of Federal College of Education, Kontagora - 78

Table 4.2.2b: Summary of Repeated-Measures ANOVA of Resistance Training on the (Abdominal Strength) of Male Football Players of Federal College of Education, Kontagora - - - - - - 79

Table 4.2.2c: Results of Bonferroni Post-hoc Analysis of the Effect of Resistance Training on Abdominal Strength of Male Football Players of Federal College of Education, Kontagora - - - - - 80

Table 4.2.3a: Mean, Standard Deviation and Standard Error of VO_2 max of Male Football Players of Federal College of Education, Kontagora - 81

Table 4.2.3b: Summary of Repeated-Measures ANOVA of Resistance Training on the VO_2 max of Male Football Players of Federal College of Education, Kontagora - - - - - - - - 82

Table 4.2.3c: Results of Bonferroni Post-hoc Analysis of the Effect of Resistance Training on VO_2 max of Male Football Players of Federal College of Education, Kontagora - - - - - - 83

Table 4.2.4a: Mean, Standard deviation and Standard Error of Explosive Power of Male Football Players of Federal College of Education, Kontagora - 84

Table 4.2.4b: Summary of Repeated Measures ANOVA of Resistance Training on the Explosive Power of Male football players of Federal College of Education, Kontagora - - - - - - 85

Table 4.2.4c: Results of Bonferroni Post-hoc Analysis of the Effect of Resistance Training on Explosive Power of Male Football Players of Federal College of Education, Kontagora - - - - - - 86

Table 4.2.5a: Mean, Standard Deviation and Standard Error of Flexibility of Male Football Players of Federal College of Education, Kontagora - 87

Table 4.2.5b: Summary of Repeated-Measures ANOVA of Resistance Training on the Flexibility of Male Football Players of Federal College of Education, Kontagora - - - - - - - - 88

Table 4.2.5c: Results of Bonferroni Post-hoc Analysis of the Effect of Resistance Training on Flexibility of Male Football Players of Federal College of Education, Kontagora - - - - - - - 89

Table 4.2.6a: Mean, Standard Deviation and Standard Error of Speed of Male Football Players of Federal College of Education, Kontagora - - - 90

Table 4.2.6b: Summary of Repeated-Measures ANOVA of Resistance Training on the Speed of Male Football Players of Federal College of Education, Kontagora - - - - - - - - 91

Table 4.2.6c: Results of Bonferroni Post-hoc Analysis of the Effect of Resistance Training on Speed of Male Football Players of Federal College of Education, Kontagora - - - - - - - 92

Table 4.2.7a: Mean, Standard Deviation and Standard Error of Agility of Male Football Players of Federal College of Education, Kontagora - - 93

Table 4.2.7b: Summary of Repeated-Measures ANOVA of Resistance Training on the Agility of Male Football Players of Federal College of Education, Kontagora - - - - - - - - 94

Table 4.2.7c: Results of Bonferroni Post hoc Analysis of the Effect of Resistance Training on Agility of Male Football Players of Federal College of Education, Kontagora - - - - - - - 95

LIST OF ABBREVIATIONS

AAHPERD: American Alliance for Health, Physical Education, Recreation and Dance

ABU: Ahmadu Bello University

ACSM: American College of Sports Medicine

ANOVA: Analysis of Variance

AOSSM: American Orthopedic Society for Sports Medicine

AP: Aquatic Plyometric Training

BAL: Balance Training

BC: Before Christ

BMI: Body Mass Index

CEPG: Core Exercise Programme

CIRC: Circuit Resistance Method

CTCEPG: Complex Training with Core Exercise Programme Group

CHEK: Corrective Holistic Exercise Kinesiology

CSEG: Core Stabilization Exercise Group

CSETG: Core Stabilization and Endurance Training Group

CMJ: Counter Movement Jump

CG: Control Group

CTG: Complex Training Group

CTYPG: Complex Training with Yogic Practices Group

CST: Core Strength Training

CT: Combined Training Group

DF: Degrees of Freedom

DJ: Depth Jump

EG: Experimental Group

ETG: Endurance Training Group

FCE: Federal College of Education Kontagora

Freq: Training Frequency

GYM: Gymnasium - the facility housing various machines, equipment and gadgets used for resistance activity training.

H: Height

HR: Heart Rate

kg: Kilogramme

LP: Land Plyometric Training

MBT: Medicine Ball Throw

MP: Mechanical Power

N: Total number of participants used in the study. For this study, N = 20.

NICEGA: Nigeria Colleges of Education Games Association

NSCA: National Strength and Conditioning Association

PEG: Plyometric Exercise Group

PG: Plyometric Group

PLYO: Plyometric Training

PTG: Plyometric Training Group

PWTG: Plyometric Weight Training Group

1-RM: One Repetition Maximum

ROM: Range of Movement at joint areas of the body

Reps: Repetitions

RI: Rest Interval

RSA: Repeated Sprint Ability

RT: Resistance Training

RTG: Rope Training Group

SD: Standard Deviation

SE: Standard Error of Mean

SG: Sprint Group

SJ: Squat Jump

ST: Strength Training Group

TRAD: Traditional Resistance Method

VO_2 MAX: Maximum Oxygen Uptake

W: Weight

WRTG: Weight Rope Training Group

WT: Weight Training

WTG: Weight Training Group

YMCA: Young Men Christian Association

LIST OF APPENDICES

i. Consent form - - - - - - - - - 125

ii. Guidelines for Resistance Training - - - - - - - 126

iii. Ethics Permission - - - - - - - - - 131

iv. Interdependent of the Biomotor Abilities - - - - - - 132

v. Introductory Letter for Collection of Data - - - - - 133

OPERATIONAL DEFINITION OF TERMS

The following terms were defined operationally as follows;

Biomotor Abilities: Used in this research to connote the physical attributes of the Federal College of Education, Kontagora Football players such as abdominal strength, endurance, speed, explosive power, flexibility and agility, which is needed in order to succeed.

Resistance Training: This is used in this study to connote the use of varied weights serving as resistance to be overcome by defined muscles of body segments performing the resistance training activities with defined repetition, set, frequency, duration and rest interval.

Frequency: Used in the study to mean the alternate days selected for use for training. Three days (Monday, Wednesday and Friday) per week for 12 weeks was selected for use as training frequency.

Circuit Resistance Training: This is used in the study to mean the order of performance of the resistance training activities such as hand dips, lateral pull, leg/knee extension, leg press, leg curl and abdominal curl; with each activity serving as a station.

Effect of Training: These were expected changes in the development of biomotor ability variables of abdominal strength, endurance, flexibility, explosive power and speed to be noticed in performance of the Federal College of Education, Kontagora male football players after undergoing the 12-week resistance training programme.

Training Repetition: It is used in the study to mean the number of one completed movement of a resistance activity, 12 repetitions is used for each activity per set in this study.

Training Set: used in the study to mean the defined maximum number of repetitions to form a set. In this study three (3) sets were used per activity.

Training Intensity: This is used in this study to mean the amount of weight or load progressively set for performance of a resistance activity usually estimated as a percentage of 1-RM of the participant. Progressive load of 50%, 60% and 65% of 1-RM was used in this study.

Training Duration: used in this study to mean the length of each resistance training session. Progressive time of 40 minutes, 50 minutes and 60 minutes, respectively was used in this study.

Rest Interval: used in this study, to mean rest period for participants performing resistance training activities. This is observed between sets and progressive rest times of $1^{1/2}$ minute, 2 minutes and $2^{1/2}$ minutes, respectively was allowed for this study.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Football is a game of continuously changing tempo requiring players to be able to sustain high level of continuous effort especially in scoring goals (Cormie, McCaulley, Triplett and McBride, 2010). The rapidly increasing popularity of football has also brought about the demand for excellent performance among various teams. Footballers require many attributes to become successful players. These include cardiovascular fitness, muscular strength and endurance, speed, flexibility, agility, power and coordination (Testore, 2012). The high intensity movements required of football players is closely related to the need for the development of strength, speed and agility (Keiner, Sander, Wirth and Schmmidtbleicher, 2014). Strength, endurance, explosive power, flexibility, speed and agility are biomotor abilities that make important contributions to efficient movement with or without the ball, thus play important roles in football techniques and tactics (Haff & Nimplhiues, 2012; Faude, Koch and Meyer, 2012).

In football, there are demands imposed on football players in terms of fitness readiness requirements to produce explosive power, strength, speed, flexibility, agility and adequate level of endurance (Bloomfield, Polman and O'Donoghue, 2009). Maintaining a high level of these components throughout the session is necessary for achieving consistent high quality performance, while the basis for these individual components of players is built during youth. High intensity activities during match situation fall under acceleration, maximal speed and agility. It is essential to stimulate and maintain these abilities constantly during the training process (Bradley, 2015). Monitoring of physical preparedness parameters in the youth age group is an important part of the training process because it is an important period of physical

development. Coaches, trainers and sports scientists can analyze the factors that affect football performance to provide useful information about the strengths and weakness of young football players (Hoff, 2008).

Strength is defined as the maximum amount of force that a muscle can exert against resistance in a single effort. Strength is an important fitness parameter among football players irrespective of gender and has been categorised as maximum strength, elastic strength and strength endurance (Ozbar, 2015). Maximum strength is the greatest force that a contracting muscle can produce. It is important in areas where a large resistance needs to be overcome or controlled. Maximum strength is required by most players of different positions in the game of football. Elastic strength is the type of strength required so that a muscle can move quickly against a resistance. The combination of speed of contraction and speed of movement is referred to as "power". This special type of strength is of great importance to the explosive aspects of football such as in running, jumping and throwing of ball.

Strength endurance is the ability of the muscle to continue to exert force in the face of increasing fatigue (Ozbar, 2015). This is the combination of strength and duration of movement. Performing sit-ups to exhaustion is the test of strength endurance performance where a movement is repeated over a fairly long period of time (about 60 sec - 8 min). This is developed using a high number of repetitions with a low resistance. The strength of football players appear to be related to the positions in the team. Jackson and Wallden (2013) maintain that maximum strength is low among mid-field players and the full backs compared to the goalkeepers, forwards and central defenders.

Endurance refers to the ability to perform work of a given intensity over a time period and is sometimes referred to as stamina. A footballer is considered to have good endurance when

he/she can continue to perform without undue fatigue. The aerobic capacities of football players when fully developed helps to develop the other components of fitness during training. There are two (2) basic types of endurance; aerobic and anaerobic endurance (DeProf, Cabri, Dufour and Clarys; 2013).

Aerobic means “with oxygen” and aerobic endurance means muscular work and movement done in the presence of oxygen (O_2) to release energy for muscular contraction. Aerobic training leads to a strong cardio-respiratory system and an increased ability to use O_2 for metabolic activities. The longer the duration of an event, the more important is the aerobic endurance. Aerobic endurance should be developed before anaerobic endurance among athletes(Tonnessen, Henn, Leirstein, Haugen and Seiler; 2013)**.**

Anaerobic means “without oxygen” and anaerobic endurance refers to the energy systems which allow muscular contraction to occur using energy they already have in store. Anaerobic training allows football players to tolerate the buildup of lactic acid. There are two types; speed endurance and strength endurance. Speed endurance helps a player to run with speed despite lactic acid buildup, strength endurance allows a player to continue to express force despite lactic acid buildup. Midfielders have to make more long sprints as a consequence of their linking roles between defence and attack players (Haugen, Tonnessen and Seiler; 2013).

According to Little & Williams (2005), speed is the capacity to travel or move very quickly. Like all biomotor abilities speed can be broken down into different types. The one beneficial to a football player is the speed of the whole body moving at maximal running or the speed of a limb, such as the throwing arm in the throw-in or the takeoff leg in the jump over of an obstacle or the leg kick in the free kicks. When considering speed, it is important to include

reaction time. This is the time between a stimulus and the response of the first movement by the players (Jackson & Wallden, 2013).

Flexibility is the ability to perform joint actions through a wide range of motion. The natural range of motion of each joint in the body depends on the arrangement of tendons, ligaments, connective tissues and muscles. The limit to a joint's range of motion is called the "end position". Injuries can occur when a limb or muscle is forced beyond its normal limits. Flexibility training can help reduce the risk of injury by gradually increasing a joints range of motion (Reilly, Bangsbo and Franks; 2000). Flexibility tends to decrease as we get older while females are usually more flexible at all ages than men. Improving flexibility, like the other biomotor abilities, is a slow process that increases the range of motion of a joint, which allows the muscles to be stretched beyond their normal point of resistance. It is required that it should be done daily with appropriate types of stretching exercises, which could either be active or passive stretching. This biomotor ability is required to play by all positions in football with the goalkeepers needing it the most (Vyas, 1997).

Power is a product of force and the ability to produce as much force as possible in the shortest possible time. Strength, power and endurance share importance in the game of football. Many activities in football are forceful and explosive as in; jumping, tackling, kicking, turning and changing direction. The power output during such activities is related to the functional strength of the muscles involved in the movements as seen by the defenders, midfielders and attackers during game situations (Haff & Nimphius, 2012).

Sheppard & Young (2006) defined agility as a rapid whole body movement with change of velocity or direction in response to a stimulus. Agility is a football player's ability to make quick movement while maintaining balance and speed. Example of agile football activities

includes running back after losing possession of the ball, dodging a defender and rapid change of direction while dribbling. All these activities require quick movements without the drastic loss of balance or speed. Agility in general requires a combination of balance, speed, coordination and strength. Drills focused on increasing agility in a football player invariably involve leg workouts. Leg strength and footwork determine the agility more than anything else (Haugen, Tonnesen, Hisdal and Seiler, 2013).

Agility is required to either match or outclass one's opponents individually. A player has to adjust his movement in less than split of second to take advantage of the space. For example, if arriving into the 18 yard box is important, it is also important to adjust one's balance so as to have a contact with the ball at its most suitable spot. A footballer who is more agile will be able to safely get in and out of positions that would have been otherwise impossible. The football player needs to be efficient in movement across the sagittal, frontal and transverse planes. Smooth movement across these planes enhances the development and display of agility. The goalkeepers, midfield, forwards and central defenders in particular must display high level agility to be efficient in these playing positions (Kurz, 2001).

Marking is one of the toughest tasks in football. Players constantly move to loss their markers. Attacking players want to dislodge their markers and need agility to change direction at the rate of speed possible. At the same time, defensive players need agility to keep up with movement of the player they are tasked to mark. Goalkeepers on the other hand, need agility to change forms of their body to make saves that are nothing more than reactions. One can react but the ability to save comes from being very agile (Thomas, French and Hayes; 2009).

1.2 Statement of the Problem

The Federal College of Education, Kontagora football players' fitness profile in the last Nigeria Colleges of Education Games Association (NICEGA) has been a source of concern to coaches and trainers alike. Efforts to improve performance in football are often focused on techniques at the expense of training and fitness in Federal College of Education, Kontagora. The game of football requires comprehensive abilities, including: physical, mental and technical abilities among the players (Le Gall, Carling, Williams and Reilly, 2010). Since football demands repeated maximum exertion of running, jumping and quick turning, players must develop the physical abilities to complement such rapid and powerful movements. The researcher observed that football players of Federal College of Education, Kontagora seems to lack sufficient strength, endurance, flexibility, power, speed and agility, considering the position of 37^{th} out of 44 participating colleges in the last NICEGA games. In addition, there is the general lack of good training facilities in the college. This fact goes to emphasize the need for optimal development of comprehensive biomotor abilities required to support the efficiency of football players of Federal College of Education, Kontagora. Unfortunately, the lack of formal training, especially resistance training in the college, has resulted in the poor display of endurance during game situations. This partly explains why the players do not sustain high tempo all through from start to the end of the official time of 90-minutes on the pitch during competitions, especially during NICEGA games.

Player's inability to do well in most organized football competitions, attested to the fact that poor speed capacity is partly responsible for their poor performance. Poor performance resulting from lack of effective powerful movements among football players at all levels of the game require urgent attention to research into different training methods including resistance

training. Many activities of the game of football are forceful and explosive in nature. Kicking, jumping, tackling, swift turning and changing pace, for example, require power to execute. Power is judged by how rapidly a load or resistance can be moved. It is the product of strength and speed.

Sport scientists, team managers, coaches and trainers in the world over are presently investigating and exploring the best ways to improve performance of athletes. Therefore, most handlers of football teams are experimenting with different training methods towards finding the scientific basis of improving the different biomotor abilities that will enhance the performance of players. Research evidence from previous studies of Lidor, Armon, Cohen and Segal (2005) as well as that of Hoffman & Maresh (2000) revealed that resistance training method have proven to be the most efficient method for developing biomotor abilities of muscular strength, muscular endurance, speed, power, flexibility and agility of football players. Unfortunately, coaches and trainers in Federal College of Education, Kontagora, Nigeria do not have the knowledge of resistance training method. It is quite obvious that the extent of resistance training on football performance indices is critical to success in football match. It is also obvious that to develop football fitness, players must undergo series of conditioning, training and re-training.

All the reasons stated above constituted the driving force behind this study, which was to assess the effects of resistance training on selected biomotor abilities of male football players of Federal College of Education, Kontagora. The biomotor abilities include abdominal strength, endurance, flexibility, power, speed and agility exercises on football player's efficiency.

1.3 Research Questions

The following research questions were raised for the study:

i. Will resistance training improve abdominal strength of male football players of Federal College of Education, Kontagora, Nigeria?

ii. Will resistance training improve the endurance of male football players of Federal College of Education, Kontagora, Nigeria?

iii. Will resistance training improve the explosive power of male football players of Federal College of Education, Kontagora, Nigeria?

iv. Will resistance training improve the flexibility of male football players of Federal College of Education, Kontagora, Nigeria?

v. Will resistance training improve the speed of male football players of Federal College of Education, Kontagora, Nigeria?

vi. Will resistance training improve the agility of male football players of Federal College of Education, Kontagora, Nigeria?

1.4 Purpose of the Study

The main purpose of this was to;

i To assess the effects of resistance training on the abdominal strength of male football players of Federal College of Education, Kontagora, Nigeria

ii To assess the effects of resistance training on the endurance of male football players of Federal College of Education, Kontagora, Nigeria

iii To assess the effects of resistance training on the explosive power of male football players of Federal College of Education, Kontagora, Nigeria

iv To assess the effects of resistance training on the flexibility of male football players of Federal College of Education, Kontagora, Nigeria

v To assess the effects of resistance training on the speed of male football players of Federal College of Education, Kontagora, Nigeria

vi To assess the effects of resistance training on the agility of male football players of Federal College of Education, Kontagora, Nigeria

1.5 Basic Assumptions

On the basis of available research evidence, the following basic assumptions were made for the study:

i. Resistance training can improve the abdominal strength performance of the male football players of Federal College of Education Kontagora, Nigeria in games and competitions.

ii. Resistance training can improve the endurance capacity of the male football players of Federal College of Education Kontagora, Nigeria in games and competitions.

iii. Resistance training can improve the explosive power performance of the male football players of Federal College of Education Kontagora, Nigeria in games and competitions.

iv. Resistance training can improve the flexibility of the male football players of Federal College of Education Kontagora, Nigeria in games and competitions.

v. Resistance training can improve the speed ability of the male football players of Federal College of Education Kontagora, Nigeria in games and competitions.

vi. Resistance training can improve the agility of the male football players of Federal College of Education Kontagora, Nigeria in games and competitions.

1.6 Hypotheses

On the basis of the research questions, the following hypotheses were drawn:

Major Hypothesis

There is no significant effect of resistance training on the biomotor abilities of male football players of Federal College of Education, Kontagora, Nigeria.

Sub-Hypotheses

i. There is no significant effect of resistance training on the abdominal strength of male football players of Federal College of Education, Kontagora, Nigeria.

ii. There is no significant effect of resistance training on the endurance of male football players of Federal College of Education, Kontagora, Nigeria.

iii. There is no significant effect of resistance training on the explosive power of male football players of Federal College of Education, Kontagora, Nigeria.

iv. There is no significant effect of resistance training on the flexibility of male football players of Federal College of Education, Kontagora, Nigeria

v. There is no significant effect of resistance training on the speed of male football players of Federal College of Education, Kontagora, Nigeria.

vi. There is no significant effect of resistance training on agility of male football players of Federal College of Education, Kontagora, Nigeria

1.7 Significance of the Study

Football has been viewed largely as an endurance sport (Ozbar, 2015). This means that football players should be physically fit optimally. This study therefore, was to assess the effect of resistance training on the biomotor abilities of male football players of Federal College Education Kontagora, Nigeria.

This study will provide Federal College Education Kontagora football players the opportunity to be trained and tested in the selected biomotor variables of abdominal strength, endurance, flexibility, explosive power, speed and agility, which stimulated their interest to get involved in self-testing activities and self-evaluation of performance.

This study will promote and improve the physical fitness levels of Federal College Education Kontagora football players. This will prepare them for the great task of playing professional football and derive economic gains for self, family and community.

This study will provide students of Human Kinetics and Health Education, and other related fields the opportunity to acquire skills required to plan and execute resistance training programmes.

This study will provide a good learning curve for Federal College Education Kontagora football coaches and trainers, and served as a powerful tool for improving sports performance and standards.

This study will help to shed light on those biomotor ability variables that can be developed through a well structured resistance training programme such as strength, endurance, flexibility, explosive power, speed, agility among others.

This study will help to unveil the potentials of Federal College Education male Kontagora football players. The training experience provided by the study, will improve both of

their playing efficiency and their chances of being considered to play for state, national and international football clubs.

This study will also add to the pool of existing researches and serves as reference material to conduct similar studies which may concern male football players, different training methods and other group of variables not used in this study.

1.8 Delimitations

This study was delimited to assessing the effect of resistance training on biomotor abilities of male football players in Federal College Education Kontagora, using the variables such as abdominal strength, endurance (VO_2 max), flexibility, explosive power, speed and agility. It was also delimited to male football players in FCE Kontagora of age range of 18 – 29 years.

The study was also delimited to the following resistance training activities; hand dips, lateral pull, leg/knee extension, leg press, leg curl and abdominal curl, conducted in the gym for a period of 12 weeks.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Introduction

Football is one of the most popular sports in Nigeria and around the world and players need physical preparation and proficiency to succeed. Today, football requires a high level of strength, power, speed, flexibility, agility and endurance; which players need for better performance during the game. The game is intermittent in nature and involves multiple motor skills, such as running, dribbling kicking, passing and tackling. In addition to these skills, Bradley, Carling, Gomez, Hood, Barnes, Ade, Boddy, Krustrup and Mohr (2013), Haugen, Tonnesen, Hisdal and Seiler (2014), added that performance depends upon a variety of individual skills and their interaction and integration among different players within the team, ensures greatest opportunity to achieve success. Also, individual physical, physiological capabilities and mental factors are important for performance (Rampinini, 2015; Tonnessen, Hern, Leirstein, Haugen and Seiler, 2013). The purpose of this study, therefore, was to assess the effects of resistance training on the biomotor abilities (abdominal strength, endurance, power, speed, flexibility and agility) of male football players of Federal College of Education, Kontagora, Nigeria. This chapter reviewed literatures related to the study. Therefore, the following sub-headings serve as the coverage of the chapter:

2.1 Introduction
2.2 Football as a Multi-factorial Sport
2.3 Bio-Motor Ability Variables
2.3.1 Bio-Motor Abilities and Physical Characteristics of Football Players
2.3.2 Endurance and Aerobic Ability in Football
2.3.3 Impact of Resistance Training on Endurance
2.3.4 Speed and Sprinting among Football Players

2.3.5 Explosive Power in Football
2.3.6 Strength in Football
2.3.7 Agility in Football
2.3.8 Flexibility in Football
2.4. Motor and Physical Profiles of Different Playing Positions in Football
2.5 Resistance Training Programme
2.5.1 Frequency of Training Programme
2.5.2 Duration of Training Programme
2.5.3 Intensity of Training Programme
2.5.4 Repetitions of Training Programme
2.5.5 Sets of Resistance Training Programme
2.6 Summary

2.2 Football as a Multi-factorial Sport

Coutts & Abt (2008), established that field-based team sport requires participants to be able to cover large distances of between 8 and 12 km, as well as regularly reproduce maximal or near-maximal sprints over the course of a match (60-120 min). Football players have to adapt to the physical demands of the game, which are multi-factorial (Gil, Gil, Ruiz, Irazusta and Irazusta 2007).

According to Gil *et al*., (2007), some of these factors are easily measurable which includes running speed, aerobic and jumping abilities, while technical, tactical and psychological skills are not so easy to determine (Morris, 2000). Optimal aerobic fitness is a prerequisite for elite football players (Mcmillan, Helgerud, Macdonal and Hoff, 2009).

Stolen, Chamari, Castagna and Wisloff (2010), reported that majority of high-intensity bursts of activities during a football match are primarily anaerobic in nature, the importance of aerobic fitness cannot be underestimated.

Helgerud, Engen, Wisloff and Hoff (2010), reported that high-intensity aerobic running sessions twice a week performed over 8 weeks, improved the players' aerobic fitness by 11 % compared to a control group who only performed football-specific drills. It was also found that these players showed a 20% increase in total distance covered during competitive match play, 23% increase in involvements with the ball and a 100% increase in the number of sprints performed by each player (McMillan *et al*., 2009). In line with this, Helgerud *et al*. (2010), Helgerud, Kemi and Hoff (2013) and McMillan *et al*. (2009), reported that it is possible to elevate VO_2max of college football players from typical values (for example 58-64 ml·kg-1·min-1) to levels approaching or exceeding 70 ml·kg-1·min-1 without hindering power related performance. Other match analysis results from Helgerud *et al*., (2010), reported that increased aerobic fitness also has additional benefits such as increased work intensity during a game; prevention of a second-half reduction in performance during a game; doubling the number of sprints completed in a game; allowing players to be involved in more 'decisive' plays; and allowing players to cover a greater distance during a game.

Several match analysis studies from a variety of team sports have shown that improved sprint performance and ability to repeat efforts at high intensity are associated with playing at higher competitive levels (Rampinini, Coutts, Castagna, Sassi, and Impellizzeri, 2007; Sirotic, Coutts, Knowles and Catterick, 2009). According to Stolen *et al*., (2010), the average work intensity, measured as percentage of maximal heart rate (HR max), during a 90-min football match is close to the anaerobic threshold (the highest exercise intensity where the production and removal of lactate is equal; normally between 80-90% of HR max in football players), and it would be physiologically impossible to keep a higher average intensity over a longer period of time due to the resultant accumulation of blood lactate. Velocity, agility and power are regarded

as some of the most important characteristics of attackers during a football match, although goalkeepers should also be fast and agile, even though their sprinting distance has been reported by Bangsbo, Mohr, Poulsen, Perez-Gomez and Krustrup (2008), to be between only 1-12 meters long.

2.3 Bio Motor Ability Variables

Das, Subramaniam and Paul (2014), investigated the fact about the influence of complex training with core exercise programme on agility among soccer players. To achieve the purpose of the study the researcher had selected sixty intercollegiate Soccer players at random and divided them into four equal groups namely experimental group 'A' underwent complex training (CTG), experimental group 'B' underwent core exercise programme (CEPG), experimental group 'C' underwent complex training with core exercise programme (CTCEPG) and control group (CG) did not participated in any of the training programme other than their regular activities. The result of the study revealed after the completion of twelve weeks of training period that the CTG, CEPG and CTCEPG were significantly improved in agility when compared with control group at 0.05 level of confidence interval.

Manjo, Rebelo, Abrantes and Sampaio (2010), conducted a study that the short-term effect of complex and contrast training on vertical jump, sprint and agility among elite Soccer players. To achieve the purpose of study twenty three (23) elite Portuesses soccer player were selected at random (age ranged from 17.6 ± 0.6 years). The selected subject were divided into two experimental group (G1 n = 9 and G2 n = 8) and one control group (G3 n = 6). The G1 and G2 groups have done their regular soccer training along with a six-week strength training programme. The load was increased by 5% from 1 repetition maximum each two weeks. The

result of the study showed reduction in sprint times ($P < 0.05$) and increased on squat and jump ($P < 0.05$) in favour of G1 and G2.

Shaikh & Mallick (2012), did study on the effect of plyometric training and weight training on selected motor ability components among University male students. For the purpose of the study the investigator selected sixty male students at random from different colleges and their age between 19-25 years. The selected subjects were divided into three groups. Experimental group one underwent weight training programme (WTG), Experimental group two underwent Plyometric training (PTG) and control group (CG) did not participated in any of the training programme. After the completion of eight-week training programme the investigator found that the experimental group significantly improved in speed, explosive power, muscular endurance and agility when compared with control group at 0.05 level of confidence.

Johnson, Burns and Azevedo (2013), investigated the effect of specific two types of exercise sequence in resistance training on strength, speed and agility in high school football players. Thirty nine adolescent football players were selected at random. Manipulating training programme, the result of the study clearly showed that both traditional resistance method (TRAD) and circuit resistance method (CIRC) significantly improved strength, speed and agility after the end of resistance training exercise sequence protocol.

Arazi, Coetzee and Asadi (2012), conducted a study comparative effect of land and aquatic-based plyometric training on jumping ability and agility of young basketball players. To achieve the goal of the study eighteen young basketball players (age 18.81 ± 1.46 years) were randomly assigned to aquatic plyometric training (AP), land Plyometric training (LP) and control group (CG). The training was for a period of eight weeks. After the 8-weeks of training period the study showed the significant improvement in post-test of the experimental group when

compared with the pre-test at ($P < 0.05$), whereas control group showed no significant differences between pre-test and post-test in jumping performance and agility.

Abdi & Sadeshi (2012), in their study reported on the effect of eight week core stability training programme on the dynamic balance. To achieve the view of the study within limitation and delimitation of the study the investigator selected 15 football players, 19 to 24 years in FC Tehran Damash with mean age 21.10 ± 1.25 years, height 179.53 ± 6.83, weight 71.80 ± 7.42 kg, body mass index (BMI) 22.23 ± 1.27 kg/m^2 and a maximum vertical Jump was 51.66 ± 5.58 cm. The result of the study indicated a high level significant progress in dynamic balance after the 8-weeks of core stability training programme at 0.05 level of confidence interval.

Mohammadi, Alizedeh and Gaieni (2012), studied the effect of balancing and resistive selected exercise on young footballers dynamic balance. To achieve the vision of this study, the investigator selected 36 young footballers (age 18.22 ± 0.83, height 173 ± 5.73 cm, weight 62.1 ± 6.88) participated and divided randomly in three groups of experimental 1 (resistive), experimental 2 (balancing) and control group. Descriptive statistic, ANOVA and Tukey's post-hoc test in significant level of ($P < 0.05$) were utilized for statistical analysis. The result of the study confirmed that experimental treatment had significant influence on dynamic balance of experimental groups.

Gregory, Kevin, Jensen and Timothy (2006), conducted a study to examine the effect of plyometric vs dynamic stabilization and balance training programme on power, balance and landing force in female athletes. To test the plane the sports scientist selected 19 female athletes from a Cincinnati area high school participated in this study. All the subjects were randomized into two groups. One group performed a protocol that involved maximum effort plyometric training (PLYO), while the second group performed a protocol that focus on dynamic

stabilization balance training (BAL). The result of the study indicated that both PLYO and BAL training are effective at increasing measure of neuromuscular power and control.

Khodabakshi, Javaheri, Zandi and Khanzadeh (2012), focused mainly on the study to find out the impact of six weeks strength exercises on static and dynamic balance of young male athletes. To test the hypothesis of the study, the investigators selected thirty 15-17 young male athletes with mean and SD (62.79 ± 3.62 kg - 171.1 ± 4.46 cm) and were divided into two groups 15 subjects for each group. They used SEBT and Romberg adjusted balance test before and after the exercise programme. The result of the study revealed a significant increase in static and dynamic balance in the group (P=0.001).

Kagitha & Kumar (2013), evaluated the effect of complex training with yogic practices on selected motor fitness variables and playing ability among Kabaddi men players. To achieve the desire of the project the investigator selected 60 Kabaddi players at random as a subject and were divided into three group's equally, namely: Complex training (CTG), complex training with yogic practices (CTYPG) and control group (CG). After the twelve (12) weeks of training period the result of the study found positive improvement on speed, agility, flexibility, explosive power, muscular endurance, coordination and playing ability in case of CTG and CTYPG when compared with CG at 0.05 level of confidence.

Ozer, Duzugum, Baltacis, Karacan and Colakoglu (2011), examined the effect of rope or weight rope jump training on strength, coordination and proprioception in adolescent female Volley ball players. To test the objective of the study, the investigators divided the selected subject into three groups namely: weight rope training group (WRTG) [n=9, 15 ± 1 years], rope training group (RTG) [n = 9, 14.1 ± 1.3 years], and control group (CG) [n = 9, 14.1 ± 1.3 years]. After the completion of twelve (12) weeks of exercise period, the investigator found significant

improvement in strength, motor coordination and proprioception among WRTG and RTG ($P < 0.05$).

Ozer, Duzqun, Baltaci, Karacan and Colakoque (2012), conducted a study effect of calisthenics and pilates exercises on coordination and proprioception in adult women. To achieve the target of the study the investigator selected healthy sedentary female participants age 25-50 years at random and divided in to three groups namely calisthenics exercise group (n = 34, mean age ± SD; 40 ± 8 years, BMI 31.04 ± 41.83 kg/m^2, a Pilates exercise group (n = 32, mean age ± SD 37 ± 8 years, BMI 31.04 ± 4.83 kg/m^2) and control group (n = 41, 41 ± 7 years, BMI 27.09 ± 4.77 kg/m^2). The result of the study determined that the coordination was significantly improved due to the influence of calisthenics exercise and pilates exercise ($P < 0.05$).

Bhayani & Singaravelan (2012), investigated the beneficial effectiveness of core stability training on improving task specific physical activity in developmental coordination disorder children. Thirty subjects participated [14 female and 13 males] aged 6 to 16 years with clinical diagnosis of developmental coordination disorder. After the six weeks of training programme, the result of the study indicated that the core stability training programme improves coordination, strength, balance, speed and also improve the task specific physical activity.

Santos & Janeria (2008), evaluated the effect of complex training on explosive strength in adolescent male basketball players. For the purpose of evaluation the investigator selected 25 young male athletes, age 14-15 years old and divided into two groups namely experimental group [EG ; n = 15], Control group [CG ;n = 10]. After the completion of 10 weeks of season training programme, the investigator explored that the EG significantly improved in squat Jump [SJ], counter movement jump [CMJ], Abalakov test [ABA], depth jump [DJ], mechanical power [MP] and medicine ball throw [MBT] ($P < 0.05$), whereas CG significantly decreased the values

($P < 0.05$) of CMJ, ABA and MP. Hence the investigator suggested that the Complex training improves the upper and lower body explosivity levels in young basketball players.

Rajamohon, Kanagasabi, Krishnaswamy and Balakrishnan (2010), conducted an investigation to determine the effect of complex and contrast resistance plyometric training on selected strength and power parameters. For these purpose the investigator selected 30 young male athletes, age 19-21 years. They were grouped into two 15 subject each group. Group 1 served as complex training and Group 2 served as contrast training. Hence, their result reported that complex training and contrast training significantly improve the strength and power parameters at 0.05 level of confidence.

Shinkle, Nesser, Demchak and Mcmannus (2012), considered that the development of core strength may transfer forces from the lower to the upper extremities. The development highlighted through the investigation to know the effect of core strength on the measure of power in the extremities. To run the study the investigator selected 25 football players performed medicine ball throw in static and dynamic position. Thus the result of the study indicated that the core strength does have a significant effect on an athlete's ability to create and transfer force.

Sadeghi, Nik, Darchini and Mohammadi (2013), investigated the effect of six-week plyometric and core stability exercises on performance of male athletes aged 11-14. For the above statement of the problem, the researcher selected 36 male athletes (11-14 years' old) participated in the semi-experimental study. They randomly divided into three groups namely core stability exercise group [CSEG: n = 12], plyometric exercise group [PEG: n=12] and control group [CG: n = 12]. Therefore, the result of the study revealed after the expiry of training period that the CSEG and PEG on standing broad jump, vertical jump, sprint, shuttle run, sit medicine ball toss test and sit and reach are significantly ($P < 0.05$) improved than the pretest.

Kwang-Jun Kim (2010), evaluated the effect of 12 weeks combined training in core muscle strengthening on the flexibility, muscular strength and driver shot performance of the core body parts of the female professional golfers. Subject was divided into two groups (of whom 9 belong to the training and 8 belonged to the control group). The result of the study determined that the 12 weeks of combined core muscle training had positive effects on flexibility and strength of core muscles. Moreover it was effective in enhancing driver shot performance in female professional golfer.

Andrejic (2010), investigated the effect of two short-term off season conditioning training programme on fitness performance in young basketball players. To move forward for achieving the objective of the above problem the investigator selected 21 young basketball players, aged 12-13 years, volunteered to participate in this study. The selected participant were randomly assigned to a strength training group (ST, n=10) or a combined Plyometric and strength training group (CT, n=11). Young basketball player were tested before and after a six weeks training period. Result of the study observed that the ST and CT have greater improvement in posttest of vertical jump, long jump, medicine ball toss, sprint, start running and stand and reach flexibility than pretest ($P < 0.05$).

Chandralekha & Jothi (2013), conducted a study related to the influence of swiss ball training on selected physical fitness variables among football players. To conduct the study, the researcher had selected 20 male footballers [aged 18 to 25 years] as experimental group. Experimental group underwent 8 weeks of Swiss ball exercises training program. The finding of the study showed that the experimental group post-test is significantly improved than pre-test in abdominal muscular strength and flexibility at 0.05 level of confidence.

Azeem & Ameer (2010), conducted a study related to the effect of weight training on sprinting performance flexibility and strength. The researchers had selected 20 students. A 45 minutes weight training [WT] schedule twice a week for 12 weeks was administered. The study had enlighten that WT improved strength, speed and flexibility from pre-test to post-test [$P < 0.05$]. Manickam & Muthukumar (2013), conducted a study on isolated plyometric training and weight training on leg strength and explosive power. For their intention they selected subject age ranged from 17 to 22 years. They were divided into three groups each group consist of 15 subjects, in which group I underwent plyometric training [PTG], group II underwent combination of plyometric and weight training [PWTG] and group III act as control group. The training period fixed for three days in a week for twelve weeks. The result of the study showed that the PTG and PWTG were significantly improved on selected criterion variables such as leg strength and explosive power, when compared with control group at 0.05 level.

Inqle, Sleap and Tolfrey (2006), conducted a study related to the effect of a complex training and detraining programme on selected strength and power variables in early pubertal boys. To achieve the purpose of the study 54 male participated for their study aged 12.3 ±0.3 years, height 1.57± 0.07 m, body mass 50.3±11.0 kg. Participants were randomly assigned to an experimental group [EG: n=33] or control group [CG: n=21]. The training was given for 3 times for twelve (12) weeks. After training the participants completed 12 weeks of detraining. Whereas the result of the study revealed after the completion of training period, improvement in anaerobic power, jumping, throwing, sprinting performance and improvement in dynamic strength due to the effect of complex training in EG group [$P < 0.05$]. However after the detraining, complex training lost similar rates to the other modalities.

Sankarmani, Ibrahim, Rajeev and Jagathesan (2012), investigated the effectiveness of plyometric and weight training in anaerobic power and muscles strength in female athletes. To conduct the study the investigator selected forty intercollegiate athletes and assigned to two training groups randomly: Plyometric weight training [PWT] and weight training [WT]. PWT and WT completed 6 weeks of training program. The result of the study out comes with that PWT and WT is more effective in improving vertical jump, 50 yard dash and 1 RM squat performance in athletes than the WT alone.

Yaoo & Lee (2012), investigated the effect of core stabilisation exercise using a sling on pain and muscles strength of patients with chronic back pain. To achieve the above statement the researcher selected 30 chronic low-back pain patients. They were divided randomly into two exercise groups. One group under gone for core stabilization exercises using sling (n=15) and the other group undergone for mat exercise group (n=15). The exercise programme performed 3 days per week for 4 week. The result of the study determined that the sling exercise programme and mat exercise programme reduced chronic low back pain and improved muscle strength.

Sekendiz, Cuq and Korkusuz (2010), conducted a study on the effect of Swiss ball core strengthen on strength, endurance flexibility and balance in sedentary women [n = 21; age 34 ± 8.09; height 1.63 ± 6.91 cm; weight 64 ± 8.69 kg] trained for 45 minutes, 3 days weeks for 12 weeks. The result of the study showed the fact that the swiss ball core strengthen exercise significantly improved muscular strength, muscular endurance, flexibility and balance.

Shahidi, Mahmodlu, Kandi and Loti (2012) examined the effect of two resistance training types on muscles fitness and anaerobic capacity in 16-18 years old soccer players. The research was quasi experimental. Thirty soccer players were selected as samples. The selected samples were divided into three groups, two experimental group [EG] and one control group [CG]. The

EG ‘A’ 17.19 ± 0.73 years, 59.49 ± 9.82 kg, 171.50 ± 6.93; EG ‘B’ 17.10 ± 0.55 years, 56.32 ± 6.75 kg, 172.10 ± 6.13 cm; CG 17.40 ± 0.42 years, 52.64 ± 4.41 kg, 170.10 ± 6.93. The EG performed the selected exercises along with technical soccer exercise, while CG only performed technical soccer exercises for 8 weeks. The result of the study shows that the EG ‘A’ and EG ‘B’ resistance training is probably effective for improving lower body explosive power, lower body muscles endurance, running speed, maximum lower body strength and abdominal muscles endurance.

Tan (2010), focused on the study of the role of resistance training in distance running. After the reviewing the articles on resistance training, the investigators explore that the resistance training improve VO_2 max, lactate threshold and running economy. Running economy shown to improve significantly post resistance training possible due to neuromuscular changes including a shortening of the stretch-shortening cycle and an increase in muscles stiffness.

Patra & Kumar (2013), studied the effect of core stabilization training on endurance of trunk extensor and functional capacity in subjects with low back pain. A total of 30 subjects [male: 14, female: 16] were divided into two groups. Group ‘A’ core stabilisation and endurance training [CSETG] and group ‘B’ endurance training [ETG]. The total duration of protocol was six weeks and frequency of exercise performed was three times a week. Therefore the study reported that the CSETG and ETG recorded significant improvement when the comparison with [P = 0.01] the groups for both trunk extensor endurance test and functional capacity, was made.

Ilyararay & Sakthigananvel (2013), conducted a study related to the effect of combination of speed and plyometric training on speed and agility. To achieve the purpose of the study, the investigator selected 30 healthy male hand ball players with age of 19 to 23 years were randomly allocated into a combination of speed and plyometric training. The selected subject

were divided into two groups of 15 each group namely experimental group I and control group II. The finding of the study revealed that there is beneficial effect on speed and agility for experimental group when compared with control group at 0.05 level of confidence.

Balaji & Murugavel (2013), investigated the motor fitness parameters responses to Core strength training [CST] on hand ball players. Experimental group [EG: age 18-25 years, n=15] and Control group [CG: 18-25 years, n=15]. EG was given training for the period of eight weeks CST. The result of the investigation confirmed that CST significantly improved the speed, agility and upper body strength.

Markovic, Jukic, Milanovic, and Metikos (2007), conducted a study to determine the effect of sprint and plyometirc training on muscles function and athletic performance. To induce the training programme the investigator selected male physical education student and assigned them randomly Sprint group [SG; n=30], Plyometric training group [PG; n=30] and Control group [CG; n=33]. The selected variables were measured prior to and after 10 weeks of training. Both SG and PG were trained 3 days a week. Whereas the result of the study observed that both SG and PG significantly improved maximal isometric squat strength, squat and counter movement jump height and power, drop jump performance from 30-cm height and three athletic performance test standing broad jump, 20 m sprint and 20 yard shuttle run.

Kotzamanidis, Chatzopoulos, Michailidis, Papaiakovou and Patikas (2005), investigated the effect of a combined high intensity strength and speed training program on the running and jumping ability of Soccer players. They selected 35 individuals and divided into three groups. The first group [COM group, n=12] performed a combined resistance and speed training programme, Second group [n=11, STR group] performed the same resistance training without speed training. The third group was the control group [n=12, CON]. The result of the study

shows that COM group performed significantly better than STR and CON groups in 30m dash, squat Jump and counter movement jump.

2.3.1 Biomotor Abilities and Physical Characteristics of Football Players

Effective movements in almost all the sports depend on the biomotor abilities of the individual athletes. Biomotor abilities are involve in all the sporting activities including soccer. In fact it determines the level of performance in any sports. In all the sports, combination of three major bio motor abilities components such as speed, strength and endurance, lead to various result in sports. The cooperation of biomotor abilities components to reach high and perfect performance level in sports (Bompa & Carrea, 2005).

Pufaa (2006), stated that motor means muscles being able to produce movement. Motor unit is a family of nerves and muscles that brings about a body movement. Motor ability is motor skill. A skill is the ability to do some things expertly and well. Motor ability is the ability to perform movement well and expertly. Motor ability if well develop can enhance the ability of the athlete to perform well.

Thompson (2009), stated that the sports training programme use exercise or practice to develop the qualities required for events. He recommended the five basic biomotor abilities: strength, endurance, speed, flexibility and coordination.

> *"When the load of an exercise is maximal it is a strength exercise, If the distance of duration or duration is maximum the exercise becomes endurance, Quickness and frequency of movement would give a speed exercise, Exercises that have relatively complex movement are called coordination".*

Orlando (2009), concluded in his literature after review of many literature and exclusive interview the knowledge of bio motor abilities and use of bio motor abilities in the development

of athletes in their perfect sports performance. Bio motor abilities play an important role in the development of athletics and perform at high level. The result of the study also indicated that the development of biomotor abilities had a positive effect on the extent athlete can perform. Biomotor abilities are very important in sports, without development of biomotor abilities one cannot improve any sports performance. In that way, to develop motor qualities like strength, speed, endurance, flexibility, power, agility and coordination abilities, the resistance training method shows how much influence it has on the development of the above qualities.

Aerobic metabolism dominates the endurance delivery during a football game; however, the most decisive actions are covered by means of anaerobic metabolism (Stolen *et al*., 2010). Muscle strength, power and speed are important physiological characteristics of football players in order to perform sprinting, jumping, tackling and kicking in a football game (Reilly *et al*., 2000; Cometti *et al*., 2001; Gissis *et al*., 2006). Cometti *et al*., (2001) and Stolen *et al*. (2010) acknowledged that in order to perform these kinds of activities, maximal strength and anaerobic power is important, particularly in the lower limbs. Football thus requires superior levels of both aerobic and anaerobic fitness. However, Arnason *et al*., (2004) did not find any relationship between team success and team averages for peak oxygen uptake, height, weight, BMI and flexibility.

2.3.2 Endurance and Aerobic Ability in Football

Cook (2009), explains that muscular endurance and muscular strength work together to produce quality performance and cannot be trained in isolated. Since the football is an anaerobic sport, which requires short and powerful bursts of power and period of short recovery. Football player must have both strength and endurance to resist fatigue, avoid injury and last longer in the game.

Endurance is the ability to perform many repetitions with a sub maximal resistance over a given period of time. Muscular endurance are of two (2) types;

[i] Dynamic muscular endurance means muscle ability to contract and relax repeatedly

[ii] Static muscular endurance means muscles ability to remain contracting for a long period.

The best method for developing endurance is repetition effort or [RE]. Endurance test based on number of repetition are performed with sub-maximal load i.e. repetition of push-ups,sit-ups or abdominal curls. Short duration endurance training increases strength and at the same time increases the ability of athletes to endure against a relatively high resistance. The number of repetition in short duration training is 15 to 25times (Rahamani-Nia 2008 &Wong, et al., 2010).

The aerobic system makes the most significant contribution to energy delivery during team-sport play (Coutts and Abt, 2005). Reports by Helgerud, Engen, Wisloff, and Hoff, (2010) and Kalapotharakos *et al*. (2006) showed that football teams with more aerobically fit players tended to be placed higher in the league positional ranking. Elite-level football players run about 10 km during a 90-minute game, at an average intensity close to the anaerobic threshold (80-90% of maximal heart rate) (Stolen *et al*., 2010). Similar results (mean distance of 10.1 km) have been reported by Hill-Haas, Dowson, Coutts, and Rowsell, (2010). Differences in game style and match intensity among countries should, however, be taken into consideration. Reports by De Prof, Cabri, Dufour and Clarys (2013) indicated that South American international football players cover significantly less total distance during a match (8638 m) than English premier league players (10104 m) and elite Danish players (10800 m). Maximal oxygen uptake (VO_2 max) is defined as the maximum amount of oxygen that the body consumes per minute during endurance exercise (Coutts & Abt, 2005). According to Stolen *et al*., (2010), the VO_2 max of adult male out-field football players varies from 50-75 $ml \cdot kg^{-1} \cdot min^{-1}$, while goalkeepers have a

VO_2max of 50-55 ml·kg^{-1}·min^{-1}. Junior football players generally have lower VO_2max values than senior football players (<60 ml·kg^{-1}·min^{-1}), there are, however, exceptions (Stolen *et al*., 2010). Helgerud, *et al*., (2010), found a VO_2 max of 64.3 ml·kg-1·min-1 in junior football players and the under-18 national football team of Hungary had an average value of 73.9 ml·kg^{-1}·min^{-1}.

Bradley (2015), noted that players registered for the S-league (a league established in 1996, which is the top professional football division in Singapore and which typically spans for 10 months), produced VO_2 max scores on the 20 m multi-stage shuttle run test of 54.8 ml·kg-1·min^{-1}, 56.8 ml·kg^{-1}·min^{-1} and 57.6 ml·kg^{-1}·min^{-1} respectively in the 2002, 2003 and 2004 season (range across all three seasons were 52.2 to 60.8 ml·kg^{-1}·min^{-1}). Results indicate that the S-league football players' aerobic fitness generally falls within the range of mean values reported for professional football players (Kalapotharakos *et al*., 2006; Reilly & Williams, 2005) but are considerably lower in comparison to top-league professionals and world-class football players (Reilly *et al*., 2000; Stolen *et al*., 2010).

A study conducted by Stroyer, Hansen and Klausen (2004), showed that elite football players who are early developers had higher VO_2 max related to body mass than non-elite players, and elite players at the end of puberty showed higher absolute VO_2max values during match play than young elite players, but identical relative aerobic loads. Stroyer, Hansen and Hansen (2004) also reported that the frequency of standing activity was significantly higher among non-elite youth players compared with elite youth players.

According to Gil *et al*., (2007), age-related changes were reported in absolute VO_2 max and relative VO_2 max among youth boys, with both parameters increasing with the age of the boys. It was furthermore added that selected football players of the 14-year-old team had

significantly higher absolute VO_2 max and relative VO_2 max (3.36 $L \cdot min^{-1}$ and 56$ml \cdot kg^{-1} \cdot min^{-1}$) than those who were non-selected (2.84 $L \cdot min^{-1}$ and 48 $ml \cdot kg^{-1} \cdot min^{-1}$). However, no significant differences were found between selected and non-selected players of the other teams, aged 15 years (absolute VO_2 max: 3.81 $L \cdot min^{-1}$ and 3.85 L·min-; relative VO_2 max: 58 $ml \cdot kg^{-1}$·min-1and 57 $ml \cdot kg^{-1} \cdot min^{-1}$), 16 years (absolute VO_2 max: 3.88$L \cdot min^{-1}$ and 4.07 $L \cdot min^{-1}$; relative VO_2 max: 53 $ml \cdot kg^{-1}$·min-1and 57 $ml \cdot kg^{-1} \cdot min^{-1}$) and 17years (absolute VO_2 max: 4.86 $L \cdot min^{-1}$ and 4.36 $L \cdot min^{-1}$; relative VO_2 max: 62 $ml \cdot kg^{-1}$·min-1 and 57 $ml \cdot kg^{-1} \cdot min^{-1}$). Gil *et al*., (2007), also noted that selected players presented lower heart rates in the endurance run, with a larger difference during the recovery periods.

McMillan *et al*., (2009), carried out a similar study to that of Helgerud *et al*., (2001), by investigating the physiological adaptations to a 10 week high-intensity aerobic interval training programme performed by professional youth football players. Similar to the study of Helgerud *et al*. (2001), significant improvements in VO_2max of 9 % ($P < 0.001$) were noticed. This means that mean VO_2 max increased from 4.45 (0.37) to 4.87 (0.45) $l \cdot min^{-1}$, which equated to a change from 63.4 (5.6) $ml \cdot kg^{-1}$·min-1 to 69.8 (6.6) $ml \cdot kg^{-1} \cdot min^{-1}$.Considering all advantages of a high level of VO_2 max in football, it would be reasonable to expect about 70 $ml \cdot kg^{-1} \cdot min^{-1}$ (Stolen *et al*., 2005). In conclusion, enhancing aerobic fitness through aerobic training improves a player's football performance during match play (Helgerud *et al*., 2001). Le Gall *et al*., (2010), also showed that maximal sprint speed, maximal anaerobic power, peak torque and jumping capacity can discriminate across various age categories and/or playing positions between youth football players who are successful or not in achieving the highest standards of play.

The 12-minute run test is used in this study to assess the cardio-respiratory endurance (aerobic capacity) of Federal College of Education Kontagora male football players. Strauss

(2011), stated that cardio-respiratory endurance is the most vital means of determining a person's maximal oxygen consumption or uptake (VO_2 max). Maximal oxygen uptake, according to Verducci (2000), indicates how well various physiological functions of the body can be adjusted to increasing metabolic demands of work. VO_2 max determination through physical evaluation provides effective indication of football-specific and general endurance ability of athletes (Tonnessen *et al.*, 2013).

2.3.3 Impact of Resistance Training on Endurance

Recently, it has been shown that resistance training play an important role in endurance performance. As a result, some researchers (Gettman & Pollock, 2009) have theorized that resistance training may benefit endurance through distance run. Since resistance training is unlikely to elicit an aerobic stimulus of greater than 50% of VO_2 max, VO_2 max is thus not compromised when resistance training is added to an endurance programme (Gettman, Ayres, Pollock & Jackson, 2011). Research has also shown that the endurance of a footballer has shown improvements of up to 8% in running economy following a period of resistance training (Williams, 2006; Pereira & Gomes, 2003). They stated further that, however, if resistance training improves endurance in distance run (aerobic capacity), its largest impact will likely be on anaerobic capacity of footballers. A consideration of different modes of resistance exercise to determine endurance is thus necessary.

Resistance training involves high load, low repetition for muscular strength whereas, endurance training involves low load, high repetition (Gettman, Ayres, Pollock & Jackson, 2011). Explaining further, they said that, if this is done in conjunction with cross-training, it will improve maximal oxygen uptake (VO_2 max).

Many coaches and trainers have recently started to prescribe resistance training to develop endurance because of the ability of endurance training to perform low load high repetition principle of resistance training (Gettman, Ayres, Pollock & Jackson, 2011).

2.3.4 Speed and Sprinting among Football Players

Speed or lack of speed is directly responsible for loss or win of the Football game. Soccer speed in Germany defines as the ability to react to as stimulus in the least amount of time through cyclical or a cyclical movement with limited resistance (Thyron, 2009). Wilmore & Costill (2005), explain that characteristic of speed are significantly related to the football players performance and classify football speed into seven categories game action speed, action speed with ball, movement speed with ball, reaction speed, decision making speed, anticipation speed and perceptual speed. Just like with the power-strength confusion, some people tend to put an equality sign in between speed and agility. Whereas agility refers to quick reactions, speed refers to running at full throttle, on a longer distance. Actually, speed has two components: acceleration and top speed. Acceleration lasts from the moment you start the sprint, to a second or two before you can reach top speed. Indeed, agility plays a crucial role in acceleration, but has little to do with top speed. So, focusing on agility exercises may improve your acceleration, but your top speed is difficult to improve, since it is determined by a formula involving your lower body strength, natural constitution and running technique.

Sprint speed plays a potential role of being successful on the field of football game. Sprinting requires the ability to quickly accelerate (Bompa & Carrera, 2005). According to Baker & Nance (2009), speed and acceleration are important aspects in football game. According to Bompa & Carrea (2005), one of the most important biomotor abilities required in sports is speed

or move very quickly or capacity to travel. From the mechanical point of view speed is expressed through ratio between pace and time.

The speed included three (3) components;

[i] Reaction time

[ii] Frequency of movement per time unit

[iii] Speed travel over a given distance.

The ability to perform repeated sprints with minimal recovery between sprint bouts, termed repeated sprint ability is an important capacity for team sports athletes (Rampinini *et al*., 2007; Barbero Álvarez *et al*., 2010). The total duration of high-intensity exercise during a football match for elite male players is about 7 min, including about nineteen (19) sprints with a mean duration of 2s (Vaczi, *et al.*, 2013). Similar to these findings, Venturelli *et al*., (2008) showed that, in general, the frequency of sprinting in field-based team sports (for example, 70-90 min in sports such as football, hockey and rugby) is about 20-60 bouts per game, with a total sprint distance of approximately 700-1000 m.

According to Reilly, Bangsbo and Franks (2000), competitive match-play calls for an all-out sprint once every 90 seconds on average and high-intensity efforts every 30 seconds for each player. The study furthermore noted that the mean distance and duration of sprints during field-based team sports is quite consistent, being between 10-20 m and 2-3 s respectively. Willardson (2007), acknowledged that sprinting performance is significantly affected by muscle strength in the lower limbs. Studies have found that football players of a higher standard perform more high-intensity running than players of a lower standard during a football match (Krustrup *et al*., 2006). Gissis *et al*., (2006), observed higher maximum speeds among elite young football players than

in sub-elite and recreational young football players. The elite young football players ran faster over 10 m (1.95 s) than sub-elite (2.14 s) and recreational football players (2.21 s).

Cometti *et al*., (2001), also found that elite and sub-elite French football players ran faster over 10 m (1.804s and 1.818 s, respectively) than amateurs (1.859 s) ($P < 0.05$). There was no significant difference in the 30 m sprint time and in the maximal ball speed during shooting among the three groups (Cometti *et al*., 2001). Gil *et al*., (2007), investigated the difference in the 30 m sprint between selected and non-selected youth football players and found that selected 14-year old players ran faster in the 30 m dash with or without cones (5.08 s and 3.95 s compared to 5.25 s and 4.2 s, respectively). In the 15 and 16-year-old category, a significant difference was only found in the cone dash between selected (4.81 s and 4.75 s) and non-selected (4.99 s and 5.02 s) football players.

A study by Mohr, Krustrup and Bangsbo (2009), confirmed that sprint capacity was reduced at the start of the second half of a match compared with the first as a result of lowering of muscle temperature in the 15-min break. The study established that by performing a low-intensity re-warm up before the second half, the reduction in sprint capacity can be avoided, which can be of particular benefit to elite teams participating in important international competitions, but also for teams who want to optimise their sprinting performance in the first minutes of the second half (Stolen *et al*., 2010). Sprinting ability over distances of 5 to 30 m is vital and forms an integral part of successful performance (Watson, 2010). Speed ability among elite football players is very important and may be related to the capacity to avoid obstacles at high speed, which is an important quality in football games (Reilly *et al*., 2000).

2.3.5 Explosive Power in Football

Power is the function of force and velocity, and it can be defined as the rate of performing work. When express by the formula Power = force × Velocity or work done/time taken. Power is the capacity of the individual to bring into maximum muscular contraction at faster rate of speed (Young, James & Montgomery, 2002).

Explosive power is the ability of neuro-muscular system to overcome resistance with speed of contraction (Aagaard, 2003). The capacity of the leg to release maximum muscular force in the shortest times as in executing a vertical jump (Baumgartner, Jackson, Mahor & Rowe, 2007). Power is the product of strength and speed and refers to the ability of the neuromuscular system to produce the greatest possible impulse in a given time period (Stolen *et al*., 2010). Power can be referred to as one of three things in soccer: the power of your shots, the power of your headers and the power of your throws. Although strength does have an important role in determining these three attributes, you also need to have the right technique to make them work. So power is a combination between strength and technique. For example, when kicking a ball towards the goal, strength will work towards a more powerful shot if you have trained out your abs, lower back and leg muscles, but at the same time you will need to kick the ball perfectly if you want to achieve a truly powerful and accurate shot. As a tire commercial once put it – power is nothing without control.

According to Wisloff (2010), muscle strength of lower limbs is significantly associated with vertical jump height. Stolen *et al*., (2010), acknowledged that maximal strength is one basic quality that influences power performance. This is because an increase in maximal strength is usually connected with an improvement in relative strength and, therefore, improvement of power abilities. Different studies have shown that the leg power of football players measured

with vertical jumps is between 38 and 45 cm (Cometti *et al*., 2001). Various vertical jump heights have been reported by previous studies, up to 55 cm in English (Strudwick, Reilly & Doran, 2002) and Norway elite football players, whereas lower jump heights (39.5 cm) were observed in Icelandic elite football players, as noted by Arnason *et al*., (2004). In contrast to these studies, Docherty, Robbins & Hodgson, 2004) found that younger players have jumped shorter heights.

In the study performed by Arnason *et al*., (2004), a significant relationship was observed between the team average for jump height (counter-movement jump and standing jump) and team success (final league standing). Gissis *et al*., (2006), also found that the jumping ability of national-level football players is significantly higher than the ability of players at sub-elite and recreational levels. A study done by Reilly *et al*., (2000), has also shown significant differences in vertical jump height among football players of different competition levels. Interestingly, McMillan *et al*., (2009), noted that after a 10 week high-intensity aerobic training intervention, squat jump (SJ) increased from 37.7 (6.2) to 40.3 (6.1) cm and counter-movement jump (CMJ) increased from 52.0 (4) to 53.4 (4.2) cm, thus concluding that the addition of high-intensity interval training at 90-95 % HR max will have no negative interference effects on strength, jumping ability and sprint performance.

Cometti *et al*., (2001), noted that, when measured by means of the squat jump (SJ) and counter-movement jump (CMJ), elite players jumped higher (SJ = 38.48 cm; CMJ = 41.56) than second division players (SJ = 33.86 cm; CMJ = 39.71 cm), but the results were also higher in amateur players (SJ = 39.83 cm; CMJ = 43.93 cm) than division players ($P < 0.01$). Gil *et al*., (2007), however, reported different findings among youth players. The study established that there were no significant difference between selected and non selected players in the squat jump,

counter-movement jump and drop jump test. A correlation was found by Arnason *et al*., (2004), between jumping ability and leg extension power, indicating that speed and acceleration of movement are important qualities, which should be given priority in training. The standing broad jump measures the explosive leg power. This is important to vigorous performances (especially football) because it determines how hard a player can hit, how high he can jump when necessary and to some extent, how fast he can run (Johnson & Nelson, 2005). The standing broad jump is one of various acknowledged test items of AAHPERD (AAHPERD, 2010).

2.3.6 Strength in Football

Strength is a crucial factor in soccer, since it affects several abilities used during a match, such as jumping, shooting, dribbling, shielding, balance, tackling or marking. Actually, strength is probably the only conditioning key component that is useful in the same measure for all players, regardless of their position on the pitch (Reilly & Doran, 2009). Shielding is often confused with power, but as can be seen below there's a difference between the two. Strength system is the greatest force the neuro-muscular system is capable of exerting in a single maximum voluntary contraction. It denotes performance in those events where great resistance has to overcome (Michailidis, Fatouros, Primpa, Michalididis and Avloniti, 2013).

Muscular strength is the component of both healths related and sports related physical activity. Muscular strength means ability of a muscle group to develop maximal contractile force against a resistance in a single contraction. Muscular strength are classify into two types;

[i] Static or isometric, which involves no changes in muscle length

[ii] Dynamic muscular strength involves either eccentric or concentric action (Heyward, 2010).

Muscular strength is assessing by one repetition maximum (maximum amount of resistance you can overcome one time). The 1RM test is usually conducted on resistance

machine. Strength can also be measure by using dynamometer. Muscular strength is important for maintain a players balance on a slippery pitch and in ball control. When resistance training added to the normal soccer training programme it improves both muscular strength and kick performance (Reilly & Doran, 2009). During the football game muscular strength is essential because each player perform dynamic movement such as sprinting, throw in, kicking, tackling and heading. So power, endurance and strength are needed to compete in the football game (Bangsbo *et al.*, 2008). According to Le Gall *et al.,* (2006) majority of the football player's injuries occur in the lower extremities. Croisier *et al.,* (2008) suggested that the development of strength symmetry and balance ratio in the function of knee flexors and extensors may reduce the incidence rate of Soccer injuries.

Explosive strength is the ability to exert a maximal amount of force in the shortest possible time interval such as a football player exploding off the line like a sprinter forcefully driving off the starting blocks. Explosive power results from explosive strength (Power [P] = Force [F] X Velocity [V]). Football players enjoy the use of explosive power (Alikhajeh, Mohamadi, Yaghoubi and Rasekhi, 2012). Explosive power is required for many vital skills in soccer such as striding, turning, kicking, sprinting and Jumping (Bangsbo *et al.,* 2008). Power is the ability to exert force at higher speeds. Power is the product of force exert on an object in the direction in which force exerted (Baldock, 2008). Power is the combination of strength and speed. Dynamic strength coupled with movement speed. Speed is the ability to apply force rapidly (Pereira & Gomes, 2003).

Stolen *et al.,* (2010), consider power the ability to produce as much force within the quickest period of time, to be as important as strength and endurance in Soccer performance. Hunter (2009), found a significant relationship between power and Soccer performance.

According to Mujika, Santisteban, Impellizzeri and Castagna (2009), explosive lower body muscular power and sprint speed are two high intensity, interrelated, physiological capacities which contribute to soccer performance.

Stolen *et al*., (2010), defined maximal strength as the highest force that can be performed by the neuromuscular system during one maximum voluntary contraction (one repetition maximum- 1RM). According to Meylan & Malatesta (2009), strength is related to factors including serum testosterone and body size and is largely modifiable through well-implemented training interventions. Muscle strength is an important factor for football players in order to perform effective kicks, tackles, jumps and sprints (Kalapotharakos *et al*., 2006).

Gissis *et al*., (2006) found that, amongst three categories of Greek football players, elite young (16 years) football players can be distinguished from sub-elite and recreational young football players in strength and speed characteristics. The findings suggested that elite young football players presented higher maximal isometric force, force at 100 ms, vertical jump height, maximum 40 apaciti rate, and 10 m sprint time than sub-elite and recreational young football players. Gissis *et al*., (2006), further added that the jumping ability (measured by means of the squat jump test) and speed (measured through a 10-m sprint time) of elite level football players (23.6 cm and 1.95 s) are significantly higher than the ability of football players of both sub-elite (21.4 cm and 2.14 s) and recreational levels (20.3 cm and 2.21s), respectively.

According to Kalapotharakos *et al*., (2006), an elite Greek football team also showed similar results and presented significantly higher peak muscle torque of knee extensors for both legs in comparison to the middle and last ranked team in the Greek league, amongst who no significant differences were observed. Cometti *et al*., (2001), did not find a correlation between maximal strength and anaerobic power performance, but mentioned that professional football

players differ from amateurs in terms of knee flexor muscle strength and short-distance sprinting speed. The findings of Kalapotharakos *et al*., (2006), proved similar to those of Reilly *et al*. (2000), in the sense that the best professional football team from the Greek league yielded similar peak torque of knee extensors at 1.05 rad/s such as the top class Danish football players. Muscle strength is not an entire body characteristic but is dependent on the ability and trainability of specific body segments to perform the desired movement (Meylan & Malatesta, 2009). According to Helgerud, Engen, Wisloff, & Hoff (2010), it would be reasonable to expect, for a 75-kg male football player, 1RM squat-values > 200 kg, and value for Bench Press being 100 kg. However, Cometti *et al*., (2001), reported 1RM Bench Press values of 65 kg for elite male football players, compared to 82 kg for elite male football players.

The sit-up test measures the dynamic strength of the abdominal and hip flexor muscles. The trunk muscle strength is one factor affecting the motor control of the trunk which plays an important role in the physical performance of a football player. The sit-up test helps maintain good posture and minimize spine, hips and other lower back problems (NSCA, 2011).

2.3.7 Agility in Football

Agility is usually achieved when a person is using their anaerobic power. The ability to change direction and react to different stimuli is a requisite of many sports, particularly team and racket sports (Young, McDowell and Scarlett, 2008). Sporis, Milanovic, Jukic, Omrcen & Molinuevo (2010) had concluded that well known training methods such as resistance and plyometric training are of importance to athletes striving to achieve a high level of explosive leg power and dynamic athletic performance. Bangsbo (2008), observed also that during a soccer match, players frequently performs an activity that requires rapid development of force, such as sprinting or quickly changing direction. Sporiset *et al.,* (2010), in their study, had shown that

basic skills without the ball have much stronger relation among speed, agility and quickness than the skills with the ball.

Agility is the ability to start, stop, and change speed and direction quickly and with precision and is thus dependent on muscle strength, speed, endurance, balance and movement skills (Sheppard & Young, 2006). Although straight sprinting speed is considered an important quality, the ability to perform rapid whole-body movement with change of velocity or direction in response to a stimulus remains a fundamental component in performance (Benvenuti *et al*., 2010). Agility can help football players on several levels. Goalkeepers will have better reflexes and will be able to get to high balls quicker if they are more agile. Defenders will be harder to dribble and their tackles will be more accurate and clean with the right level of agility. Mid-fielders can dribble with ease if they are agile and strikers work well around their quickness in order to get in front of the defenders and finish on crosses, or dribble their way to goal when possible.

According to Little & Williams (2005), developing agility will provide a strong foundation for motor skill function and reduce the risk of injury. Results from the President's Council on Physical Fitness and Sports (1985), as quoted by Wilmore & Costill (2004), showed a steady increase in performance of the agility run test between the ages of 6 and 18 years. However, the dearth of research on maturation and agility prohibit definite statements on this relationship (Meylan & Malatesta, 2009). According to Ferrigno & Brown (2005), agility exercises between the ages of 9-13 years should not yet include sharp changes in direction, but rather consist of rounded patterns. Ferrigno & Brown (2005), further mentioned that performing sharp changes indirection at high running speeds will prevent appropriate execution of a drill especially during the early developmental stages. During the pubertal growth spurt alterations in

body size, structure, and weight will significantly influence coordination, which is why many of the movement skills that have already been developed should be re-perfected (Haff & Nimphius, 2012). During later teenage years (17+ years) more complexity and specificity are the focus, with sport-specific drills being utilized regularly during training (Haff & Nimphius, 2012).

Ferrigno & Brown (2005), maintained that team sport players are challenged to unknown match situations, which is why agility tests that separate the cognitive skills from the motor elements of performance could be counterproductive. The development of field tests combining cognitive tasks with football specific movement patterns and technical actions are strongly needed (Benvenuti *et al*., 2010).

The AAHPERD 20 meter shuttle run test has been used to measure the agility of players for running and changing direction and a reliability co-efficient of 0.94 for boys and 0.82 for girls were obtained (AAHPERD, 2010). It involves the participants running and swiftly changing direction.

2.3.8 Flexibility among Football Players

Flexibility is a terminology that means range of motion (ROM) in the joints. Musclo-tendenous unit length and musculo-tendenous unit flexibility is a range of motion available in a joint, or in a group of joints that is influenced by muscles, tendons and bones (Witvrouw, Asselam, D'Have and Camber, (2003). According to sports fitness advisor on flexibility of the body's muscles and joints, flexibility play an integral part in many athletic movements or during football game. Flexibility is of three types;

[i] Dynamic flexibility: ability to perform dynamic movement within joint i.e. kicking an imaginary ball.

[ii] Static active flexibility: ability to stretch an antagonist muscle using only the tension in the agonist muscles.

[iii] Static passive flexibility: ability to hold the stretch using weight or some external forces.

Witvrouw *et al*., (2003), in their study, found the result after analysis of literature in soccer player with hamstring muscles flexibility, less than 90% have significantly higher risk for injury. Engebretsen, Holme, Engebretsen and Bahr (2010) found after multivariate analysis, a history of acute hamstring injury was found to be significant risk factor among soccer player. Laia, Rampini and Bangsbo (2009), suggested that by joint range of motion, performance may be enhanced and risk of injury reduce.

Flexibility is an important component of fitness, and it is a common practice among athletes to engage in warm-up prior to training sessions and competitive events, consisting of static stretching for a few seconds, involving a number of specific muscle groups (Zakas, 2005; Zakas, Doganis, Papakonstandinou, Sentelidis and Vamvakoudis, 2006). Although it has been found that static stretching is effective in producing an acute increase in range of motion (ROM) in a joint (Zakas, 2005), studies have shown that static stretching may also result in a significant acute reduction of 5-30 % strength (Miller, Herniman, Richard, Cheatam, and Michael, 2006) and power production of the stretched muscle groups. However, Zakas *et al.*, (2006), observed that these studies, included static stretching tasks, lasted much longer, sometimes for many minutes. Nelson, Guillory, Cornwell, and Kokkonen, (2001) used five different static stretches for the quadriceps over a 20-min time-frame, whereas Testore *et al.*, (2006), employed stretching protocols to the plantar flexors for a total of 30 min. Static stretching over a period of 270 s used by Powers & Howley (2012), also found a decrease (9.5 %) in the maximal isometric force of the

quadriceps, but not in jumping performance, whereas Khetmalis (2012), used routine static stretching lasting 45 s (3×15 s), and found no significant decrease in jumping performance.

Athletes tend to incorporate stretching in their everyday programme and usually they try to minimize stretching time because this would be against their technique training (Zakas, 2005). According to Zakas *et al*., (2006), a stretching session with static lengthening, without causing pain, lasting 30s, may significantly increase ROM of knee flexion, and not induce loss in concentric isokinetic peak torque production of the quadriceps muscle groups, while a stretching session with static lengthening, lasting for 5 or 8 min may significantly increase ROM of knee flexion, but may also induce significant loss in concentric isokinetic peak torque production of the quadriceps muscle groups at lower and higher angular velocities in football players.

In an attempt to model multiple risk factors with propensity for muscle strain injury in football players, Zakas (2005), identified flexibility via active hip flexion and knee flexion ROM as modifiable variables which were significant predictors. Henderson, Barnes and Portas (2010), found that active hip flexion ROM is higher on the dominant limb than the non-dominant (69.3 ± 9.8˚ vs. 66.5 ± 10.9˚, $P < 0.05$), but no differences were observed for passive hip flexion ROM between dominant and non-dominant limbs. The study added that, although non-significant, both active and passive ROM demonstrated a trend for being higher in non-injured football players than injured football players and that for every 1˚ decrease in active straight leg raise, propensity for injury is increased by 1.29 times. The study concluded that propensity for hamstring injury in the dominant (kicking) leg is greater with increases in age and non-counter-movement jump performance and decreases in active range of hip flexion. Henderson, Barnes & Portas (2010), suggested that improvements in active ROM could decrease injury risk and recommend, in

accordance with Arnason *et al*., (2008), that limitations in less flexible athletes should be addressed through appropriate static stretching and strengthening regimes.

The sit-and-reach test measures the flexibility level of participants'. The sit and reach test was developed by Wells & Dellon (Wilmore, 2000), to measure the flexion of the trunk and back as well as the elasticity of the hamstring muscles. A reliability of 0.92 was reported by Johnson & Nelson, (2005) and Heward, (2010).

According to Williams (2006), Flexibility can be developed through resistance training. Resistance exercises stretches the muscles and connective tissues regularly. Through dynamic stretching, flexion and extension, body parts are specifically strengthened. Resistance training is superior in improving hip flexibility. Generally, when athletes are involved in resistance training, muscles are stretched (Lockie, Schultz, Callahan and Luczo, 2015). The sit and reach test was developed to measure the flexion of the hip, back and the elasticity of the hamstring muscle.

2.4 Motor and Physical Profiles of Different Playing Positions in Football

A study performed by Gil *et al.*, (2007), showed that forwards performed the best in physiological tests, including endurance, velocity, agility and power. Arnason *et al*., (2004), did not find a difference in peak oxygen uptake between midfield players and strikers or defenders. A study carried out by Gil *et al*., (2007), measured endurance by means of a rectangular progressive test on a 400 metre athletics track. Football players had to run 6 repetitions of 800 m at an increasing pace of 1.5 km/h with each run, thus covering 9, 10.5, 12, 13.5, 15, 16.5 and 18 km/h with 1 min recovery time between each run. The study reported that goalkeepers had the highest cardiac frequency during runs and recovery periods as well as the highest dropping-out rate with only 4 % finishing the seventh run, in contrast to 40% forwards, 30.8% midfielders and

22% defenders who successfully completed the run. The heart beats of the forwards were also the lowest in all the tests conducted.

Reports by Gil *et al.,* (2007), confirmed that goalkeepers had the lowest oxygen consumption values compared to other players when measured using the Astrand test and that relative maximal oxygen consumption in midfielders was higher ($P < 0.05$) in a selected group compared to a non-selected group. The study also found that the best endurance was measured among the forwards, however, according to Gil *et al*., (2007), mid-fielders need the highest endurance capacity because they run the longest distances in a match due to their linking role between the back and the centre of the field with the front.

Le Gall *et al.,* (2010), reported a significant difference in maximal anaerobic power between professional and amateur defending players ($d = 0.64$, $p < 0.05$). In the same study significant differences were found for maximal anaerobic power values in midfielders ($d = 0.62$, $P < 0.05$) and for counter-movement jump in the forwards ($d = 0.50$, $p < 0.05$) of professionals compared to amateurs. It has been reported by Reinzi *et al*., (2000), that in elite football, forwards are the fastest players and sprint the longest distances during a football match. Gil *et al*., (2007), confirmed this finding by measuring faster times in the 30m flat sprint in forwards, compared to defenders and goalkeepers. In conjunction with this, Krustrup *et al*., (2006), also reported that fullbacks and attackers sprinted significantly longer than central-backs and mid-fielders. According to Kirkendall (2000), the slowest players are goalkeepers followed by mid-fielders.

Helgerud *et al.,* (2010), measured jump heights of 50-55 cm in their players, with attackers and defenders jumping higher than midfielders. Gil *et al*., (2007), reported best performance in the three-jump test amongst forward players; and in the squat jump, midfielders

produced the shortest jumps. The study also found that, amongst 14-21year-old players, selected forward and defender players jumped slightly higher in the counter-movement jump than non-selected players, but this difference 48 apaciti not statistically significant. According to Gil *et al*., (2007: 444), power of the lower legs is very important for defenders, because they must be able to jump high in order to stop a ball from going in the goalpost.

Gil *et al*., (2007), also found that forwards were the fastest in an agility test (30 metres with ten cones), producing a statistically significant difference between forwards and goal-keepers. When compared according to selection and non-selection, all selected football players ran faster in the agility test compared to the non-selected and significant differences were recognized in the case of the forwards ($P = 0.05$) and mid-fielders ($P < 0.05$) (Gil *et al.,* 2007 : 441). A study done by Arnason *et al.,* (2004), established that goal-keepers had greater ROM in hip extension (hip flexor flexibility) ($P < 0.04$) and knee flexion (rectus femoris flexibility) ($P < 0.02$) than outfield players. No significant differences were found in flexibility measurements of the hamstring, hip flexor, rectus femoris and adductor between the strikers, midfielders and defenders.

Gil *et al*., (2007), observed that the best predictor to be selected in the group of forwards was the 30 m and ten-cone test, followed by the drop jump test ($P = 0.038$), explaining 73.1 % of selection in the forwards group. The most important variable for midfielders were also the 30 m and ten-cone test, followed by the height of the players ($P = 0.047$), explaining 70.6 % of selected players. Finally, for the defender groups, the predictor variables were amount of fat in the extremities followed by the counter-movement jump ($P < 0.026$), explaining 73.8 % of the selected players. Gil *et al*., (2007), and Krustrup *et al.,* (2006), thus, concluded that the most important factors for the selection of forward football players are agility and power of the lower

extremities, which is consistent with the role of attackers who must jump, be agile and fast and who must cover the longest distances in high-intensity running, whereas important factors for selection of midfielders appear to be agility and height. Each positional role has its own characteristics, and together with the different physiological workload of each position, it is clear that some of the training sessions should be dedicated to training specific to each position as already being done with goalkeepers (Gil *et al*., 2007).

2.5 Resistance Training Programme

Resistance training is concerned with improving the condition of the body in terms of muscular strength, power and muscular endurance, through the use of repetitive movements against a resisting load of some kind (Payne, 2012). Progressive resistance training dates back as far as the sixth century BC, when the legendary wrestler Milo of Croton trained by carrying a newborn calf on his back every day until the calf was fully grown (Farrow, Young and Bruce, 2009). Another Greek, the physician Galen, described resistance-training exercises using an early form of dumbbell in the 2nd century. The ancient Greeks also used strength-building exercises for military purposes and one of the earliest bodybuilding contests has been found in records from the Greek city of Sparta (Farrow *et al.*, 2009). Since the ancient Greeks, the role of strength training has received a large boost in popularity and knowledge.

Resistance training (RT) is a type of physical exercise recommended to improve a wide range of health-related parameters including neuromuscular fitness, cognitive abilities, insulin sensitivity, bone density, and cardiovascular wellness and is also practiced to enhance aesthetics and sports performance. The benefits associated with RT are dependent on the proper manipulation of the variables that make up the RT programme, which include magnitude of load,

number of sets and repetitions, frequency, rest interval, exercise selection, time under tension, muscle action, velocity of movement, and exercise order (ACSM, 2011).

Resistance training (RT) is used as a general phrase synonymous with other common term such as strength training and weight lifting. The resistance training (RT) is described as specialized form of conditioning that is used to increase one's ability to resist or exert force (American Orthopedic Society for Sports Medicine, 2008). The RT increases muscle strength by different physiological mechanism, which are related to neural factor (Angard, Simonsen, Andersen, Magnusson and Dyhre-Poulsen, 2010). Strength training exercise that uses weight/ resistance to strength and enhance a muscular ability to contract and do work. Strength training can be classified into two types;

[i] General strength training exercises are those they are using in overall body conditioning. General exercise plays an important role in the initial stage of player performance.

[ii] Specialized exercises to develop a base upon which a specialized exercise can be performed most effectively (Baldock, 2008).

Brooks, Fahey and Baldwin (2010), stated that strength training improves muscular strength and kicking performance for the football players. Falk & Mor (2006), established that resistance training improve the selected motor fitness skills among athletes. Corroll, Riek and Carson (2011), found that the strength training significantly prevents injury, recovery from injury and improves balance, endurance, flexibility, coordination and stamina. Thus is because the influence of resistance training depends upon the duration, frequency, speed and volume of the training programme. Soccer players needs weight training in the physical fitness progamme in order to enhance their anaerobic capacity and muscle fitness. It also has recommended the best intensity training for soccer group is 50-60% of one repetition maximum [1RM] (Shahidi *et al*

2012). Kravitz, Akalam, Nowicki and Kinzey (2003), showed that maximum repetition at 70% of 1RM are better predictor of 1RM for squat and bench press than at 80% and 90% of 1RM. However for dead lift, 80% and 90% of 1RM was better predictor.

Pereira & Gomes (2003), found in their studies that the number of repetition for a given % of 1RM is different for different exercise, so is the load for a given number of repetitions maximum (nRM), when compared at different velocities.

Resistance training is any exercise that causes the muscles to contract against an external resistance with the expectations of increase in strength, tone, mass and endurance. Resistance training is another name for exercising the muscles using an opposing force like dumb bells or resistance bands. In the old days it used to be called 'weight training' but this phrase invoked images of huge sweaty men with bulging biceps and wasn't very popular with women(Singh, Singh and Singh, 2010).

The health benefits of appropriately prescribed long-term (more than 12 weeks) resistance training are well known. They include improvements in muscle strength and endurance; other possible health benefits include increase in muscle mass, which translates into improvements in functional capacity. In addition, increased weight bearing with resistance training is considered beneficial in improving bone density and combating the effects of osteoporosis (Turner & Robling, 2003).

Achieving appropriate levels of function is very important for football players so that they are able to carry out most of the daily skills necessary for performance. Due to the fact that muscle wasting (sarcopenia) and weakness, brought about by poor physical conditioning among college players, more emphasis has been placed on developing resistance-training programs for college football players. When developing resistance-training programs for this group, important

components to consider are the various training-related variables: frequency, duration, exercises, sets, intensity, repetitions, and progression (Wisloff, 2010).

2.5.1 Frequency of Resistance Training Programme

Training frequency is used to describe how frequently training is performed; for example, 2 days/week. Frequency refers to the number of exercise sessions per week. The traditional recommendation for frequency is to engage in three training sessions per week for individuals primarily seeking improvement in their overall health and fitness capacity. Even though some individuals may be motivated to train more frequently, resistance-training studies with the college footballers have indicated a range of two to three days per week to be effective and adequate in improving strength. So, the recommendation is that the individual train at least three days per week but no more than four, suggesting an average training frequency of three days per week. Also, the frequency of exercise should be structured so that there is at least 48 hours between training sessions. An individual could satisfy this requirement with a "total body" routine, meaning that they would exercise all of the chosen muscle groups during each training session two or three days per week. Another approach could be a "split" routine where some of the chosen muscle groups are exercised on one or two days a week while the remaining are exercised on a separate one or two days. This "split" routine approach may not be appropriate for those individuals who are just beginning their program (Little & Williams, 2007).

2.5.2 Duration of Resistance Training Programme

Duration describes the length of each training session. In reference to training duration, longer training sessions are not necessarily more effective. If one has an appropriately designed program based on sound training variables, lengthy training sessions are not necessary. In fact, they should avoid unnecessary lengthy training sessions, because they may increase the risk of

injury, manifested by extreme fatigue. Present guidelines for resistance training recommend a range of approximately 20-45 minutes per session. In other words, one should attempt to train for at least 20 but no longer than 45 minutes. This range suggests an approximate average duration of 30 minutes per session (Ozbar, Ates and Agopyan, 2014).

Exercise may be categorized as either multi-joint, meaning more than one joint is dynamically involved to perform the exercise (e.g., bench press, shoulder press, leg press), or uni-joint, meaning only one joint is dynamically involved (e.g., bicep curls, triceps extensions, leg extensions). Resistance-training program should focus primarily on multi-joint exercises. Uni-joint exercises are not discouraged entirely but should not make up the majority of exercises within the training program. Additionally, machines are recommended over free weights (i.e., barbells and dumbbells) due to skill-related and safety factors. As the individual progresses, they can use free-weight exercises appropriate for their level of skill, training status and functional capacity (Feigenbaum & Pollock, 2009).

Moss, McWammell, Twist and Michalsik (2015), stated that traditionally, muscle groups are classified as the following: 1) chest, 2) shoulders, 3) arms, 4) back, 5) abdomen, and 6) legs. Specifically, the chest group contains the pectoral muscles, the shoulder group contains the deltoid, rotator cuff, scapular stabilizers and trapezius muscles, the arm group contains the biceps, triceps, and forearm muscles, the back group contains the *latissimus dorsi* of the upper back and the erector muscles of the lower back, the abdomen group contains the rectus abdominis, oblique, and intercostals muscles, and the leg group contains the hip (gluteals), thigh (quadriceps), and hamstring muscles. It is important to incorporate all six of these muscle groups into the comprehensive resistance-training programme.

It has been recommended that one to two exercises per muscle group is normally adequate. Noteworthy here is the need to understand that by employing primarily multi-joint exercises in the resistance training programme one may actually exercise more than one muscle group or specific muscle per exercise. For example, in performing the leg press exercise the quadriceps, hamstrings, and gluteal muscles are all involved and, in many cases, this could eliminate the need to perform any uni-joint exercises for those particular muscles. If a person is performing both multi-joint and uni-joint exercises for a particular muscle group, it is recommended that the multi-joint exercise(s) be performed before the uni-joint exercise. Additionally, within each resistance-training workout, a larger muscle group that is legs, back, and chest should be worked before smaller muscle groups (i.e., arms and shoulders). Studies have shown improvements in muscle strength employing ranges of one to three sets of each exercise during the training program. Based on current guidelines, it would be recommended that the individual start with one set of each exercise and, depending on individual need, possibly progress up to no more than three sets when the fitness professional deems it appropriate. However, an average of two sets of each exercise would be beneficial for most individuals. To avoid excess fatigue, a two-to-three minute rest period between sets and exercises is recommended (Thomas, French and Hayes, 2009).

2.5.3 Intensity of Resistance Training Programme

Training intensity is the amount of weight or load used in a specific exercise. The intensity of an exercise is usually estimated as a percentage of 1 RM (e.g. 80% of 1 RM), or any RM resistance for the exercise (8 RM). The relative effort required to complete individual set or an entire workout. Intensity is a function of resistance used in each resistance training (Manna, Khanna and Dhara, 2010). Intensity refers to the amount of weight being lifted, and is a critical

component of the resistance-training program, considered by many fitness professionals to be the most important training-related variable for inducing improvements in muscle strength and function (Little & Williams, 2007).

In other words, the more weight lifted, the more strength gained. Even though this may not always be the case, the importance of intensity in facilitating strength improvements is well documented. Intensity is often expressed as a percentage of the maximum amount of weight that can be lifted for a given exercise (1RM). For example, if someone who has a maximum effort of 100 pounds on the bench press exercise performs a set with 80 pounds, they would be training at 1RM of 80%. Studies have suggested that older individuals are able to tolerate higher intensities of exercise, up to 85%.

However, study has also shown intensities ranging from 65%-75% of maximum to significantly increase muscle strength. Therefore, in order to increase strength while simultaneously decreasing the risk of musculoskeletal injury that often accompanies higher intensities of resistance training, a low-intensity to moderate-intensity range of 65%-75% is recommended (Little & Williams, 2007).

2.5.4 Repetitions of Resistance Training Programme

A repetition is one complete movement of an exercise. It normally consists of two phases: concentric muscles action or lifting of the resistance and the eccentric muscles action or lowering of the resistance (Manna *et al.*, 2010).

This is the maximum number of repetitions per set that can be performed until failure at a given resistance using an appropriate exercise technique. A set at a certain RM therefore means that the set is performed to momentary voluntary fatigue. 1 RM is the heaviest resistance that can be lifted for one complete repetition of an exercise. 8 RM, for example, is a lighter resistance that

allows the completion of eight, but not nine, repetitions using an appropriate exercise technique. A repetition is one (complete) movement of an exercise. It normally consists of two phases: the concentric muscle action, in which the muscle shortens, and the eccentric muscle action, in which the muscle lengthens.

Repetitions (reps) refer to the number of times an individual performs a complete movement of a given exercise. There is an inverse relationship between intensity and repetitions, indicating that as the intensity increases the repetitions should decrease (Little & Williams, 2007). Based on previous research, a rep continuum has been established that demonstrates the number of repetitions possible at a given relative intensity. For example, an intensity of 60% relates to 16-20 reps, 65% = 14-15 reps, 70% = 12-13 reps, 75% = 10-11 reps, 80% = 8-9 reps, 85% = 6-7 reps, 90% = 4-5 reps, 95% = 2-3 reps, and 100% = 1 rep. In view of the previously mentioned recommendations for an intensity of 65%-75% of maximum, this would suggest that for each training exercise the individual perform an adequate amount of weight that would allow for 10-15 reps. In the event that no initial strength testing was performed, simply through trial-and-error an individual could determine appropriate training loads that would allow them to perform only 10-15 reps. They could then be sure of training at 65%-75% of maximum effort.

2.5.5 Sets of Resistance Training Programme

This is a group of repetitions performed continuously without stopping while a set can be made up any number of repetitions (Manna *et al.*, 2010). A group of repetitions normally performed continuously without stopping. While a set can be made up of any number of repetitions, sets during weight training typically range from one to 20 repetitions.

In order to continually enjoy improvements in strength and functional capacity, it is important to consistently incorporate progression and variation into the resistance-training

program (Gettman, Ayres, Pollock, and Jackson 2011). Progressing and varying one's program commonly involves incorporating the overload principle. The overload principle involves making adjustments to the training variables of the resistance-training program such as frequency, duration, exercises for each muscle group, number of exercise for each muscle group, sets and repetitions. In terms of adjustment, normally the overload principle involves making increases to these variables. For example, making progressive increases in intensity has been shown to be important in increasing muscle strength. In terms of the rate of progression, one should consider attempting to progress their resistance-training program on a monthly basis. However, it should be noted that increasing the intensity in some older adults may be contraindicated due to orthopedic and/or other medical limitations. As a result, making adjustments in other training variables would be recommended (Mohammed, Veayens, Mattys, Multael and Lenoir, 2009).

2.6 Summary

Football is a complex sport with huge demands on the player, and performance is assumed to depend on a number of factors, including psychological factors, player techniques, team tactics and physical fitness.

Studies on biomotor abilities and measurement of selected physical characteristics of male football players were reviewed. These studies showed that, regardless of current fitness status of football players, mind-body interventions through training can improve performance. Performance can be improved when players have well developed biomotor abilities of strength, endurance, flexibility, power, speed and agility, coupled with high tactical and technical standard that help them make a major contribution to team play in intensely contested matches.

Literature has established that, resistance exercise programs can be modified not only by the external load, but also by the speed of contraction and level of induced fatigue. Altering resistance exercise programmes in just one of these ways will induce a distinct skeletal muscle response. However, the combined effects of adjusting training in two or more of these areas simultaneously will result in more complex physiological interaction that may either hinder or improve training related strength gains. The health benefits of appropriately prescribed long-term (more than 12 weeks) resistance training are well known. They include improvements in muscle strength and endurance. Other possible health benefit includes increase in muscle mass, which translates into improvements in functional capacity. In addition, increased weight bearing with resistance training is considered beneficial in improving bone density and combating the effects of osteoporosis (Turner & Robling, 2003).

Studies have shown that achieving appropriate levels of function is very important for football players so that they are able to carry out most of the daily skills necessary for performance. Due to muscle wasting (sarcopenia) and weakness, brought about by poor physical conditioning among football players, more emphasis has been placed on developing resistance-training programs for college football players (Mohammed *et al.*, 2009).

Studies have also shown that many activities in football are forceful and explosive (for example, tackling, jumping, kicking, turning and changing pace), thus muscle strength is important to perform these activities. Evidence also indicates that resistance training programmes have shown improvement first muscular strength, then endurance, flexibility, power speed and agility. Improvements in functional capacity and bone density are also associated with the health benefits of resistance training (Ozbar, 2015).

Studies have also shown that forward positional players display the best performance in endurance, velocity, agility and power tests, which may be due to the fact that trainers and technical staff may select leaner and stronger football players with the best physiological characteristics for the forwards group, reflecting the belief that the success of a match depends primarily on this particular group of players (Gil *et al*., 2007). Football players in Federal College of Education Kontagora should possess moderate to high aerobic and anaerobic power, have good agility, joint flexibility and muscular development, and be capable of generating high torques during fast movements. The knowledge of physical attributes of football players can provide useful information, allowing the coach to design and develop effective training and match strategies (Kalapotharakos *et al*., 2006).

CHAPTER THREE

METHODOLOGY

3.1 Introduction

The purpose of this study was to assess the effects of resistance training programme on the biomotor abilities of male football players of FCE, Kontagora, Nigeria. The biomotor abilities assessed were; muscular strength, muscular endurance, speed, flexibility, explosive power and agility. To achieve this purpose, the research design, population, sample and sampling technique, instrumentation, testing procedures, training protocols, experimental controls and procedures for data analysis are all explained in this chapter.

3.2 Research Design

In this study, the one (1) group repeated measures research design was used. Participants for the study carried out resistance training programme for a duration of 12-weeks which was organized in a circuit of six (6) stations of training activities. The activities were the hand dips, lateral pull, leg/knee extension, leg press, seated leg curl and abdominal curl. These activities were performed on a Universal Gym Machine (Livestrong). Participants were also involved in biomotor ability tests of muscular strength, muscular endurance, flexibility, power, speed and agility, four (4) times to ascertain the effects of the training programme with the following interval; base-line test, 4^{th}, 8^{th} and 12^{th} week test.

3.3 Population of the Study

The population of this study comprised all the male football players of FCE, Kontagora, Nigeria. The College maintains a total number of thirty three (33) male football players and are categorized into three (3) teams, namely: 1^{st}, 2^{nd} and 3^{rd} eleven. In the case of inter-collegiate or extramural competitions, the College selects its team from the pool of the 3 sets of eleven players

to represent it. The cosmopolitan nature of Kontagora town, coupled with the Federal outlook of the college, made it a good source of players, representing most ethnic groups in Nigeria.

3.4 Sample and Sampling Technique

A multi-stage sampling technique was used to select the participants for this study. Firstly, the purposive sampling technique was used to select only football players that were within the age range of 18-29 years, which served as qualification for further selection for the study. Secondly, the stratified sampling technique was used to further select participants for the study. In this technique, all the male football players within the age range of 18-29 years were stratified, based on their playing positions of defence, mid-field, forward and goalkeeper; for representation sake. A total of 20 male football players were selected to serve as participants for the study using the simple random sampling technique. Two (2) goal keepers, six (6) defenders, six (6) mid-field and six (6) forward players were randomly selected from the playing positions. In the simple random sampling technique, "Yes" and "No" were written on separate pieces of papers. The number of "Yes" was written as follows; Goal keepers (2) out of 3, Defence (6) out of 10, Mid-fields (6) out of 10 and Forwards (6) out of 10. The remaining 13 spots represented "No".

All the "Yes" and "No" of each category were mixed and shuffled. These papers were then wrapped in small sizes to prevent any clue of what to pick. They were next put into four (4) different pots or cups representing the categories of position of players that is, cup (1) for Goal keepers, cup (2) for Defence, cup (3) for Mid-field and Cup (4) for Forward players. The researcher then took each cup containing the ballots to each category of positions one after the other for a lucky dip to select two Goal keepers, six defenders, six mid-fields and six forwards; totaling twenty (20) players in all for the study.

3.5 Instrumentation

The following facilities, instruments and equipment were used in this study for data collection;

i. 400 m running track and field

ii. Tape measure (30 metre)

iii. Marker Beacons

iv. Gymnastic mats

v. Stadiometer (OMRON) model NJ07072 made in U.S.A

vi. Hand-stop watches – Digital sport timers, made in China

vii. Sit-and-reach box

viii. Universal Gym Machine (LIVESTRONG) made in U.S.A - for resistance training

ix. Whistle

x. Cone markers for direction

3.6 Test Item Selection and Testing Procedure

Six (6) biomotor abilities were tested on each participant throughout the duration of study. Measurements of height and weight were also carried out to ascertain the physical characteristics of the participants. These tests were as follows;

i. Abdominal strength

ii. Endurance (VO_2 max)

iii. Flexibility

iv. Speed

v. Explosive power (leg power)

vi. Agility

3.6.1 Informed Consent and Ethic Permission

Before these tests were administered, written informed consent forms were given to all the participants to fill, duly sign and return. Request for ethic approval to use human subjects for research was granted by the ethic committee of the Ahmadu Bello University, Zaria.

3.6.2 Testing Procedure

Before the commencement of tests, all the participants underwent performance of series of exercises to serve as warm-up activity for 10 minutes. Detail explanation and demonstration of every test item preceded actual tests. Before the tests began, participants were allowed to inspect the instruments to be used in the study to avoid fright. The tests were administered to the participants individually and have their names drawn alphabetically to avoid bias and assign numbers for easy identification. Performance tests were administered before (base-line) during and after (4^{th},8^{th} and12^{th}week) of the training programme. Post-training tests were conducted at least 48 hours after the last training session to minimize the influence of fatigue (Jullien *et al,* 2008). All the tests were performed on the FCE, Kontagora track and field facility.

3.6.3 Standing Height and Weight

Height is the perpendicular distance between the top of the head (the vertex) and the bottom of the feet. The participants' heights were measured while standing and looking straight ahead, and bare footed against the stadiometer (instrument for measuring height). A horizontal broad blade wooden rule was then rested on the head of each participant. The height was read off the instrument to the nearest 0.5cm.

Weight is the measure of the body mass. The weight of the participants was measured using the stadiometer instrument since it goes with a weighing scale. The participant stood on the instrument with minimal movement, with hands by their sides. Shoes and excess clothing were

removed. Body weight was measured to the nearest 0.5 kg. Both measurements were used for the calculation of BMI of the participants as weight in kg divided by height in meters square (W/H^2).

3.6.4 Sit – up Test for Abdominal Strength

Strength is the ability of a muscle or muscle group to generate tension (Heyward, 2010). Strength is an important component of the physical fitness requirements of a football player. This is important where force is required in kicking and throw-in of the ball.

Tests of strength have challenged humans since the dawn of history. Strength is highly specific, one type of strength does not necessarily predict another. Strength test help determine current fitness level and help set achievable goals. You could test your strength doing almost any exercise (AAHPERD, 2010; YMCA, 2010). The following sit-up test can test your maximum performance as a strength goal.

The sit-up test measures the dynamic strength of the abdominal and hip flexor muscles. The trunk muscle strength is one factor affecting the motor control of the trunk which plays an important role in the physical performance of a football player. The sit-up test helps maintain good posture and minimize spine, hips and other lower back problems (NSCA, 2011).

Equipment: Gymnastics mat and whistle.

Procedure: The participants lied on their backs, knees bent, heels flat on the floor. Hands held behind the head, with elbows out to the sides. A partner held down the feet. The participants performed as many correct sit-ups as possible in one minute. In the up – position, the individual touched the knees with the elbows and then returned to the lying position before starting the next sit-up.

3.6.5 12 – Minute Run/Walk Test for Endurance

This is the ability of a muscle group to execute repeated contractions over a time period sufficient to cause muscular fatigue or to maintain a specific percentage of maximum voluntary contraction for a prolonged time (ACSM, 2010). Muscular endurance is a critical ability in the game of football and is important for use of force involving any pushing and throwing movements (ACSM, 2010; NSCA, 2011).

The use of both laboratory and field tests in examining football players abilities to perform, provides a useful indication of players general fitness level (Stroyer, *et al.*, 2004). Over the years, various tests were developed to measure VO_2 max but most of these tests require laboratory setting. Laboratory tests provide accurate test results with the use of reliable equipment but very expensive and cannot accommodate large population at a time, while field tests provide acceptable level estimate results that are specific to the sport, with reduced cost, use of minimal equipment and with ease in manner which tests are conducted (Grant, *et al.*, 1997; LeGal, *et al.*, 2010). The laboratory tests include; tread mill running/walking, cycle ergometer pedaling and stepping tests (Machol and Ladney, 2011).

To bridge the limitations of laboratory tests stated above, varied field tests were developed as alternatives to the more complex laboratory tests. These tests are not only reliable, haven been compared with the laboratory tests, but found more convenient when large samples are involved. Some of these field tests include; the multi-stage shuttle run test (bleep test), 12-minutes run test, 6 minutes run test, 9 minutes run test and 1.5 ($1^{1/2}$) mile run test (Stroyer, *et al.*, 2010). Brooks *et al*., (2010), stated that the widely used tests for measuring aerobic capacity (VO_2 max), are the 12 minute run and the 1.5 miles run test; and also reported that they correlated as high as 0.91 to selected laboratory tests.

The 12-minute run test was used to assess the cardio-respiratory endurance (aerobic capacity) of FCE, Kontagora male football players. Strauss (2011) stated that cardio-respiratory endurance is the most vital means of determining a person's maximal oxygen consumption or uptake (VO_2 max).

Maximal oxygen uptake, according to Verducci (2000), indicates how well various physiological functions of the body can be adjusted to increasing metabolic demands of work. VO_2 max determination through physical evaluation provides effective indication of football-specific and general endurance ability of athletes (Tonnessen, *et al.,* 2013).

12 – Minute Run/Walk Test

The cooper test (Cooper, 1968) was used to monitor the development of the athlete's aerobic endurance and to obtain an estimate of the VO_2 max.

Equipment/Facility

- 400 metre track
- Hand stop watch
- Whistle

Procedure: To perform this test, participants were given a brief description of the test. In addition to other information, this test requires the participants to run as far as possible in 12 minutes. They ran round the 400 metre track of the Federal College of Education Kontagora as many times as possible within 12 minutes. Before the commencement of test, participants were engaged in a ten minutes warm-up exercise. As the researcher gave the command "GO", he simultaneously started the hand of the stop watch and the participants commenced the test. Running was done at participants own pace and were told to maintain constant pace. Participants were also told to walk or even stop when tired. Participants ran in group of six (6) each. The

researcher and research assistants counted the number of laps covered by each participant. The officials (Researcher & Assistant) kept the participants informed of the remaining time at the end of each lap (400m). When the 12 minutes elapsed, the whistle was blown and all the participants stopped running and the distance each participant covered was recorded to the nearest 10 metres. The total distance covered in laps X 400 metre = total distance in metres.

According to Cooper (1968), for an evaluation of each participant's performance, select the age group and gender, then enter the total distance covered then calculate. To estimate the VO_2 max of each participant, the following formula was used: Distance covered in metres -504.9 ÷ 44.73 ml/kg/min. It was measured as millilitres of O_2 used in one minute per kilogram of body weight (Cooper, 1968) in Mackenzie (2011). The data obtained are put against a normative data table created by Cooper (1968), (Special calculator retrievable online).

3.6.6 Sit-and-Reach Test for Flexibility

This is the functional capacity of the joints to move through the full range of motion (ROM) (ACSM, 2010; YMCA, 2010). Maintaining adequate joint flexibility is important to athletic performance as it is also to functional health (Johnson & Nelsom, 2005). The importance of good flexibility to performance in football is all hinged on good trunk movements, range of movement at knee, ankle and spinal areas.

The sit and reach test measures the flexibility level of participants. The sit and reach test was developed by Wells and Dellon (Wilmore, 2000), to measure the flexion of the trunk and back as well as the elasticity of the hamstring muscles. A reliability of 0.92 was reported by Johnson & Nelson (2009) and Heward (2010).

Equipment: sit and reach box.

Procedure: Flexibility was evaluated using a standardized sit and reach box. The box was placed against the wall. Participants were told to remove their shoes and assume a sitting position on the floor with legs fully extended forward through the box with hands placed on top each other. The participant sits and reaches directly forward along the measuring scale on the box. In this position, the participant stretched forward, making a maximum reach on each trial. The knees fully extended and the feet still in contact with the box. Three trials were allowed, the maximum distance reached in the fourth performance and maintained for (10) seconds and recorded to the nearest centimeter (cm), was the measure of flexibility.

Scoring: The score was recorded to the nearest centimeter as the distance before (negative) or beyond (positive) the toes.

3.6.7 50-Metre Dash Test for Speed

Speed is defined as the velocity of a body, body parts or an object; that is the rate of motion (Petterson & Mathisen, 2012). Speed is basically the result of rapid application of force to a mass. The force here is caused by muscle contraction. If the force is greater than the resistance, movement occurs and as the force becomes proportionately greater, the speed with which the mass moves become increased (Hughes, Lloyd and Meyers, 2012).

Speed, mostly in the form of acceleration, is an important factor in almost all games and sport. It becomes a determinant in scoring, passing and defending or preventing a goal in a football game. In other words, speed makes the difference where a player is able to gain an advantage over an opponent (Buchheit, Mendez-Villanueva, Delhomel, Brughelli & Ahmaidi, 2010).

Speed is measured by the time taken to cover a set distance. Total body speed can be measured by the athlete covering a set distance from 50 to 100 metres. Norm standard would

vary considerably by gender, age, body size and sport (Jakovljevic, Karalejic, Pajic, Macura and Erculj, 2012).

Purpose: The purpose of this test was to determine acceleration, maximum running speed and speed endurance, depending on the distance run.

Equipment used: Measuring tape, marked track, stopwatch and cone markers.

Procedure: The test involved running a single maximum sprint over a set distance, with time recorded. After a warm-up, the test was conducted over a distance of 50 meters. The test was administered to two participants at a time, both participants took a crouch position behind the starting line. The starting command "on your mark, get set, "Go". When the "Go" command was given, the starter makes a downward sweep of the arm to give a visual signal to the timer who stands at the finish line. On the command "Go" the participants ran the entire 50 meters as fast as possible, passing through the plane of the finish line. The score was the amount of time, between the starter's signal and the instance the participant crossed the finish line. Time was recorded in seconds to the nearest tenth of a second. The best of three attempts was recorded.

3.6.8 Standing Broad Jump Test for Explosive Leg Power

Power is the ability to apply force rapidly. Power is typically demonstrated in projecting the body (as in jumping) or an object (as in throwing). The muscles must apply great force at a rapid rate in order to give the body or object the momentum necessary to carry it in the desired distance (Johnson & Nelson, 2009).

The standing broad jump measures the explosive leg power. This is important to vigorous performances (especially football) because it determines how hard a player can hit, how high he can jump when necessary and to some extent, how fast he can run (Johnson & Nelson, 2009).

The standing broad jump is one of various acknowledged test items of AAHPERD (AAHPERD, 2010).

Equipment Required: Flat, smooth surface, a tape measure for marking and measuring.

Procedure: Before commencement of test, participants were engaged in a jump specific warm-up activity. Participants were asked to stand behind a drawn take-off line or on a jump-off board, with the feet several inches apart and the toes just behind the take-off line. In preparation for the jump, the participant bend the knee, both hands are swung backwards, and jumped as far forward as possible using the arm to propel body forward to help him go further. The researcher emphasized double take-off feet with knees extended. Three trails were allowed, measuring each jump from the take-off line to the heel part of the body that touched the ground nearest the take-off line. A two minutes rest period was allowed between each jump to ensure maximal effort. The score is the best distance recorded of the three trials (Chamari, *et al.*, 2004).

3.6.9 Agility Test (20 Metre Shuttle Run)

Agility refers to the ability to move and change position or direction rapidly without losing balance or sacrificing speed (Little & William, 2005; Sheppard & Young, 2006). This is important to football skills as demonstrated in such movements as dodging, running, stopping, starting and changing directions quickly.

The AAHPERD 20 meter shuttle run test has been used to measure the agility of players for running and changing direction and a reliability co-efficient of 0.94 for boys and 0.82 for girls were obtained (AAHPERD, 2010). It involves the participants running and swiftly changing direction.

Equipment: Two cones 10 metres apart, stop watch and a tape measure.

Procedure: Two parallel lines were drawn on the ground 20 meters apart, two cones were also placed 10 meters away from the start/finish line and the other cone was placed 10 meters away from the first cone at the other end of the 20 metre end line. The participants started in the middle of the 20-metre marked area, where the 1st cone is stationed. On the command "Go" and the stop watch started, each participant under strict supervision, moves quickly either to the right or left. Each participant was required to touch the end-line with the hand corresponding to the direction in which the initial movement occurred. After touching the end line with the corresponding hand, the direction quickly changed as the participant headed towards the other end-line. Each participant again changed direction for a final time before running to the start/finish line. This was done three (3) times with rest periods of two (2) minutes between trials and the two best times was averaged and recorded to the nearest tenth of a second (Morrow, et al, 2011).

3.7 Training Protocol

3.7.1 Inclusion and Exclusion Criteria

Participant who completed the informed consent form and whose ages were between 18 and 29 years old were included in this study. In addition to this, participants who had recent physical injury or poor medical condition were excluded from the study.

3.7.2 Resistance Training Programme

Sports are integral part of the system of education in Nigeria. Training is a system or a process in which football players improve their fitness to meet the demand of the game. Resistance training refers to the training that uses some kind of weights as resistance to produce the contraction of a muscular force.

The training consisted of resistance exercises using the Universal Gym Machine (Livestrong-made in USA), with emphasis on the upper-body, lower-body and abdominal regions, alternating between upper and lower body exercises so that while arms are recovering, the legs are working. The machines had variable resistance which required less time to set by quickly using a selector pin to change resistance.

Participants performed10-minute warm-up activities, consisting of the following;

a. General warm-up: 5 minutes of easy jogging, jumping jacks, squat-thrust and cycling on bicycle ergo-metre.
b. Stretching (active and static): 5 minutes (include stretches for shoulders, back, upper and lower legs).

Cool down: (5 minutes)

a. Walking (keep walking to avoid blood pooling in legs)
b. Easy stretching

Prior to each training and after training sessions, were observed throughout the training duration. Participants also performed different dynamic resistance exercises arranged in a circuit with each activity serving as a station. Six (6) stations consisting of six resistance exercises were used; they include the hand dips, lateral pull, leg/knee extension, leg press, leg curl and abdominal curl. This training programme was structured to last for 12weeks, with training sessions divided into three (3) phases. Each phase lasted for four (4) weeks. The training phases were therefore arranged as follows; phase one -1^{st} – 4^{th} week, phase two – 5^{th} – 8^{th} week and phase three – 9^{th} – 12^{th} week respectively.

Each training session lasted for 60 minutes (one hour) and three training sessions (Monday, Wednesday and Friday) per week. The resistance training for phase one was based on

50% 1-RM of 12 repetitions of 3 sets, with rest interval (RI) put at $1^{1/2}$ minutes between sets. Phase two consisted of 60% 1-RM of 12 repetitions of 3 sets with rest interval (RI) at 2-3 minutes between sets and phase three will also increase in intensity based on 65% 1-RM of 12 repetitions of 3 sets with rest interval put at 2-3 minutes between sets. The goal of the training programme was the development of abdominal strength, endurance, flexibility, explosive power, speed and agility.

After each phase of training was concluded, biomotor ability tests of abdominal strength, endurance, flexibility, explosive power, speed and agility was carried out and results recorded. There were three (3) phases of training and four stages of tests (a pre-training and three post-training tests). All work-out sessions in the gym was supervised by the researcher and two (2) research assistants who provided some technical assistance, motivation and encouragement to the participants. The training protocol was summarized and presented in Tables 3.7.2 a & b.

Table 3.7.2 (a): Phases of Resistance Training Programme

Training phase	**Week**	**Warm-up (minutes)**	**Resistance training time (min.)**	**Total time (min.)**	**Intensity**	**Reps**	**Set**	**Rest Interval**	**Freq.**
1	1-4	10	30	40	50% 1-RM	12	3	$1^{1/2}$	3 days per week
2	5-8	10	40	50	60% 1-RM	12	3	2	3 days per week
3	9-12	10	50	60	65% 1-RM	12	3	$2^{1/2}$	3 days per week

Source: ACSM (2010) Guidelines for Resistance Training

Table 3.7.2 (b): Six – Station Circuit Resistance Training Programme

Station	Activity	Muscles developed
1	Hand dip	Triceps Deltoids Pectoralis
2	Lateral pull	Latisimus dorsi Biceps
3	Leg/knee extension	Quadriceps/Extensor muscles
4	Leg press	Gluteus maximum Quadriceps Hamstrings
5	Leg curl	Hamstrings Gastrocnemius Knee flexors
6	Abdominal curl	Trunk flexors

Source: ACSM (2010) Guidelines for Resistance Training

3.8 Experimental Control

In order to avoid the influence of extraneous and intervening variables on the results, the following conditions were observed and controlled;

1. The researcher ensured that all measurements were carried out on the same day and time to allow for equal testing conditions for all participants.
2. Random assignment of participants was adopted during training. Participants were assigned into four (4) groups consisting of five (5) participants each. The groups were also assigned alphabetic names of A, B, C and D. Assisted by the Gym technicians, the groups were alternated in each time of commencement of training; for example, as group (A) started the activities first. It is then followed by B, C and D. In the next training session, D, C, B and A will begin in that order. This varied order of training was adopted

to give each group equal opportunity without bias and to boost confidence during training. No group was put at a disadvantage during participation.

3. The purpose of each test item was explained to the participants before the commencement of tests and exercise training sessions.
4. The time for commencement of tests ranged from either 6.00am to 10.00am or 4.00pm to 7.00pm each test and training day. This is because these times of the day were more suitable and temperature friendly for carrying out physical activities.
5. All participants were encouraged to wear sports outfits that was appropriate for tests and training conditions.
6. All trainings were preceded by ten (10) minutes warm-up activities.

3.8.1 Research Assistants

For the purpose of data collection, six (6) research assistants were used. They were given adequate instructions by the researcher on the purpose of the study, the purpose of each test items, equipment and protocols involved. A rehearsal of the general conduct of activities was organized by the researcher to improve their level of understanding, and to guide them in their evaluation of different parameters of the participants that may be assigned to them. They were also involved in recording, measurements and supervision of participants during the training sessions.

Two (2) fitness instructors assisted the researcher in making sure that the machines used were in order, helped in setting up the resistance to overcome on the machine and helped maintain order in the Gym and order of conduct of each activity per participant.

Three (3) physical and health education teachers of the department of physical and health education (Researcher's colleagues), helped in the timing of participants, measurement of distances and setting of cones at designated areas during field testing activities.

One (1) male medical officer (nurse) was invited from the college clinic to help by attending to participants in cases of minor injuries or any other minor medical emergencies.

The roles of the researcher, among others, included;

- Recording time of performance of each participant
- Recording distances reached by each participant
- Setting the resistance, counting the repetitions and sets of each activity on the machine
- Warm-up the participants before commencements of activity
- Putting participants in rightful formations of straight line, circle or whatever was needed to be done
- Make decisions concerning conducts and discipline of participants, all issues concerning welfare of participants
- General and specific supervision of conduct of activities and tests

3.9 Procedures for Data Analysis

Descriptive statistics of mean, standard deviation and standard error of mean were computed for estimating the magnitude of change due to the training programme. Data collected from pre and post – training programme of the study were analysed using the statistical Software Package for Social Sciences (SPSS Version 2.0). One-way Analysis of Variance (ANOVA 1) repeated – measures were used to test the stated hypotheses, and for determining the significant effects of the training programmeon the selected variables. The decision to reject or retain the null hypothesis was made at an alpha – level of 0.05.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

The purpose of this study was to assess the effect of resistance training on the biomotor abilities of male football players of FCE, Kontagora, Nigeria. To achieve this purpose, the data collected at base-line, 4^{th}, 8^{th} and 12^{th} week of training respectively were statistically analyzed, the results of which were presented and discussed according to hypotheses in this chapter. The biomotor variables assessed were abdominal strength, endurance (VO_2 max), explosive power, flexibility, speed and agility of male football players of Federal College of Education Kontagora, Nigeria. A total of twenty (20) participants were recruited for the study for a duration of 12 weeks.

4.2 Results

Before presenting the results according to the research questions and hypotheses, information on the physical characteristics; age, weight, height of the participants is presented in Table 4.2.1

Table 4.2.1: Physical Characteristics of Male Football Players

Variable	N	Mean	SD	SE
Age (years)	20	22.10	1.97	0.44
Weight (kg)	20	63.55	3.01	0.67
Height (m)	20	1.71	0.05	0.01
BMI (kg/m^2)	20	21.71	1.58	0.35

Note: SD = Standard deviation, SE = Standard Error, BMI = Body Mass Index

Table 4.2.1 shows the physical characteristics of the participants used for this study. The mean age and corresponding standard deviation of the participants were 22.1$\pm$1.97 years, while

the mean weight (kg), height (m), and BMI (kg/m^2) of the participants were 63.55±3.01kg, 1.71 ± 0.05 m, and 21.71 ± 1.58kg/m^2) respectively. The observation of the BMI classification revealed that the participants were within normal (21.71 kg/m^2) range.

Answering of Research Questions and Hypotheses

The data collected at base-line, immediately after the 4th, 8th and 12th week of resistance training on abdominal strength of the participants is presented in Table 4.2.2a

Table 4.2.2a: Mean, Standard Deviation and Standard Error of Abdominal Strength of Male Football Players of Federal College of Education, Kontagora

Variable	Test Period	N	$\bar{X}$	SD	SE
Abdominal Strength (Number of correct execution of sit-up per minute)	Base-line	20	25.05	3.43	0.77
	4th Week	20	29.75	2.45	0.55
	8th Week	20	32.85	2.21	0.49
	12th Week	20	34.75	1.48	0.33

Table 4.2.2(a) shows the mean, SD and SE of the effect of resistance training on abdominal strength, which was assessed with sit up test performance (number of correct execution) in one (1) minute at base-line, 4th, 8th and 12th week of training respectively. The performance in abdominal strength test improved from 25.05 ± 3.43, (times per minute) to 29.75 ± 2.45, at the 4th week. The results further revealed that at the 8th and 12th week of resistance training respectively, the performances increased to 32.85 ± 2.21 and 34.75 ± 1.48, respectively. In order to find out whether the observed progressive improvement in abdominal strength was significant, the data collected was analysed according to the sub hypotheses raised for the study.

Sub-Hypothesis 1: There is no significant effect of resistance training on the abdominal strength of male football players of FCE, Kontagora, Nigeria.

The results on the effect of resistance training on abdominal strength at base-line, 4^{th}, 8^{th} and 12^{th} week is presented in Table 4.2.2b.

Table 4.2.2b: Summary of Repeated – Measures ANOVA of Resistance Training on the (Abdominal Strength) of Male Football Players of Federal College of Education Kontagora

Source		Type III Sum of Squares	Df	Mean Square	F	Sig.
Training	Sphericity Assumed	1076.200	3	358.733	203.87	.001
	Greenhouse-Geisser	1076.200	1.615	666.221	203.87	.001
	Huynh-Feldt	1076.200	1.743	617.314	203.87	.001
	Lower-bound	1076.200	1.000	1076.200	203.87	.001
Error(Training)	Sphericity Assumed	100.300	57	1.760		
	Greenhouse-Geisser	100.300	30.692	3.268		
	Huynh-Feldt	100.300	33.124	3.028		
	Lower-bound	100.300	19.000	5.279		

* Significant P < 0.05

Table 4.2.2b shows the summary of repeated – measures ANOVA on abdominal strength of the participants. An observation of the results revealed that resistance training had significant effect on abdominal strength of male football players at the 4^{th}, 8^{th} and 12^{th} week of training respectively (p = 0.001). The sub-hypothesis which states that there is no effect of resistance training on the abdominal strength of male football players of FCE, Kontagora, Nigeria was rejected. In order to determine when the significant effect of resistance training on abdominal strength occurred, Bonferroni post – hoc test was used. The result is has presented in Table 4.2.2c

Table 4.2.2c: Results of Bonferroni Post – hoc Analysis of the Effect of Resistance Training on Abdominal Strength of Male Football Players of Federal College of Education Kontagora

(I) Training	(J) Training	Mean Difference (I-J)	Std. Error	Sig.
Pre training	4th Week	-4.700*	.398	.001
	8th Week	-7.800*	.457	.001
	12th Week	-9.700*	.624	.001
4th Week	Pre training	4.700*	.398	.001
	8th Week	-3.100*	.270	.001
	12th Week	-5.000*	.377	.001
8th Week	Pre training	7.800*	.457	.001
	4th Week	3.100*	.270	.001
	12th Week	-1.900*	.289	.001
12th Week	Pre training	9.700*	.624	.001
	4th Week	5.000*	.377	.001
	8th Week	1.900*	.289	.001

*. The mean difference is significant at 0.05 alpha-level.
* Significant $P < 0.05$

The results of post-hoc test in Table 4.2.2c using the Bonferroni correction revealed significant effect on abdominal strength after the 4th week of training up to the 12th week implying the effect was significant at all the stages. The result demonstrated that resistance training increased abdominal strength, starting from the 4th week of resistance training.

The data collected at base-line, 4th, 8th and 12th week of resistance training on VO_2 max of the participants is presented in Table 4.2.3a

Table 4.2.3a: Mean, Standard Deviation and Standard Error of VO_2 max of Male Football Players of Federal College of Education, Kontagora

Variable	Test Period	N	$\bar{X}$	SD	SE
VO_2 max	Pre training	20	48.4	10.30	2.30
	4^{th} Week	20	54.55	7.16	1.60
	8^{th} Week	20	57.40	6.68	1.49
	12^{th} Week	20	60.16	4.88	1.09

Table 4.2.3a shows the mean, SD and SE of VO_2 max of footballer's resistance training obtained with the 12 minutes run-test performance at baseline, 4^{th}, 8^{th} and 12^{th} week of training. An observation of the result revealed that performance in VO_2 max test improved from 48.4 $\pm$ 10.30, to 54.55 $\pm$ 7.16, at the 4^{th} week. The results further revealed that at the 8^{th} and 12^{th} week of resistance training, the performances increased to 57.40$\pm$6.68 and 60.16 $\pm$ 4.88. The data collected were analysed using repeated-measures ANOVA.

Sub-Hypothesis 2: There is no significant effect of resistance training on the VO_2 max of male football players of FCE, Kontagora, Nigeria.

The effect of resistance training on VO_2 max at base-line, 4^{th}, 8^{th} and 12^{th} week was analysed using repeated measures ANOVA, the results of which are presented in Table 4.2.3b.

Table 4.2.3b: Summary of Repeated Measures ANOVA of Resistance Training on the VO_2 max of Male Football Players of Federal College of Education Kontagora

Source		Type III Sum of Squares	Df	Mean Square	F	Sig.
Training	Sphericity Assumed	1521.356	3	507.119	27.571	.001
	Greenhouse-Geisser	1521.356	2.194	693.398	27.571	.001
	Huynh-Feldt	1521.356	2.492	610.485	27.571	.001
	Lower-bound	1521.356	1.000	1521.356	27.571	.001
Error(Training)	Sphericity Assumed	1048.422	57	18.393		
	Greenhouse-Geisser	1048.422	41.687	25.150		
	Huynh-Feldt	1048.422	47.349	22.142		
	Lower-bound	1048.422	19.000	55.180		

* Significant P < 0.05

Table 4.2.3b shows the summary of repeated-measures ANOVA on VO_2 max of the participants. The results showed that resistance training had significant effect on VO_2 max of male football players at the 4^{th}, 8^{th} and 12^{th} week of training respectively ($p = 0.001$). The sub-hypothesis which states that there is no significant effect of resistance training on the VO_2 max of male football players of FCE, Kontagora, Nigeria was rejected. In order to determine when the significant effect of resistance training on VO_2 max occurred, Bonferroni post hoc test was used, and the results of which were presented in Table 4.2.3(c)

Table 4.2.3c: Results of Bonferroni Post hoc Analysis of the Effect of Resistance Training onVO_2 max of Male Football Players of Federal College of Education, Kontagora

(I) Training	(J) Training	Mean Difference (I-J)	Std. Error	Sig.
Pre training	4th Week	-6.148*	1.314	.001
	8th Week	-8.998*	1.472	.001
	12th Week	-11.759*	1.743	.001
4th Week	Pre training	6.148*	1.314	.001
	8th Week	-2.851*	.676	.003
	12th Week	-5.611*	1.417	.005
8th Week	Pre training	8.998*	1.472	.001
	4th Week	2.851*	.676	.003
	12th Week	-2.760	1.280	.265
12th Week	Pre training	11.759*	1.743	.001
	4th Week	5.611*	1.417	.005
	8th Week	2.760	1.280	.265

Based on estimated marginal means
*. The mean difference is significant at 0.05 alpha level.
* Significant P < 0.05

Post-hoc test in Table 4.2.3c using the Bonferroni correction revealed an increase in VO_2 max at the 4th week of training up to the 12th week, which implied the effect was significant at all the stages. Thus, resistance training increased VO_2 max, starting from the 4th week of resistance training, however there was no significant increase between the 8th and 12th week.

The data collected at base-line, 4th, 8th and 12th week of resistance training on explosive power of the participants are presented in Table 4.2.4a.

Table 4.2.4a: Mean, Standard deviation and Standard error of Explosive Power of Male Football Players of Federal College of Education, Kontagora

Variable	Test Period	N	$\bar{X}$	SD	SE
Explosive Power	Pre training	20	2.24	0.32	0.07
	4th Week		2.50	0.30	0.07
	8th Week		2.63	0.23	0.05
	12th Week		2.85	0.12	0.03

Table 4.2.4a shows the mean, standard deviation and standard error of the effect of resistance training on explosive power assessed with the broad jump (m) test at base-line, 4^{th}, 8^{th} and 12^{th} week of training. An observation of the table revealed that performance in explosive power test improved from 2.24 ± 0.32 to 2.50 ± 0.30, at the 4^{th} week. The results further revealed that at the 8^{th} and 12^{th} week of resistance training respectively, the performances increased to 2.63 ± 0.23 and 2.85 ± 0.12.

Sub-Hypothesis 3: There is no significant effect of resistance training on the explosive power of male football players of FCE, Kontagora, Nigeria.

Information on the effect of resistance training on explosive power at baseline, 4^{th}, 8^{th} and 12^{th} week was analysed using repeated-measures ANOVA, the results of which are presented in Table 4.2.4b.

Table 4.2.4b: Summary of Repeated Measures ANOVA of Resistance Training on the Explosive Power of Male Football Players of Federal College of Education, Kontagora

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
Training	Sphericity Assumed	3.955	3	1.318	48.646	.001
	Greenhouse-Geisser	3.955	1.898	2.084	48.646	.001
	Huynh-Feldt	3.955	2.102	1.881	48.646	.001
	Lower-bound	3.955	1.000	3.955	48.646	.001
Error(Training)	Sphericity Assumed	1.545	57	.027		
	Greenhouse-Geisser	1.545	36.056	.043		
	Huynh-Feldt	1.545	39.943	.039		
	Lower-bound	1.545	19.000	.081		

* Significant P < 0.05

Table 4.2.4b shows the summary of repeated-measures ANOVA on explosive power of the participants. The results revealed that resistance training had significant effect on explosive power of male football players at the 4^{th}, 8^{th} and 12^{th} week of training (P =0.001). The sub-hypothesis which states that there is no effect of resistance training on the explosive power of male football players of Federal College of Education, Kontagora, Nigeria is hereby rejected. In order to determine when the significant effect of resistance training on explosive power occurred, Bonferroni post- hoc test was used, and the results are presented in Table 4.2.4c.

Table 4.2.4c: Results of Bonferroni Post hoc Analysis of the Effect of Resistance Training on Explosive Power of Male Football Players of Federal College of Education, Kontagora

(I) Training	(J) Training	Mean Difference (I-J)	Std. Error	Sig.
Pre training	4th Week	-.262*	.035	.001
	8th Week	-.398*	.068	.001
	12th Week	-.613*	.061	.001
4th Week	Pre training	.262*	.035	.001
	8th Week	-.136	.050	.085
	12th Week	-.351*	.050	.001
8th Week	Pre training	.398*	.068	.001
	4th Week	.136	.050	.085
	12th Week	-.215*	.041	.001
12th Week	Pre training	.613*	.061	.001
	4th Week	.351*	.050	.001
	8th Week	.215*	.041	.001

Based on estimated marginal means
*. The mean difference is significant at 0.05 alpha level.
* Significant $P < 0.05$

Post-hoc analysis in Table 4.2.4c using the Bonferroni correction revealed significant increase in explosive power at the 4th week of training up to the 12th week which implied that the effect was significant at all the stages. The resistance training increased explosive power starting from the 4th week of resistance training up to the 12th week. However, there was no significant difference between the 4th and 8th week of training in the explosive power.

The data collected at base-line, 4th, 8th and 12th week of resistance training on flexibility of the participants are presented in Table 4.2.5a.

Table 4.2.5a: Mean, Standard deviation and Standard error of Flexibility of Male Football Players of Federal College of Education, Kontagora.

Variable	Test Period	N	$\bar{X}$	SD	SE
Flexibility	Pre training	20	19.50	2.98	0.67
	4^{th} Week	20	21.04	1.58	0.35
	8^{th} Week	20	22.11	1.00	0.22
	12^{th} Week	20	22.53	0.87	0.19

Table 4.2.5a shows the mean, standard deviation and standard error of the effect of resistance training on flexibility which was assessed with the sit and reach test at base-line, 4^{th}, 8^{th} and 12^{th} week of training. An observation of the Table revealed that performance in flexibility test improved from 19.50 ± 2.98 to 21.04 ± 1.58, at the 4^{th} week. The results further revealed that at the 8^{th} and 12^{th} week of resistance training, the performances increased to 22.11 ± 1.00 and 22.53 ± 087 respectively.

Sub-Hypothesis 4: There is no significant effect of resistance training on the flexibility of male football players of FCE, Kontagora, Nigeria.

Information on the effect of resistance training on flexibility at baseline, 4^{th}, 8^{th} and 12^{th} week was analysed using repeated-measures ANOVA, and the results are presented in Table 4.2.5b.

Table 4.2.5b: Summary of Repeated – Measures ANOVA of Resistance Training on the Flexibility of Male football players of Federal College of Education, Kontagora

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
Training	Sphericity Assumed	109.653	3	36.551	26.082	.001
	Greenhouse-Geisser	109.653	1.140	96.201	26.082	.001
	Huynh-Feldt	109.653	1.164	94.170	26.082	.001
	Lower-bound	109.653	1.000	109.653	26.082	.001
Error(Training)	Sphericity Assumed	79.878	57	1.401		
	Greenhouse-Geisser	79.878	21.657	3.688		
	Huynh-Feldt	79.878	22.124	3.610		
	Lower-bound	79.878	19.000	4.204		

* Significant P < 0.05

Table 4.2.5b shows the summary of repeated-measures ANOVA on flexibility of the participants. An observation of the results revealed that resistance training had significantly improved flexibility of male football players at the 4^{th}, 8^{th} and 12^{th} week of training respectively (P = 0.001). The sub-ypothesis which states that there is no significant effect of resistance training on the flexibility of male football players of FCE, Kontagora, Nigeria was rejected. In order to determine when the significant effect of resistance training on flexibility occurred, Bonferroni post-hoc test was used, and the results are presented in Table 4.2.5c.

Table 4.2.5c: Results of Bonferroni Post hoc Analysis of the Effect of Resistance Training on Flexibility of Male Football Players of Federal College of Education, Kontagora

(I) Training	(J) Training	Mean Difference (I-J)	Std. Error	Sig.
	4th Week	-1.544*	.408	.008
Pre training	8th Week	-2.613*	.546	.001
	12th Week	-3.031*	.542	.001
	Pre training	1.544*	.408	.008
4th Week	8th Week	-1.069*	.187	.001
	12th Week	-1.487*	.196	.001
	Pre training	2.613*	.546	.001
8th Week	4th Week	1.069*	.187	.001
	12th Week	-.418*	.093	.001
	Pre training	3.031*	.542	.001
12th Week	4th Week	1.487*	.196	.001
	8th Week	.418*	.093	.001

Based on estimated marginal means
*. The mean difference is significant at 0.05 alpha-level.
* Significant at $P < 0.05$

Post-hoc analysis in Table 4.2.5c using the Bonferroni correction revealed significant increase in flexibility at the 4th week of training up to the 12th week which implied that the effect was significant at all the stages. The result demonstrated that resistance training increased flexibility starting from the 4th week of resistance training.

The data collected at baseline, 4th, 8th and 12thweek of resistance training respectively, on speed of the participants are presented in Table 4.2.6a.

Table 4.2.6a: Mean, Standard deviation and Standard error of Speed of Male Football Players of Federal College of Education, Kontagora.

Variable	Test Period	N	$\bar{X}$	SD	SE
Speed	Pre training	20	7.14	0.72	0.16
	4^{th} Week	20	6.36	0.33	0.07
	8^{th} Week	20	5.96	0.25	0.06
	12^{th} Week	20	5.62	0.29	0.06

Table 4.2.6a shows the mean, standard deviation and standard error of the effect of resistance training on speed which was assessed with the 50m dash test at baseline, 4^{th}, 8^{th} and 12^{th} week of training. The performance in speed test improved from 7.14 ± 0.72 to 6.36 ± 0.33, at the 4^{th} week. The results further revealed that at the 8^{th} and 12^{th} week of resistance training respectively, the performances increased to 5.96 ± 0.25 and 5.62 ± 0.29.

Sub-Hypothesis 5: There is no significant effect of resistance training on the speed of male football players of FCE, Kontagora, Nigeria.

Information on the effect of resistance training on speed at baseline, 4^{th}, 8^{th} and 12^{th} week was analysed using repeated-measures ANOVA, and the results of which are presented in Table 4.2.6b.

Table 4.2.6b: Summary of Repeated Measures ANOVA of Resistance Training on the Speed of Male football players of Federal College of Education, Kontagora

Source		Type III Sum of Squares	Df	Mean Square	F	Sig.
Training	Sphericity Assumed	25.734	3	8.578	54.919	.001
	Greenhouse-Geisser	25.734	1.599	16.090	54.919	.001
	Huynh-Feldt	25.734	1.723	14.932	54.919	.001
	Lower-bound	25.734	1.000	25.734	54.919	.001
Error(Training)	Sphericity Assumed	8.903	57	.156		
	Greenhouse-Geisser	8.903	30.389	.293		
	Huynh-Feldt	8.903	32.745	.272		
	Lower-bound	8.903	19.000	.469		

* Significant at $P < 0.05$

Table 4.2.6b shows the summary of repeated measures ANOVA on speed of the participants. The results revealed that resistance training had significant effect on speed of male football players at the 4^{th}, 8^{th} and 12^{th} week of training respectively, ($P = 0.001$). The sub hypothesis which states that there is no significant effect of resistance training on the speed of male football players of FCE, Kontagora, Nigeria was rejected. In order to determine when the significant effect of resistance training on speed occurred, Bonferroni post-hoc test was used, the results are presented in Table 4.2.6c.

Table 4.2.6c: Results of Bonferroni Post hoc Analysis of the Effect of Resistance Training on Speed of Male Football Players of Federal College of Education, Kontagora

(I) Training	(J) Training	Mean Difference (I-J)	Std. Error	Sig.
	4th Week	.780*	.131	.001
Pre training	8th Week	1.185*	.167	.001
	12th Week	1.520*	.171	.001
	Pre training	-.780*	.131	.001
4th Week	8th Week	.405*	.088	.001
	12th Week	.740*	.073	.001
	Pre training	-1.185*	.167	.001
8th Week	4th Week	-.405*	.088	.001
	12th Week	.335*	.079	.003
	Pre training	-1.520*	.171	.001
12th Week	4th Week	-.740*	.073	.001
	8th Week	-.335*	.079	.003

Based on estimated marginal means
*. The mean difference is significant at 0.05 alpha level.
* Significant at $P < 0.05$

Post-hoc analysis in Table 4.2.6c using the Bonferroni correction revealed significant increase in speed at the 4th week of training up to the 12th week, which implied the effect was significant at all the stages. The resistance training increased speed starting from the 4th week of resistance training.

The data collected at base-line, 4th, 8th and 12th week of resistance training respectively on agility of the participants are presented in Table 4.2.7a.

Table 4.2.7a: Mean, Standard deviation and Standard error of Agility of Male Football Players of Federal College of Education, Kontagora

Variable	Test Period	N	$\bar{X}$	SD	SE
Agility	Pre training	20	9.52	0.63	0.14
	4^{th} Week	20	8.72	0.58	0.13
	8^{th} Week	20	8.44	0.47	0.11
	12^{th} Week	20	8.02	0.30	0.07

Table 4.2.7a shows the mean, standard deviation and standard error of the effect of resistance training on agility which was assessed with the 20m shuttle run test at baseline, 4^{th}, 8^{th} and 12^{th} week of training respectively. An observation of the result revealed that performance in agility test improved from 9.52 ± 0.63 to 8.72 ± 0.58, at the 4^{th} week. The results further revealed that at the 8^{th} and 12^{th} week of resistance training respectively, the performances increased to 8.44 ± 0.47 and 8.02 ± 0.30.

Sub-Hypothesis 6: There is no significant effect of resistance training on the agility of male football players of FCE, Kontagora, Nigeria.

Information on the effect of resistance training on agility at baseline, 4^{th}, 8^{th} and 12^{th} week respectively was analyzed using repeated-measures ANOVA, the results of which are presented in Table 4.2.7b.

Table 4.2.7b: Summary of Repeated Measures ANOVA of Resistance Training on the Agility of Male football players of Federal College of Education, Kontagora

Source		Type III Sum of Squares	Df	Mean Square	F	Sig.
Training	Sphericity Assumed	24.346	3	8.115	91.425	.001
	Greenhouse-Geisser	24.346	2.004	12.147	91.425	.001
	Huynh-Feldt	24.346	2.241	10.865	91.425	.001
	Lower-bound	24.346	1.000	24.346	91.425	.001
Error (Training)	Sphericity Assumed	5.059	57	.089		
	Greenhouse-Geisser	5.059	38.080	.133		
	Huynh-Feldt	5.059	42.575	.119		
	Lower-bound	5.059	19.000	.266		

* Significant at $P < 0.05$

Table 4.2.7b shows the summary of repeated measures ANOVA on agility of the participants. An observation of the results revealed that resistance training significantly improved the agility of male football players at the 4^{th}, 8^{th} and 12^{th} week of training respectively ($P = 0.001$). The sub-hypothesis which states that there is no significant effect of resistance training on the agility of male football players of FCE, Kontagora, Nigeria was rejected.

In order to determine when the significant effect of resistance training on agility occurred, Bonferroni post hoc test was used, and the result of which are presented in Table 4.2.7c.

Table 4.2.7c: Results of Bonferroni Post hoc Analysis of the Effect of Resistance Training on Agility of Male Football Players of Federal College of Education, Kontagora

(I) Training	(J) Training	Mean Difference (I-J)	Std. Error	Sig.
	4th Week	.810*	.074	.001
Pre training	8th Week	1.090*	.101	.001
	12th Week	1.510*	.120	.001
	Pre training	-.810*	.074	.001
4th Week	8th Week	.280*	.083	.018
	12th Week	.700*	.108	.001
	Pre training	-1.090*	.101	.001
8th Week	4th Week	-.280*	.083	.018
	12th Week	.420*	.068	.001
	Pre training	-1.510*	.120	.001
12th Week	2	-.700*	.108	.001
	3	-.420*	.068	.001

Based on estimated marginal means
*. The mean difference is significant at 0.05 alpha-level.
* Significant at $P < 0.05$

Post-hoc analysis in Table 4.2.7c using the Bonferroni correction revealed significant increase in agility at the 4th week of training up to the 12th week which implied the effect was significant at all the stages. Thus, the resistance training increased agility, starting from the 4th week of resistance training.

4.3 Discussion

The purpose of this study was to assess the effect of resistance training on the biomotor abilities of male football players of Federal College of Education, Kontagora, Nigeria. The results of hypotheses formulated and tested revealed that there was significant effect of resistance training on the biomotor ability variables of abdominal strength, endurance (VO_2 max), flexibility, explosive power, speed and agility of male football players of Federal College of Education, Kontagora, Nigeria after 12 weeks of training programme.

Findings of the study on hypothesis one revealed that resistance training had significant effect on the abdominal strength of male football players of Federal College of Education Kontagora, Nigeria at 4^{th}, 8^{th} and 12^{th} week, respectively. The significant increase in abdominal strength of the male players may be attributed to the increase in muscle fiber size and the recruitment of more motor units of nerve cells due to varying training intensities and led to higher peak muscle torque of the lower extremities (Kalapotharakos, Strimpakos, Vithoulka, Karvounidis, Diamantopoulos and Kapreli, 2006). These findings also agreed with the findings of Reilly & Doran (2009), Stolen, Chamarri, Castagna and Wisloff (2010) as well as the findings of Michailidis, Fatouros, Primpa, Michalaidis and Avloniti (2013), who reported that abdominal muscles improved when resistance training was added to the regular sessions of football training programmes.

Alikhajeh, Mohamadi, Yaghoubi and Rasekhi (2012), revealed that improved abdominal strength of footballers is required for many vital skills especially in kicking, jumping, turning and sprinting. The findings of Meylan & Malatesta (2009), revealed that the muscle strength of football players is not an entire body characteristics but is dependent on the ability and trainability of specific body segment to perform the desired movement. These findings indicated

that the improved abdominal strength among the male football players of F.C.E Kontagora will impact positively on their match day performances and increase their achievement and successes.

Findings on the second hypothesis revealed that resistance training had significant effect on the VO_2 max (endurance) of male football players of FCE Kontagora at 4^{th}, 8^{th} and 12^{th} week respectively. The increase in VO_2 max was due to the significant effect of 12 weeks resistance training programme. This finding agreed with the findings of LeGall *et al.,* (2010), and those of McMillan *et al.,* (2009), Stolen *et al.,* (2010).

Helgerud *et al.,* (2013), found significant effect on VO_2 max after 10 weeks of resistance training programme performed by male youth football players. This finding agreed with the findings of LeGall *et al.,* (2010), that improved VO_2 max greatly improved football players performance during competitions. Bradley (2015), also found improved VO_2 max among male youth football league after 8 weeks resistance training for three consecutive seasons (2004, 2003 and 2004), which produced VO_2 max scores as follows; 54.8ml kg-1 min 1, 56.8.ml kg-1 and 57.6 ml kg^{-1} min^{-1} respectively in the 2002, 2003 and 2004 seasons. Furthermore, this finding corroborated with the findings of Gil *et al.,* (2007), who reported significant effect of long duration, low load resistance training among male youth selected football players. The resultant effect of these findings concerning improved VO_2 max is that male football players presented lower heart rates in endurance run, with a larger difference during recovery periods (Bradley, 2015; Helgerud *et al.,* 2010; LeGal *et al.,* 2010). Tonnessen *et al.,* (2013), Verducci (2009) and Thyron (2009), all supported gains in football specific and general endurance ability through increased maximal oxygen uptake (VO_2 max). These benefits of improved VO_2 max will improve the endurance ability of FCE, Kontagora male football players and allows them maintain in concentration throughout the duration of training and competitions.

Findings on the third hypothesis revealed that resistance training had significant effect on the explosive power of male football players of FCE, Kontagora at 4^{th}, 8^{th} and 12^{th} week respectively. The improvement in explosive power at all assessment stages, agreed with the findings of Cometti *et al.,* (2001), Gil *et al.,* (2007), Armason *et al.,* (2004) and Docherty *et al.*, (2004), who found improved explosive power among young male football players after high intensity leg extension resistance training. McMillan *et al.,* (2009), also recorded significant increase in broad and squat jump performance among young male football players after 8 weeks of leg extension resistance training.

Wisloff (2010), revealed that resistance training is more effective to improve explosive leg power among football players than any other method of training. This is in line with the Young, James and Montgomery (2002), who found significant improvement in leg power kicks, power jump headings and jump throws among male football players who went through 12 weeks of leg/knee extensions resistance training. All these significant improvement findings regarding explosive leg power due to resistance training, are physiological function of the neuro-muscular system ability to overcome resistance with speed of contraction, leading to the increase capacity of the leg to release maximum muscular force in the shortest time possible (force and velocity) (Baumgartner, Jackson, Mahor and Rowe, 2007; Stolen *et al.*, 2010).

The benefits of these findings on explosive power to FCE male football players will be achievements in powerful and accurate shots towards the goal, power throws and power jump headings during training and competitions.

Findings on the fourth hypothesis revealed that resistance training had significant effect on the flexibility of male football players of FCE, Kontagora at 4^{th}, 8^{th} and 12^{th} week, respectively. The improvement in flexibility at all assessment stages agreed with the findings of

Zakas (2005), Zakas *et al.*, (2006), Miller *et al.,* (2006), Testore *et al.*, (2006) and Powers & Howley (2012). They found that long duration resistance training on hip flexors and knee flexors produced range of movement (ROM) of hip and knee flexion in non injured football players. They concluded that the propensity for hamstring injury in the dominant kicking leg will be greater with increases in age. Henderson *et al.,* (2010), also revealed improvement in flexibility resulting from significant increase in ROM of the knee flexion through 10 weeks of resistance training. Amason *et al.,* (2008), examined the effect of static stretching on the flexion of the trunk and back as well as the elasticity of the hamstring muscles. They revealed that flexibility was enhanced 30% more than baseline assessment. However, Henderson *et al.,* (2010), found dynamic resistance training to have improved flexibility more than static stretches. Their findings indicated that active hip, knee flexion range of movement on dominant limb was higher than run-dominant limb (69.3 ± 9.8^0 V 66.5 ± 10.9^0, $P < 0.05$) increased flexibility due to resistance training had brought about positive range of motion changes at the joints, strengthening musculo-tendenous unit length and musculo-tendenous unit flexibility. The benefits of flexibility on the male football players of FCE Kontagora would be the enhancement performance through harmonious movements during football competitions, training and tournaments. This will reduce risk of injuries, especially hamstring muscle injuries that are very common with football players (Engebretsen *et al.*, 2010; Laia *et al.,* 2009; and Witvrouw *et al.*, 2003).

Findings on the fifth hypothesis revealed that resistance training had significant effect on the speed of male football players of FCE Kontagora at 4^{th}, 8^{th} and 12^{th} week respectively. The improvement in speed at all the assessment stages, agreed with the findings of Vaczi *et al.*, (2013), Venturelli *et al.,* (2008), Alvarez *et al.,* (2010), Mohr *et al.,* (2009) and Reilly *et al.*,

(2000). They revealed that sprinting performance was significantly improved when muscle strength of the lower limbs were developed with resistance training. Long duration resistance training of the lower limbs helps improve potentials for sprinting. They stated further that leg press resistance training helps football players to be quicker and faster on short distances of 10m, 20m and 30 metres respectively.

Baker & Nance (2009), also revealed that resistance training helps speed and acceleration, the most important aspects football players require for skillful game performance. Similar to these findings, Vaczi *et al.,* (2013), Barbero-Alvarez *et al.,* (2010) and Venturelli *et al.,* (2008), revealed that the ability to perform repeated sprints with minimal recovery between sprint bouts was greatly enhanced due to 10 weeks of resistance training. They mentioned further that these was helped by the improvement in muscle strength of the lower limbs.

The field benefits of speed to football players' performance cannot be over emphasized. Therefore, the benefits of these findings to FCE, Kontagora male football players would be to meet the demand of the sprinting frequency requirement of the game of football. The players would be able to specifically meet up with game action speed, action with ball, movement speed with ball, reaction speed, decision making speed, anticipation speed and perceptual speed (Wilmore & Costil, 2005). Vaczi *et al.,* (2013), mentioned that the frequency of sprinting in field sports such as football with sometimes more than 90 minutes duration, has about 20-60 bouts per game, with a total sprint distance of approximately 700-1000 m. According to Reilly, Bangsbo and Franks (2000), competitive match play calls for an all out sprint once every 90 seconds on average and high intensity efforts every 30 seconds for each football player.

Findings on the sixth hypothesis revealed that resistance training had significant effect on the agility of male football players of FCE Kontagora at 4^{th}, 8^{th} and 12^{th} week, respectively. The

improvement in agility at all the assessment stages was in line with the findings of Benvenuti *et al.,* (2010), who revealed steady increase in performance of the agility run test after long duration of 12 weeks resistance training of under 20 male football players.

Little and Williams (2005), Meylan & Malatesta (2009) and Ferrigno & Brown (2005), also revealed improvements due to resistance training activity of leg press; sharp changes in direction at high running speeds was noticed among the football players during game situation. This finding was in line with the findings of Sporis et al., (2010), Haff & Nimphins (2012) and Young et al., (2008) who concluded that well known training methods such as resistance training and plyometric training of football players were of significant importance and could lead to meaningful improvement in explosive leg power and general dynamic athletic performance. Bangsbo (2008), also in agreement with this, findings opined that reasonable duration of resistance training helps football players to perform activities requiring rapid development of force such as sprinting or quickly changing directions. He further added that, there is strong relation among speed, agility and quickness.

The benefits of these findings to FCE Kontagora male football players would be to help them with the ability to perform rapid whole body movement with change of velocity or direction during game or competition situations. It will help goal keepers in particular have better reflexes and be able to get to high balls quicker. Defenders would also be difficult to be dribbled and their tackles more accurate and clean. Midfielders would dribble with ease and strikers would also work around their quickness in order to get in front of the defenders and finish on across, or dribble their way to goal where possible. Agility is thus the ability to start, stop and change direction quickly with precision (Sheppard & Young, 2006).

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary

The study was conducted to assess the effects of resistance training on biomotor abilities of male football players in FCE, Kontagora, Nigeria. To achieve the purpose of this study, twenty (20) male football players were drawn from the total population (33) of all the male football players of FCE, Kontagora, Nigeria; and served as participants for the study. A multi-stage sampling technique of purposive, stratified and simple random sampling were used to select the participants. The twenty (20) male football players sampled for the study comprises of all the playing positions in the football game (that is, defence, mid-field, forward and goalkeepers). The repeated-measures research design was adopted for the study, which provided room for the resistance training method to be organised around six (6) stations of circuit activities (Hand dips, lateral pull, leg press, leg curl, leg/knee extension and abdominal curl) and four (4) assessments of participants biomotor abilities at base-line, at 4^{th}, 8^{th} and 12^{th} week of resistance training.

The training programme lasted for 12 weeks. The participants were all given informed consent forms to fill and return, confirming their readiness and willingness to undergo the training procedures. A written ethical permission was also obtained from ABU, Zaria, Ethical Committee, to carry out the research.

All the resistance training sessions were preceded by ten (10) minutes warm up activities which included 5 minutes of easy jogging, jumping jacks, and stretching (active and static) for 5 minutes of the muscles of the upper and lower limbs. The resistance training programme was structured to last for 12 weeks, with training sessions divided into three (3) phases. Each phase

lasted for four (4) weeks, and arranged as follows; phase one – 1^{st} – 4^{th} week, phase two – 5^{th} – 8^{th} week and phase three - 9th – 12^{th} week respectively.

Participants performed six (6) selected different dynamic resistance activities arranged in a circuit with each activity serving as a station. These six (6) activities included; the hand dips, lateral pull, leg press, leg/knee extension, leg curl and abdominal curl. Each training session lasted for 60 minutes (one hour) and three training sessions per week on alternate days (Monday, Wednesday and Friday). The resistance training of phase one was based on 50% 1-RM of 12 repetitions, for 3 sets with rest interval (RI) of one and half ($1^{1/2}$) minutes between sets. Phase two was based on 60% 1-RM of 12 repetitions for 3 sets with rest interval (RI) of two (2) minutes between set and phase three (3) intensity of training was based on 65% 1-RM of 12 repetitions for 3 sets with two and half ($2^{1/2}$) minutes rest interval (RI) between set.

After each phase of training was concluded, each participants biomotor ability tests of sit-up for abdominal strength, VO_2 max for endurance, sit and reach for flexibility, broad jump for explosive power, 50 metre dash for speed and 20 metre shuttle run for agility were carried out first at baseline and after each phase of the three phases of training. Results obtained were recorded for each phase (at baseline, at 4^{th}, 8^{th} and 12^{th} week of training respectively).

Data collected were statistically analysed using descriptive statistics and inferential statistics of repeated measures ANOVA. The hypotheses were tested at 0.05 alpha-level of significance. The research results revealed that abdominal strength increased at all the assessment stages above base-line results ($P = 0.001$). Similarly, results of VO_2 max revealed increased endurance ability of the participants above baseline results ($P = 0.001$). Explosive power of participants also improved at all assessment stages when compared with baseline data ($P = 0.001$). The flexibility of participants also improved at all assessment stages when compared

with baseline data (P = 0.001). The speed ability of participants also improved at all assessment stages when compared with baseline data (P = 0.001). The agility of the participants similarity improved at all assessment stages when compared with baseline data (P = 0.001).

From the results above, it could be concluded that there was significant effect of resistance training (RT) on the selected biomotor abilities (abdominal strength, endurance, power, flexibility, speed and agility) of male football players of Federal College of Education Kontagora, Nigeria. Based on the study, the following summary of the major findings includes;

i. There was significant improvement in the abdominal strength of male football players of Federal College of Education (FCE), Kontagora (P = 0.001) at the 4^{th}, 8^{th} and 12^{th} week of resistance training.

ii. There was significant improvement in the VO_2 max of male football players of Federal College of Education (FCE), Kontagora (P = 0.001) at the 4^{th}, 8^{th} and 12^{th}week of resistance training.

iii. There was significant improvement in the explosive power of male football players of Federal College of Education (FCE), Kontagora (P = 0.001) at the 4^{th}, 8^{th} and 12^{th} week of resistance training.

iv. There was significant improvement in the flexibility of male football players of Federal College of Education (FCE), Kontagora (P = 0.001) at the 4^{th}, 8^{th} and 12^{th} week of resistance training.

v. There was significant improvement in the speed of male football players of Federal College of Education (FCE), Kontagora (P = 0.001) at the 4^{th}, 8^{th} and 12^{th} week of resistance training.

vi. There was significant improvement in the agility of male football players of Federal College of Education (FCE), Kontagora (P = 0.001) at the 4^{th}, 8^{th} and 12^{th} week of resistance training.

5.2 Conclusions

Based on the findings of the study, the following conclusions were drawn;

i. There was significant effect of resistance training on the abdominal strength of male football players of FCE, Kontagora, Nigeria (P = 0.001). The trunk, hips and abdominal muscules are more resilencent during performance.

ii. There was significant effect of resistance training on the VO_2 max (endurance) of male football players of FCE, Kontagora, Nigeria (P = 0.001). The general endurance of the players is generally improved.

iii. There was significant effect of resistance training on the explosive power of male football players of FCE, Kontagora, Nigeria (P = 0.001). The explosive leg power of players is greatly improved.

iv. There was significant effect of resistance training on the flexibility of male football players of FCE, Kontagora, Nigeria (P = 0.001). The free movements of players at the joints are greatly enhanced.

v. There was significant effect of resistance training on the speed of male football players of FCE, Kontagora, Nigeria (P = 0.001). This makes players to freely move fast and quickly towards the direction of movement to achieve the desire goal.

vi. There was significant effect of resistance training on the agility of male football players of FCE, Kontagora, Nigeria (P = 0.001). This helps the players to manoeuver within available space during performance.

5.3 Contribution to Knowledge

This study contributed to knowledge in the following ways;

i. Provided trainers and coaches the opportunity to fully understand the planning and execution of resistance training programme among football players in Nigeria.

ii. Provided high standard of playing football at the colleges of education level in Nigeria.

iii. Improved the physical fitness level of football players across all tertiary institutions in Nigeria.

iv. Provided students and football players the opportunity to be trained in biomotor ability variables of strength, endurance, flexibility, explosive power, speed and agility.

v. Provided a source of reference material for further research in education and exercise science and sports areas.

5.4 Limitation of the Study

This study was limited in the following ways;

i. That variables of biomotor abilities were not wholly included in the study. The study only selected few of the biomotor ability variables. It could have brought about better judgement if all the variables were included. However, further research on the variables not selected would address the short comings.

ii. That the age range of 18 – 29 years limits the researcher in making generalization as older male football players were set at disadvantage, meaning that the older players might have felt cheated for being excluded in the study, a problem which only further study can address.

5.5 Recommendations

On the basis of the findings of this study, the following recommendations are made;

i. Football is the most popular sport in Federal College of Education Kontagora, therefore, the FCE, Kontagora authorities should fully equip or upgrade to acceptable standards, the existing physical fitness laboratory or gym in the College to meet the training needs of all football players. This would further popularize the use of resistance training as a preferred method of improving many physiological variables of football players in the colleges of education and other tertiary institutions in Nigeria.

ii. Biomotor ability training and tests of abdominal strength, endurance (VO_2 max), flexibility, explosive power, speed and agility should be carried out regularly by coaches and trainers of male football players of the College. This would improve the general performance of the team and most desirably win titles for the College, especially the seemingly elusive Nigeria Colleges of Education Games Association (NICEGA) Football Championship Cup.

iii. Coaches and trainers should be sponsored for further studies at home and abroad to improve their knowledge in modern scientific training methods, especially resistance training method. This would help to establish standards and produce quality football players in colleges of education and other tertiary institution in Nigeria.

5.6 Recommendation for Further Studies

The researcher identified some related problem areas that may need further investigation and assessment;

1. As this study was conducted on male football players of FCE, Kontagora, Nigeria; a similar assessment using the same variables should be conducted on female football players in any Federal or State College of Education in Nigeria.
2. Studies could also be conducted on football players from Colleges of Education, Polythenics and Universities in Nigeria using other training methods for a defined group with different variables not included in this study.

REFERENCES

Aagaard, P. (2003). Training-induced changes in neural function. *Exerc Sport Sci Rev*.31 :61-67.

Abdi, J., & Sadeshi, H. (2012). Effect of eight week core stability training programme on the dynamic balance.*9th International Conference on the Conservative management of spinal deformities.*

Ade, C; Boddy, J; Krustrup, M and Mohr, M. (2013). Match performance and physical capacity of players in the top three competitive standards of English professional soccer. *Human Movement Science,* 32: 808-821

Ager, D. (2000).*The Soccer Referee's Manual*. 3rd ed. London: A&C Black Publishers.

Alikhajeh, Y., Mohamadi, M.A., Yaghoubi, M., and Rasekhi, M.J. (2012).The effect of different warm-up protocol on young soccer players explosive power. *International Journal of Applied Exercise Physiology, 1(2).*

Almuzaini, K.S. (2000). Optimal peak and mean power on the Wingate test: Relationship with sprint ability, vertical jump, and standing long jump in boys. *Pediatric Exercise Science,* 12:349-359.

American Alliance for Health, Physical Education, Recreation and Dance AAHPERD (2010) in Bangsbo, J. (2012). *Physiology of Training.* London: Longman Publishers (Eds), p. 47-58

American College of Sports Medicine ACSM (2010), *Guidelines for Exercise Testing and Prescription* 8th edition Philadelphia. Lea & Febiger.

American College of Sports Medicine ACSM (2011) Position stand on quantity and quality of exercise for developing and maintain cardio-respiratory, muscle-skeletal and neuromotor fitness an athletes. *Journal of Medical in Sports and Exercise*, 43: 1334-1359

American orthopedic society for sports medicine (2008). *Proceeding of the Conference on strength training and the prepubescent,* Chicago.

Andrejic, O. (2010).The effect of plyometric and strength training program on the fitness performance in young basketball players. *Journal of Physical Education and Sports,*10 (3): 221-229.

Angard, P., Simonsen, E.B., Andersen, J.L., Magnusson, P., and Dyhre-Poulsen, P. (2010). Increase rate of force development and neural drive of human skeleton muscles following resistance training. *Journal Applied Physiology,* 93: 1318-1326.

Arazi, H., Coetzee, B., & Asadi, A. (2012). Effect of land and aquatic-based plyometrictraining on Jumping ability and agility of young basketball players. *South African Journal for researcher in Sports Physical Education and Recreation,* 34: (2), 1-14.

Arnason, A., Sigurdsson, S.B., Gudmundsson, A., Holme, I., Engebretsen, L. & Bahr, R. (2004). Physical fitness, injuries, and team performance in soccer. *Medicine and Science in Sports and Exercise*, Vol 278-285.

Ashish, D. (2005). Study of Different body characteristics in relation to positional play in Soccer. *Journal of Sport Science,* 23 (3)122-138.

Azeem, K., & Ameer, A.A. (2010). Effect of weight training on sprinting performance flexibility and strength. *British Journal of Sports Medicine,* 44 (14).

Baker, D.,& Nance, S. (2009). The relation between running speed and measure of strength and power in professional football league players. *Journal of strength Conditioning research,* 13(13), 230-235.

Balaji, E., & Murugavel, K. (2013). Motor fitness parameters response to core strength training [CST] on hand ball players. *International journal for life science and education research,* 1(2), 76-80.

Baldock, M. (2008). *Block Periodization, Fundamental Concept and Training Design Ultimate Athletic Concept,* USA: Michigam.

Bangsbo, J., Mohr, M., Poulsen, A., Perez-Gomez, J & Krustrup, P. (2008). Training and testing the elite athlete. *Journal of Exercise Science and Fitness,* 4 (1), 1-14.

Barbero-Álvarez, J.C., Coutts, A., Granda, J., Barbero-Álvarez, V. and Castagna C. (2010). The validity and reliability of a global positioning satellite system device to assess speed and repeated sprint ability (RSA) in athletes. *Journal of Science and Medicine in Sport,* 13: 232-235.

Baumgartner, T.A; Jackson, A.S; Mahor, M.T; & Rowe, D.A (2007).*Measurement for Evaluation in Physical Education & Exercise Science* (8th Edition). Boston: McGraw Hill Publishers.

Benvenuti, C., Minganti, C., Condello, G., Capranica, L. & Tessitore, A. (2010).Agility assessment in female futsal and soccer players. *Medicina (Kaunas),* 46(6):415-420.

Bhayani, K., & Singaravelan, T., (2012). Effectiveness of core stability training on improving task specific physical activity in developmental coordination disorder children. *RevistaRomana De Kineto terapie,* 18 (30), 33-40.

Bloomfield, J., Polman, R., and O'Donoghue, P. (2009); Physical demands of different positions in FA premier league soccer. *Journal of Sports Science Medicine,* (6): 63-70.

Bompa, T.O and Haff, G.G. (2009). *Periodization*: *Theory and Methodology of Training. Champaign, Illinois:* Human Kinetics Publishers.

Bompa, T.O., & Carrea (2005). *Periodization Training for Sports: Science based Strength and Conditioning Plans for 20 Sports.* (2nd ed). Champaign, IL: Human Kinetics.

Bradley, P.S., Carling C., Gomez, D.A., Hood, P., Barnes C., Ade, J., Boddy, M., Krustrup, P., and Mohr, M., (2013). Match performance and physical capacity of players in the top three competitive standards of English professional soccer. *Human Movement Science*, 32: 808-821.

Bradley, P.S. (2015). Match running performance during fixture congestion in elite soccer: research issues and future directions. *Journal of Sports Medicine and Exercise Science,* 38 (4): 225-259.

Brooks, G.A, Fahey, T.D. and Baldwin, K.M (2010). *Exercise Physiology: Human Bioenergetics and its Application*. New York, NY: McGraw Hill.

Brooks, K.Y; Casajus, J.A and Burges, D. J (2010). Seasonal variation in fitness variable in professional soccer players. *Journal of Sports Medicine and Physical Fitness,* 41: 463-469.

Buchheit, M, Mendez-Villanueva, A; Delhomel, G; Brughelli, M and Ahmaidi, S. (2010). Improving repeated sprint ability in young elite soccer players: Repeated shuttle sprints vs. explosive strength training. *Journal of Strength Conditioning Research*,24: 2715-2722.

Castanga, J.B; D'Ottavio, S and Abt, G. (2003). Activity profile of young soccer players during actual match play. *Journal of Strength Conditioning Research*,17: 775-780.

Chamari, K. Hachana, Y; Ahmed Y.B. Galy, O. Sghaier, F, Chatfard, J.C. Hue, O. and Wisloff, U. (2004) Field and laboratory testing in young elite football players. *British Journal of Sports Medicine, 38: 192-196*

Chandralekha, K., & Jothi, K. (2013). Influence of Swiss ball training on selected physical fitness variables among football players. *Lokavishkar International e-journal,* 2 (2): 28-31.

Cometti, G., Maffiuletti, N.A., Pousson, M., Chatard, J.C. and Maffulli,N. (2001).Isokinetic strength and anaerobic power of elite, subelite and amateur French soccer players. *International Journal of Sports Medicine,* 22: 45-51.

Cook, G. (2009). *Athletic body in balance*: Champaign, Illinois; Human Kinetic Publishers.

Cooper, K.H (1968). A means of assessing maximal oxygen intake. JAMA-Journal of American Medical Association 203, 135-138 in Grant, et al (1997). A comparison of methods of predicting maximum oxygen uptake. *British Journal of Sports Medicine*, 29 (3) P.147-152

Cormie, P. McGuigan, M.R, and Newton, R.U, (2011). Developing maximal neuromuscular power production. *Journal of Sports Medicine*, 4 (2): 125-146.

Cormie, P., McCaulley, G.O., Triplett, N.T. and McBride, J.M. (2010). "Optimal loading for maximal power output during lower body resistance exercises" *Medicine and Science in Sports and Exercise*, 39 (2): 340-349.

Corroll, T.J., Riek, S., and Carson, R.G. (2011). Neural adaptation to resistance training: Implication for movement control. *Sports Medicine*, 31(12): 829-840.

Coutts, A. & Abt, G. (2005).*Training aerobic capacity for improved performance in team sports*.[Format]. Available from: https://secure.ausport.gov.au/data/assets/pdf_file/0006/269574/27403Coutts.pdf [Accessed: 07/06/2016].

Croisier, J.L., Ganteaume, S., Binet, J., Genty, M., and Farret, J.M. (2008). Strength imbalances and prevention of hamstring injury in professional Soccer players: A Prospective study. *American Journal of Sports Medicine*, 36: 1469-1475.

Das, A. K., Subramaniam, P.K. and Paul, K.P.P.S. (2014). Effect of Complex training with Core exercise programme on agility among Soccer players. *Global Journal for Research Analysis*, 3(1): 76-77.

De Prof, F., Cabri, J.,Dufour, W., and Clarys, J.P. (2013). *Strength Training and Kick Performance in Soccer Players in Science and Football.* (eds T. Reilly, A. Lees, K. Davisand W.J. Murphy), London : E & FN Spon, , pp.108-113.

Delgado-Bordonau, J, &Mendez-Villanueva, A (2012). Tactical periodization: Mourinho's best-kept secret? *Soccer National Strength Conditioning Association Journal*, 3: 28-34.

Dellal, A; Hill-Haas, S; Lago-Penas, C. and Chamari, K.(2011). Small-sided games in soccer: amateur vs professional players' physiological responses physical and technical activities. *Journal of Strength and Conditioning Research*, 25: 2371-2381.

Diallo O, Dore' E, Duche P. and Van Praagh, E. (2001). Effects of plyometric training followed by a reduced training programme on physical performance in prepubescent soccer players. *Journal of Sports Medicine and Physical Fitness*, 42: 342-348.

Docherty, D., Robbins. & Hodgson, M. (2004). Complex training revisited: A review of its current status as a viable training approach. *Strength Condition Journal*, 26: 52-57.

Edgecomb, S.K and Norton, K.I (2006). Comparison of global positioning and computer-based tracking systems for measuring player movement distance during Australian Rugby football. *Journal of Science and Medicine in Sport,* 9: 25-32.

Engebretsen, A.H., Holme, I., Engebretsen, L., and Bahr, R. (2010). Intrinsic risk factor for hamstring injuries among male soccer players. *American Journal of Sports Medicine,* 20 (10): 1-7.

Falk, B., & Mor, G. (2006). The effect of resistance and martial arts training in 6 to 8 years old boys. *Pediatric Exercise Science,* 8: 48-56.

Farrow, D; Young, W. & Bruce, L. (2009). The development of a test of reactive agility for football. A new methodology, *Journal of Science and Medicine in Sport*, 8: 52-60.

Faude, O., Koch, T. and Meyer, T. (2012). Straight sprinting is the most frequent action in goal situations in professional football. *Journal of Sports Sciences,* 30 (7): 625-631

Feigenbaum, M & Pollock, M. (2009) Prescription of resistance training for health and disease. *Journal of Exercise Science and Sports Medicine,* 31: 38-45

Ferrigno, V. &Brown, L.E.(2005).*Training for Speed, Agility, and Quickness*. Champaign, Illinois: Human Kinetics Publishers

Figueiredo, A.J; Coelho, E; Silva, M.J; Cumming, S.P. and Malina, R.M. (2010). *Size and Maturity Mismatch in Youth Football Players. Paediatric Exercise Science*, 22(4): 596-612.

Gabbet, T.J. (2006) Skill based conditioning game as an alternative to traditional conditioning for football players. *Journal of Sports Medicine,* 20 (60): 309-314.

Gettman, I.R. & Pollock, M.L (2009) Circuit resistance training: A critical review of its physiological benefits. *Journal of Physician and Sports Medicine* 9 (1): 44-60

Gettman, I.R., Ayres, J.J., Pollock, M.L, and Jackson (2011).The effect of circuit resistance training on strength and endurance. *Journal of Medical Science and Sports,* 10 (3): 171-176.

Gil, S.M., Gil, J., Ruiz, F., Irazusta, A. and Irazusta, J. (2007). Physiological and anthropometric characteristics of young soccer players according to their playing position: Relevance for the selection process. *Journal of Strength and Conditioning Research,* 21 (2): 438-445.

Gissis, I., Papadopoulos, C., Kalapotharakos, V.I., Sotiropoulos, A., Komsis, G. and Manolopoulos, E. (2006). Strength and speed characteristics of elite, subelite, and recreational young soccer players. *Research in Sports Medicine,* 14: 205-214.

Grant, S. Edgecomb, S.K & Norton, K.I (1997).A comparison of methods of predicting maximum oxygen uptake. *British Journal of Sports Medicine,* 29(3): 147-152.

Gravina, L; Gil, S.M; Ruiz, F; Zubero, J; Gil, J and Irazuta, J. (2008). Anthropometric and physiological differences between first team and reserve soccer players ages 10-14 years at the beginning and end of the season. *Journal of Strength and Conditioning Research,* 22: 1308-1314.

Gregory, D.M., Kevin, R.F., Jensen, L.B., & Timothy, E.H. (2006). Effect of Plyometricvs dynamic stabilization and balancing training on power, balance and landing force in female athletes. *Journal of strength and conditioning research,* 20(2), 345-353.

Haff, G.G, & Nimphius, S (2012); Training principles for power, *Journal of Strength and Conditioning Research* 34 (6): 2

Harris, D.J & Atkinson, G. (2011). Update – ethical standards in sport and exercise science. *International Journal of Sports Medicine 32*, 819-821.

Haugen T, Tonnesen E, Hisdal J, and Seiler S. (2013). The Role and Development of Sprinting Speed in Soccer *International Journal of Sport Physiology and Performance*. Human Kinetics, Inc.

Haugen, T., Tonnessen, E., Hisdal, J. and Seiler, S. (2014). The role and development of sprinting speed in soccer. *International Journal of Sports Physiology and Performance* 9, 432-441

Helgerud, J., Engen, L.C., Wisloff, U. and Hoff, J. (2010). Aerobic endurance training improves soccer performance. *Journal of Medicine and Science in Sports and Exercise*, 33 (11): 1925-1931.

Helgerud, J., Kemi, O.J. and Hoff, J. (2013). Pre-season concurrent strength and endurance development in elite soccer players. In: Hoff, J. & Helgerud, J. (eds.). *Football (soccer): New Developments in Physical Training Research*. Trondheim: NTNU, 53-65.

Henderson, G., Barnes, C.A. and Portas, M.D. (2010). Factors associated with increased propensity for hamstring injury in English Premier League soccer players. *Journal of Science and Medicine in Sport,* 13:397-402.

Heyward, V.H. (2010). *Advanced Fitness Assessment and Exercise Prescription*, Illinois Human Kinetics 6th Edition

Hill-Haas, S.V; Dowson, B.F; Coutts, A.J. and Rowsell, G.J (2010). Time Motion Characteristics and Physiological Response of two-sided Training Regimes in Youth Football Players. *British Journal of Sports Medicine 36(3): 118-221*.

Hill-Haas, S; Coutts, A; Rowsell, G. and Dowson, B; (2014). *Variability of Acute Physiological Response and Performance Profiles of Youth Football Players in Small – Sided Games.* Science Medicines and Sport 11:487-490.

Hoff, J. (2008). Training and testing physical capacities for elite soccer players. *Journal of Sport Science* (23): 573-582

Hoffman J.R & Maresh, C.M (2000). Physiology of Basketball. *Journal of Exercise and Sport Science pp. 733-744.*

Hughes, M.G; Lloyd, R. & Meyers, R. (2012). Sprinting and Plyometric Ability in Youths: *The Effect of Natural Development and Training*. New York: Nova Science Publishers, Inc.

Hunter. (2009). *Lower- Limb explosive power and physical match performance in collegiate female soccer players.* Unpublished master theses, Department of Kinesiology, Humboldt state university, Arcate, C.A.

Ilyararay, S., & Sakthigananvel, D. (2013). Effect of combination of speed and plyometric training on speed and agility. *International Research Journal of Health Fitness and Sports Science*, 1(2): 52-65.

Inqle, L., Sleap, M., & Tolfrey, K. (2006). Effect of a Complex training and detraining programme on selected strength and power variables in early pubertal boys, *Journal of Sports Science*, 24(9): 987-97.

Jackson, A. & Walldeen, M. (2013).Developing the football player as an athlete. *The C.H.E.K Institute Report* Vol. 1:10-16

Jakovljevic, S.T; Karalejic, M.S; Pajic, Z.B; Macura, M.M. and Erculj, F.F. (2012). Speed and agility of 12- and 14-year-old elite male basketball players. *Journal of Strength Conditioning Research* 26: 2453-2459.

Johnson B.A, Salzberg CL, and Stevenson D.A. (2011). A systematic review: Plyometric training programs for young children. *Journal of Strength Conditioning Research* 25, 2623-2633.

Johnson, B.L., & Nelson, J. K. (2005). *Practical measurement for Evaluation in Physical Education*. (3rd ed.). New Delhi: Surjeet Publication, pp.125.

Johnson, S., Burns, S., & Azevedo, K. (2013). Effect of Exercise sequence in resistance training on strength speed and agility in high school football players, *International Journal of Exercise Science*, 6(2):126-133.

Jones, P; Bampouras, T.M. and Marrin, K. (2009). An investigation into physical determinants of change of direction speed. *Journal of Sports Medicine Physical Fitness* 49, 97-104

Jullien, H ; Bisch, C ; Largouet, N.; Manovrier, C & Carling, C.J. (2008). Does a short period of lower limb strength training improve performance in field-based tests of running and agility in young professional soccer players? *Journal of Strength Conditioning Research* 22, 404-411.

Kagitha, V. R., & Kumar, P.P.S.P. (2013). Effect of complex training with yogic practices on selected motor fitness variables and playing ability among Kabaddi menplayers. *International Journal of Humanities and Social Science Invention*, 2(10): 2319-7714.

Kalapotharakos, V.I., Strimpakos, N., Vithoulka, I., Karvounidis, C., Diamantopoulos, K. and Kapreli, I. (2006). Physiological characteristics of elite professional soccer teams of different ranking. *Journal of Sports Medicine and Physical Fitness,* 46: 515-519.

Keiner, M., Sander, A., Writh, K., and Schmidtbleicher, D. (2014). Long term strength training effects on change of direction sprint performance. *The Journal of Strength and Conditioning Research* 28 (1): 223-231

Khetmalis, M.S.(2012). Comparison between selected coordinative abilities and motor abilities of female athletes of selected international schools in Pune. *International Journal of Research Pedagogy and Technology in Education and Movements Sciences*, 1(2):11-13.

Khodabakshi, M., Javaheri, S.A.H., Zandi, A.E.A.M., and Khanzadeh, R. (2012). Effect of balancing and resistive selected exercise on young footballers dynamic balance. *European Journal of Sports and Exercise Science*, 1(3): 77-84.

Kirkendall, D.T. (2000) Physiology of Football. *Journal of Exercise and Sport Science pp. 875 - 884*

Kotzamanidis C. (2006). Effect of plyometric training on running performance and vertical jumping in pre-pubertal boys. *Journal of Strength Conditioning Research* 20, 441-445.

Kotzamanidis, C., Chatzopoulos, D., Michailidis, C., Papaiakovou, G., & Patikas, D.(2005).Effect of a combined high intensity strength and speed training program on the running and jumping ability of Soccer players. *Journal of Strength Condition Resistance*, 19 (2), 369-375.

Kravitz, L., Akalam, C., Nowicki, K. and Kinzey, S.J. (2003). Prediction of 1RMmaximum in high-school power lifter. *Journal Strength Condition Res*, 17, 16-72.

Krustrup, P; Mohr, M; Nybo, L; Jensen, J.M; Nielsen, J.J. & Bangsbo, J. (2006). The Yo-Yo IR2 test: physiological response reliability and application to elite soccer. *Medicine and Science in Sports and Exercise* 38, 1666-1673

Kwang-Jun Kim. (2010). Effect of 12 weeks combined training in core muscle strengthening on the flexibility, muscular strength and driver shot performance in female professional golfers. *International Journal of Applied Sports Science*, 22(1): 111-127.

Laia F.M, Rampini, E., and Bangsbo, J. (2009).High intensity training in football. *International Journal of sports Physiology and Performance,* 4, 291-306.

Le Gall F., Carling, C., Reilly, T., Vandewalk, H., Chruch, J., and Rochcongar, P. (2006). Incidence of injuries in elite French youth Soccer players: Season study. *American Journal of Sports Medicine,* 34, 928-938.

Le Gall, F., Carling, C., Williams, M. and Reilly, T. (2010). Anthropometric and fitness characteristics of international, professional and amateur male graduate soccer players from an elite youth academy. *Journal of Science and Medicine in Sport,* 13: 90-95.

Lidor, R. & Ziv, G. (2010). Physical and Physiological Attributes of Female Volleyball Players- *A Review the Journal of Strength & Conditioning Research 2(7) 1963 – 1973.*

Lidor, R., Armon, M., Cohen, Y. and Segal, G. (2005). Measurement of Talent in Team Sport. *Journal of Strength and Conditioning Research 19 (2) pp318-325.*

Little, T. & Williams, A. (2007). *Measures of Exercise Intensity During Football Training Drills with Professional Football Players.* Strength and Conditioning Research 21, 236-371.

Little, T. & Williams, A.G. 2005. Specificity of acceleration, maximum speed, and agility in professional soccer players. *Journal of Strength and Conditioning Research,* 19:76-78.

Lockie, R.G; Schultz, A.B; Callahan, S.J and Luczo, T.M.; (2015). *A preliminary Investigation into the Relationship between Functional Movement and Athletic Physical Performance in Male Team Sport Athletes*. Biology of Sports, 32(1):41-51.

Machol, R.E & Ladney, S.P (2011). Management science in sports. *Journal of Operational Research*, North Holland Publications, Netherland.

Mackenzie, B. (2011) Cooper VO_2 max test (www) available from: *https://www.brianmac.co.uk/gentest.htm(Accessed* 3/6/2017).

Malina, R.M; Eisenmann, J.C; Cumming, S.P; Ribeiro, B. and Aroso, J. (2004). Maturity-associated variation in the growth and functional 117 capacities of youth football (soccer) players 13-15 years. *European Journal of Applied Physiology* 91, 555-562.

Manjo A.J.M., Rebelo, A.N., Abrantes, C., and Sampaio, J. (2010). Short term effect of Complex and Contrast training in soccer player's Vertical Jump, Sprint and agility abilities. *Journal of strength Cond Res,* 24(4), 936-41.

Manna, I., Khanna, G.L., and Dhara, P.C. (2010). Effect of training on physiological and biochemical variables of soccer players of different age groups, *Asian Journal of Sports Medicine,* 1(1): 5-22.

Markovic, G., Jukic, I., Milanovic, D., and Metikos, D. (2007). Effect of Sprint and plyometric training on muscle function and athletic performance. *Journal of Strength and Conditioning Research,* 21(2): 543-549.

Mcmillan, K., Helgerud, J., Macdonal, R. and Hoff, J. (2009). Physiological adaptations to soccer specific endurance training in professional youth soccer players. *British Journal of Sports Medicine,* 39:273-277.

Mendez-Villanueva, A ; Buchheit, M ; Simpson, B. and Bourdon, P.C. (2013). Match Play Intensity Distribution in Youth Soccer. *International Journal of Sports Medicine,* 34: 101-110

Mero, A. (1998). Power and speed training during childhood. In: Van Prsagh, (ed). *Pediatric Anaerobic Performance*. Champaign, IL: Human Kinetics, pp. 241-267.

Meylan, C. & Malatesta, D. (2009). Effects of in-Season Plyometric Training within Soccer Practice on Explosive Actions of Young Players. *Journal of Strength Conditioning Research,* 23: 2605-2613.

Michailidis, Y; Fatouros, I: Primpa, E; Michalididis, C; and Avloniti A, (2013). Plyometrics' trainability in preadolescent soccer athletes. *Journal of Strength and Conditioning Research* 27:1, 38-49

Miller, M.G; Herniman, J.J; Richard, M.D; Cheatam, C.C. and Michael, T.J. (2006). The effect of a 6-week plyometric training program on agility. *Journal of Sports Science and Medicine,* 5: 459-465.

Mitchell, C & Tavener, B. (2005). Field Hockey Techniques and Tactics, Human Kinetics, US.

Mohammadi, V., Alizedeh, M., and Gaieni, A. (2012). Effect of six weeks strength exercises on static and dynamic balance of young male athletes, *Procedia- Social and Behavioral Science,* 31, 247-250.

Mohammed, H; Veayens R, Mattys, S. Multael, M. and Lenoir, M. (2009). Anthropometric and Performance Measure for the Development of Talent Identification Model in Youth Football. *Journal of Sports Sciences,* 27(2): 257 – 266

Mohr, M., Krustrup, P., and Bangsbo, J. (2009). Match performance of high standard soccer players with special reference to development of fatigue, *Journal of Sports Science,* 21,519-528.

Morris, T. (2000).Psychological characteristics and talent identification in soccer. *Journal of Sports Science,* 18:715-726.

Morrow, J.R, Jackson, A.W; Disch, J.G and Mood, D.P (2011). *Measurement and Evaluation in Human Performance* (4th Edition) Champaign, Illinois: Human Kinetics Publishers

Moss, S.L; McWammell, N; Twist, C; and Michalsik, L.B. (2015). Anthropometric and Physical Performance Characteristics of Top-elite, Elite and Non-elite Male Football Players. *Journal of Sport Sciences,* 54 (2): 268 – 278.

Mujika, L., Santisteban, J., Impellizzeri, F.M., and Castagna, C. (2009). Fitness determinants of success in men's and women football. *Journal of Sports Science,* 27: 107-114.

National Strength and Conditioning Association (2011). NSCA's Guide to Test & Assessment. New York McGraw-Hill (7^{th} ed).

Nelson, A.G., Guillory, I.K., Cornwell, A. and Kokkonen, J. (2001). Inhibition of maximal voluntary isokinetic torque production following stretching is velocity-specific. *Journal of Strength and Conditioning Research,* 15(2): 241-246.

Orlando, I.O. (2009). *Investigation Physical Education Teacher and Coaches Knowledge on Bio Motor abilities of Athletes in senior high schools in the Ashanti region of Ghane.* Department of health, Physical education, recreation and sports, University of Education.

Ozbar, N. (2015). Effect of Plyometric Training in Explosive Strength, Speed and Kicking Speed in Female Football Players. *Anthropologist* 19(2): 333-339.

Ozbar, N; Ates, S; and Agopyan, A. (2014). The Effect of 8 –Week Plyometric Training on Leg Power, Jump and Sprint Performance in Male Football Players. *Journal of Strength and Conditioning Research,* 28(10): 288-294.

Ozer, D., Duzugum., Baltacis, G., Karacan, S., and Colakoglu, C. (2011). Effect of rope or weight rope jump training on strength, coordination and proprioception in adolescent female Volley ball players. *International Journal of Advancement in Research & Technology,* 1(6): 1-9.

Ozer, K.D., Duzqun, I., Baltaci, G., Karacan, S., and Colakoque, F. (2012). Effect of Calisthenics and Pilates exercises on Coordination and proprioception in adult women. Journal of sports rehabilitation, 21(3), 235-43.

Patra, P., & Kumar, R. (2013). Effect of core stabilization training on endurance of trunk extensor and functional capacity in subject with low back pain. *International Journal of Pharmacy and Biological Science,* 3(2): 571-581.

Payne, H. (2012). *Weight training for all sports.* New York: Pelham Books, pp.26.

Pereira, M.I.R., & Gomes, P.S.C. (2003). Muscular strength and endurance test: reliability and predication of one repetition maximum-Review and new evidence. *Rev BrasEsporte,* 9 (5).

Pettersen, S.A. & Mathisen, G.E. (2012). Effect of Short Burst Activities on Sprint and Agility Performance in 11-to 12-Year-Old Boys. *Journal of Strength and Conditioning Research* 26, 1033-1038.

Powers, S.K; & Howley, E.T. (2012). *Exercise Physiology, Theory and Application to Fitness and Performance New York* McGraw-Hill (8^{th}ed).

Pufaa, H. (2006).*Motor learning in Physical Education.* Tema: Kobi press Ltd.

Rahmani-Nia, F. (2008). *Sports physiology: A guide to coach physical education organization.* Ministry of Education.

Rajamohon, G., Kanagasabi, P., Krishnaswamy, S., and Balakrishnan, A. (2010). Effect of complex and contrast resistance and plyometric training on selected strength and power parameters. *Journal of Experimental Science,* 1(12): 01-12.

Rampinini, E. (2015). Physical fitness and specific motor performance of young soccer players aged 11-12 years. *Journal Sports Science*. 16:434-5.

Rampinini, E., Coutts, A.J., Castagna, C., Sassi, R. & Impellizzeri, F.M. (2007). Variation in top-level soccer performance. *International Journal of Sports Medicine,* 28 (12): 1018-04.

Reilly, T. & Williams, M.A. (2005), *Science and Football New York*. Rutledge.

Reilly, T., & Doran, D. (2003). *Science and Soccer* (2nd ed.). London: Routledge Taylor & Francis group.

Reilly, T., Williams, A.M., Nevil, A. and Franks, A. (2000). A multidisciplinary approach to talent identification in soccer. *Journal of Sports Science,* 18:695-702.

Reilly, T; Bangsbo, J. and Franks, A. (2000). Anthropometric and Physiological Predisposition for Elite Football. *Journal of Sports Science 18(9): 669-683.*

Reilly, T; Williams, A.M; Newill, A. and Franks, A. (2000). A multidisciplinary approach to talent identification in soccer. *Journal of Sports Science* 18, 695-702.

Rienzi, E., Drust, B., Reilly, T., Carter, J.E. and Martin, A. (2000).Investigation of anthropometric and work-rate profiles of elite South American international soccer players. *Journal of Sports Medicine and Physical Fitness,* 40(2):162-169.

Rowland, T.W. (2005). *Children's Exercise Physiology*. Champaign, III: Human Kinetics.

Rumpf, M.C; Cronin, J.B; Pinder, S.D; Oliver, J. & Hughes, M. (2012). Effect of different training methods on running sprint times in male youth. *Journal of Pediatric Exercise Science,* 24, 170-186.

Ryan, P. (2012). *Training and Exercise for Children and Teenagers.* Medicine and Science in Sports and Exercise Part, 1(47): 64-76.

Sadeghi, H., Nik, H.N., Darchini, M.A., and Mohammadi, R. (2013). Effect of six week plyometric and core stability exercises on performance of male athletes 11-14years. *Advance in Environmental Biology*, 7(6), 1195-1201.

Sankarmani, B., Ibrahim Sheriff. S., Rajeev, K.R., and Jagathesan Alagesan.(2012). Effectiveness of plyometric and weight training in anaerobic power and muscles strength in female athletes. *International Journal of pharmaceutical Science Health Care,* 2(2): 172-180.

Santos, E.J., & Janeria, M.A. (2008). Effect of complex training on explosive strength in adolescent male basketball players. *Journal of Strength Condition resistance,* 22 (3), 903-9.

Sassi, R., Reilly, T. and Impellizzeri, F.A (2007). Comparison of Small – Sided Games and Interval Training in Elite Professional Football Players. *Journal of Sports Science,* 22: 562 – 569

Sekendiz, B., Cuq, M., and Korkusuz, F. (2010). Effect of Swiss ball core strengthen on strength, endurance flexibility and balance in sedentary women. *Journal of Strength Condition Resistance,* 24(11): 3032-40.

Shahidi, F., Mahmodlu, A.G., Kandi, Y.M.N.P and Loti, G. (2012). Effect of two resistance training types on muscles fitness and anaerobic capacity in 16-18 years old soccer players. *Scholar research library, Annual: Biological research,* 3(6), 2713-2717.

Shaikh, A., & Mallick, N.I. (2012). Effect of plyometric training and weight training on selected motor ability components among University male student. *International Journal of Advancement in Research &Technology,* 1(6), 1-9.

Shepherd, R.J, McPherson, B.D; Stevens, T. and Suiton, J.R (2009) *Exercise Fitness and Health Illinois*: Human kinetics books inc. 100-136

Sheppard, J.M;&Young, W.B. (2006). Agility literature review: Classifications, training and testing. *Journal of Sports Science,* 24, 919-932.

Shinkle, J., Nesser, T.W., Demchak, T.J., and Mcmannus, D.M. (2012). Effect of core strength on the measure of power in the extremities. *Journal of strength Condition Resistance,* 26 (2), 378-80.

Singh, A.K. (2015). Selected Motor ability components of field hockey goal keepers at different levels of participation. *Journal of Physical Research* 2(3)68-78

Singh, S. Singh, R. and Singh, M. (2010) Anthropometric Measurement, Body Composition and Somatotyping of High Jumpers. *Brazilian Journal of Biomotricity*. 4(4) 66-71

Sirotic, A.C., Coutts, A.J., Knowles, H. and Catterick, C.A. (2009). A comparison of match demands between elite and semi-elite rugby league competition. *Journal of Sports Sciences,* 27(3):203-211.

Sporis, G., Milanovic, L., Jukic, I., Omrcen, D and Molinuevo, J.S. (2010). The effect of agility training on athletic performance. *Kinesiology,* 42(1), 65-72.

Spreuwenberg L.G., Kraemer, W.J., and Spiering, B.A (2009) Influence of exercise order in a resistance training exercise session. *Journal of Strength and Condition Research 20:141-144*

Stolen, T., Chamari, K., Castagna, C. and Wisloff, U. (2010).Physiology of soccer. *Journal of Sports Medicine,* 35(6):501-536.

Strauss, A. (2011) *The Influence of Anaerobic and Aerobic Fitness on the Technical Skill Ability of National Elite Male Under – 18 African Football Players*. M.SC Dissertation Tshwane University of Technology, South Africa.

Stroyer J, Hansen L, and Klausen K. (2004).Physiological profile and activity patterns of young soccer players during match play. *Journal of Medical Science in Sport Exercise* 36, 168-174.

Strudwick, A; Reilly, T. and Doran, D. (2002) Anthropometric and Fitness Profiles of Elite Football Players in Two Football Codes. *Journal of Sports Medicine and Physical Fitness. 42(2) 239-242.*

Tan, P. (2010). The role of resistance training in distance running. *Proceeding of Singapore Health Care,* 19 (3).

Testore, A. (2012). Speed, Agility & Speed Endurance Development on Preseason Preparation of Young Football Players. *Journal of Medicine and Physical Fitness,* 62 (3), 24-30.

Testore, A; Meeusen, R, Piacentini M.F. Demarie, S. and Capranica, L; (2006) Football Drills. *Journal of Medicine and Physical Fitness,* 46 (1), 36-42.

Thomas J.R, Nelson J.K and Silverman S.J (2005); *Research Methods in Physical Activity*. Champaign Illinois: USA Human Kinetics Publishers 5th edition

Thomas, K; French, D. and Hayes, P.R. (2009). The effect of two plyometric training techniques on muscular power and agility training in youth soccer players. *Journal of Strength Conditioning and Research* 23, 332-335.

Thyron, M.R. (2009). *The 7 Speeds of Soccer- A German Perspective.* Germany

Tiwazere, J. (2004) *Epidemiology of Football Injuries in Rwanda:* A Need for Physiotherapy Intervention. M.SC Dissertation, University of the Western Cope

Tonnessen, E., Hem, E., Leirstein, S., Haugen, T. & Seiler, S. (2013). Maximal aerobic power characteristics of male professional soccer players 1989-2012. *Journal of Sport Medicine and Physical Fitness* 44, (5) 156-210.

Turner, C.H. & Robling, A.G. (2003) *Designing Exercise Regimens to Increase Bone Strength. Exercise Sports Science Review* 31:45-50.

Uppal, A.K & Datta, A.K (1988). Motor fitness components predictors of Hockey performance, *New Horizons of Human Movement*, Seoul Olympic Scientific Congress, p.58.

Vaczi, M; Tollar, J; Meszler, B; Juhasz, I. and Karsai, I. (2013). Short-Term High Intensity Plyometric Training program Improves Strength, Power and Agility in Male Soccer Players. *Journal of Human Kinetics* 36, 17-26

Venturelli, M; Bishop, D. and Pettene, L. (2008). Sprint Training in Preadolescent Soccer Players. *International Journal of Sport Physiology* 3, 558-562.

Verducci, M. (2000). Measurement Concepts in Physical Education. S.T. Louis: C.V Mosb4 company publishers. P.98-160

Viru, A; Loko, J; Harro, M; Volver, A. and Viru, M. (1999).Critical periods in the development of performance capacity during childhood and adolescence. *European Journal of Physical Education* 4, 75-119.

Vyas, R. (1997). Comparison of coordinate abilities of Batsman and Bowler in Cricket. *Unpublished Phd Dissertation of LNUPE,* Gwalor, India.

Watson, A.W.S (2010). Physical fitness and athletic performance: *A Guide to Student Athletes and Coaches London*: Longman Publishers. P.2-10 & 168-286.

Willardson, J.M. (2007).Core stability training: Application to condition research. *Journal of Strength and Condition research,* 21(3), 979-985.

William, E.P (2006) Arnheim Athletic Training: A Competency Based Approach. New York McGraw Hill Pub. Company 12th edition Higher education.

Williams, A.M. & Reilly, T.(2000). Talent Identification and Development in Soccer. *Journal of Sport Science,* 18:657-667.

Willmore, J. & Knuttgen, H. (2003) *Aerobic Exercise and Endurance Improving Fitness for Health Benefits*. The Physician and Sports Medicine 31(5) 45-56.

Willmore, J.H & Costill, D.L (2004) *Children and Adolescents Sport. Physiology of Sports and Exercise.* Champaign Illinois: Human Kinetics 3rdedition.

Wilmore, J.H., & Costill, D.L. (2005).*Physiology of sports and exercise* (3rd ed.). Champagin, IL: Human Kinetic Journals

Wisloff, A.J. (2010). Technical performance during soccer matches of the Italian Serie A league: effect of fatigue and competitive level. *Journal of Science and Medicine in Sport* 12: 227-233

Witvrouw.E., Asselam, L.D.P, D'Have and Camber, D.(2003).Muscle flexibility as a risk factor for developing muscle injuries in male professional Soccer players. *The American Journal of Sports Medicine.*

Wong, P-L., Chamari, K., and Wisloff, U. (2010).Effect of 12 weeks on field combined strength and power training [CSPT] on physical performance among U-14 young soccer players. *Journal of Strength and Conditioning Research,* 24(3), 644-652.

Yaoo, Y.D., & Lee, Y.S. (2012).Effect of core stabilization exercise using a sling on pain and muscles strength of patients with chronic back pain. *Journal of Physical Therapy Science,* 24(8), 671-4.

Young Men Christian Association (2010), *General Testing Guidelines on Physical Fitness Test Battery,* Chicago U.S.A.

Young, W B., James, R., and Montgomery, I.(2002). Is muscle power related to running speed with changes of direction? *Journal of Sports Medicine Physical Fitness*,42, 282-288

Young, W.B; McDowell, M.H. and Scarlett, B.J. (2008).Specificity of sprint and agility training methods. *Journal of Strength and Conditioning Research*15, 315-319.

Zakas, A. (2005). The effect of stretching duration on the lower-extremity flexibility of adolescent soccer players. *Journal of Bodywork and Movement Therapies,* 9 (3):220-225.

Zakas, A., Doganis, G., Papakonstandinou, V., Sentelidis, T. and Vamvakoudis, E. (2006). Acute effects of static stretching duration on isokinetic peak torque production of soccer players. *Journal of Bodywork and Movement Therapies,* 10:89-95.

Zwiren, L.D; Farrow, D; Young, W. and Bruce, L. (1996). Estimation of VO_2 max: *A Comparative Analysis of Five Exercise Test.* Research quarterly for exercise and sport, 62 (1), P.73-78

APPENDIX I

CONSENT FORM

DEPARTMENT OF PHYSICAL AND HEALTH EDUCATION

AHMADU BELLO UNIVERSITY, ZARIA NIGERIA

INFORMED CONSENT FORM

To be able to participate in this test, I……
a subject do undersigned to voluntarily undergo a 12 week long study on the effect of resistance training programme on selected biomotor abilities of male football players in Federal College of Education, Kontagora, Nigeria.

As part of the said study, I understand and agree that during participation, complications may arise, if the individual exercising is not tolerating work well, it usually becomes necessary that exercise can be stopped by my decision or that of researcher or his representative. Other risks in addition to mild headache, nausea, vomiting or even fainting may occur during participation but rare.

Subject's signature……

Course ……

Witness name……...

Signature ……

Address ……

Date ……

APPENDIX II

DYNAMIC RESISTANCE TRAINING USING CIRCUIT OF EIGHT TRAINING

STATIONS	EXERCISE	WEIGHT (Kg)	CYCLE	WEEK	WARM UP	CONTINUOUS TRAINING	TOTAL TIME	INTENSITY	REP.	SET	FREQUENCY
One	Seated leg press	60kg	1	1-4	10	25	35	70% 1-RM	12	3	$1^{1/2} - 2$
Two	Flat beach press	40kg	2	5-8	10	30	40	75% 1-RM	10	3	2 – 3
Three	Leg curl	40kg	3	9-12	10	40	50	80% 1-RM	8	3	2 – 3
Four	Lateral pull down	60kg									
Five	Heel (cal) raise	50kg									
Six	Curl up	40kg									
Seven	Triceps press down	40kg									
Eight	Arm curl/ hanomier curl (with dumb bells)	40kg									

Source: ACSM (2010) Guidelines for Resistance Training

DATA FITNESS ASSORTMENT RECORD SHEET

Name_____

Age_____

Height _____

weight_____

BMI_____

No	Major factor to be measured	Type of Test	Measurement of parameters In Different Duration			
			Unit	Pre test	During test	Post test
1	Strength	Push up	Reps/S			
2	.Agility	Illinois	Dis/S			
3	Muscular endurance	Sit up	Rep/s			
4	Flexibility	Sit and reach	Cm(Inch)			
5	Speed	35 M sprint run	Dis/s			

Source:http://www.brianmac.co.uk

TRAINING SCHEDULE FOR FIRST MONTH (2016)

Week per months	Day	Objective	Kind of exercise	Time (min.)	Rep/ set	Rest	Duration	Exercise intensity
First week	Monday Wednesday Friday(4:30 PM-5:30)	To develop physical fitness	Warm up (walking jogging and running)	15		10 min	65min	55%-69% MHR (Moderate)
			Light stretching	5		1mi		
			Push	1	5x3	5mi		
			Mini football match	15	5x3			
			Cool down + stretching	9		4mi		
Second week	Monday Wednesday Friday (4:30PM-5:30)	To improve strength ,agility	Warm up (walking jogging and running)	15		10 min	65min	55%-69% MHR (Moderate)
			Light stretching	7		1mi		
			Sit and reach	1				
			Mini football match	15	4x3	5mi		
			Cool down + stretching	9	4x3	2mi		
Third week	Monday Wednesday Friday(4:30 PM-5:30)	To improve speed endurance and agility exercise	Warm up (walking, jogging and running)	10		10 min	65min	
			Light stretching	7				
			Mini football game	8	5x3	2mi		55%-69% MHR(Moderate)
			50 m sprint	8	5x3	4mi		
			Squat up	6		2mi		
			Cool down + stretching	6		2mi		
	Monday Wednesday Friday(4:30 PM-5:30)	To improve explosive strength, agility	Warm up (walking, jogging, jumping jack and running on spot)	15		10 min	65min	
			Light stretching	5		1mi		
			Mini football match	5		1mi		55%-69% MHR
			40 m shallow water sprinting	8	5x3	4mi		
			Hip extension – flexion	6	5x3	2mi		
			Cool down	6		2mi		
Fourth week	Monday Wednesday Friday(4:30 PM-5:30)	To improve explosive strength ,agility and speed endurance	Warm up (walking, jogging and Running	15		10 min		
			Light stretching	8		2mi	65	
			Running	7		1mi	min	55%-69% MHR55
			15m sprint with quick step up on spot	6	4x3	3mi		
			Set up	4	4x3	1mi		
			Cool down + stretching	7		3mi		
	Monday Wednesday Friday (4:30PM-5:30)	To improve explosive strength ,agility and speed endurance	Warm up (walking, jogging, jumping jack and running on spot)	15		10 min	65 min	55%-69% MHR
			Light stretching	7		2mi		
			Rope jumping	7		2mi		
			Quick running on spot + 10 m sprinting	6	5x3	2mi		
			Sit and reach	4	5x3	2mi		
			Cool down	6		2mi		

TRAINING SCHEDULE FOR SECOND MONTH (2016)

week per months	Day	Objective	Kind of exercise	Time (min.)	Rep/ set	Rest	Duration	Exercise intensity
Fifth week	Monday Wednesday Friday (4:30PM-5:30)	To develop physical fitness	Warm up (walking jogging and running) Light stretching Push up Shuttle run Mini football match Cool down + stretching	13 5 1 4 13 9	 5x3 5x3 	10 min 1mi 1mi 4mi 4mi	65min	55%-69% MHR (Moderate)
Sixth week	Monday Wednesday Friday (4:30PM-5:30)	To improve strength ,agility	Warm up (walking jogging and running) Light stretching Sit and reach Jumping jack Mini football match Cool down + stretching	13 7 1 4 13 9	 4x3 4x3	10 min 2mi 1mi 4mi 3mi	65min	55%-69% MHR MHR(Moderate)
Seventh week	Monday Wednesday Friday (4:30PM-5:30)	To improve speed endurance and agility exercise	Warm up (walking, jogging and running) Light stretching Push up Mini football game 50 m sprint Squat up Cool down + stretching	9 7 2 7 8 6 6	 5x3 5x3 	10 min 2mi 2mi 2mi 2mi 2mi	65min	55%-69% MHR
	Monday Wednesday Friday (4:30PM-5:30)	To improve explosive strength, agility	Warm up (walking, jogging, jumping jack and running on spot) Light stretching Mini football match 40 m shallow water sprinting Hip extension – flexion Cool down	15 5 5 8 6 6	 5x3 5x3 	10 min 1mi 1mi 4mi 2mi 2mi	65min	55%-69% MHR
Eight week	Monday Wednesday Friday (4:30PM-5:30)	To improve explosive strength ,agility and speed endurance	Warm up (walking, jogging and Running Light stretching Running 15m sprint with quick step up on spot Sit up Cool down + stretching	15 8 7 6 4 7	 4x3 4x3 	10 min 3mi 2mi 2mi 1mi 2mi	65 min	
	Monday Wednesday Friday (4:30PM-5:30)	To improve explosive strength ,agility and speed endurance	Warm up (walking, jogging, jumping jack and running on spot) Light stretching Push up Rope jumping Quick running on spot + 10 m sprinting Sit and reach Cool down	13 7 2 7 6 4 6	 5x3 5x3 	10 min 2mi 2mi 2mi 1mi 3mi	65 min	55%-69% MHR

TRAINING SCHEDULE FOR THIRD MONTH (2016)

week per months	Day	Objective	Kind of exercise	Time (min.)	Rep/ set	Rest	Duration	Exercise intensity
Ninths week	Monday Wednesday Friday (4:30PM-5:30)	To develop physical fitness	Warm up (walking jogging and running)	13		10 min	65min	55%-69% MHR(Moderate)
			Light stretching	5		1mi		
			Push up	1	5x3			
			Sprint run	4				
			Mini football match	13	5x3	5mi		
			Cool down + stretching	9		4mi		
Tenth week	Monday Wednesday Friday (4:30PM-5:30)	To improve strength ,agility	Warm up (walking jogging and running)	15		10 min	65min	55%-69% MHR
			Light stretching	7		2mi		
			Sit and reach	1				
			Jump jack	3				
			Mini football match	12	4x3	5mi		
			Cool down + stretching	9	4x3	4mi		
Eleventh week	Monday Wednesday Friday (4:30PM-5:30)	To improve speed endurance and agility exercise	Warm up (walking, jogging and running)	10		10 min	65min	
			Light stretching	7		2mi		55%-69% MHR
			Mini football game	8	5x3	3mi		
			50 m sprint	8	5x3	3mi		
			Squat up	6		2mi		
			Cool down + stretching	6		2mi		
Twelve week	Monday Wednesday Friday (4:30PM-5:30)	To improve explosive strength ,agility and speed endurance	Warm up (walking, jogging and Running	15		10 min		
			Light stretching	8		3mi	65	
			Running	7		2mi	min	55%-69% MHR
			15m sprint with quick step up on spot	6	4x3	2mi		
			Set up	4	4x3	1mi		
			Cool down + stretching	7		2mi		
	Monday Wednesday Friday (4:30PM-5:30)	To improve explosive strength ,agility and speed endurance	Warm up (walking, jogging, jumping jack and running on spot)	15		10 min	65 min	
			Light stretching	7		2mi		55%-69% MHR
			Rope jumping	7		2mi		
			Quick running on spot + 10 m sprinting	6	5x3	2mi		
			Sit and reach	4	5x3	2mi		
			Cool down	6		2mi		

ACSM (2010) Sports Fitness Programme

APPENDIX III

ETHICS PERMISSION

Department of Physical and Health
Education,
Ahmadu Bello University,
Zaria.
8th March, 2017.

The Dean,
School of Postgraduate Studies,
Ahmadu Bello University,
Zaria.

Through:

The Head,
Department of Physical and Health Education,
Ahmadu Bello University,
Zaria.

Dear Sir/Ma,

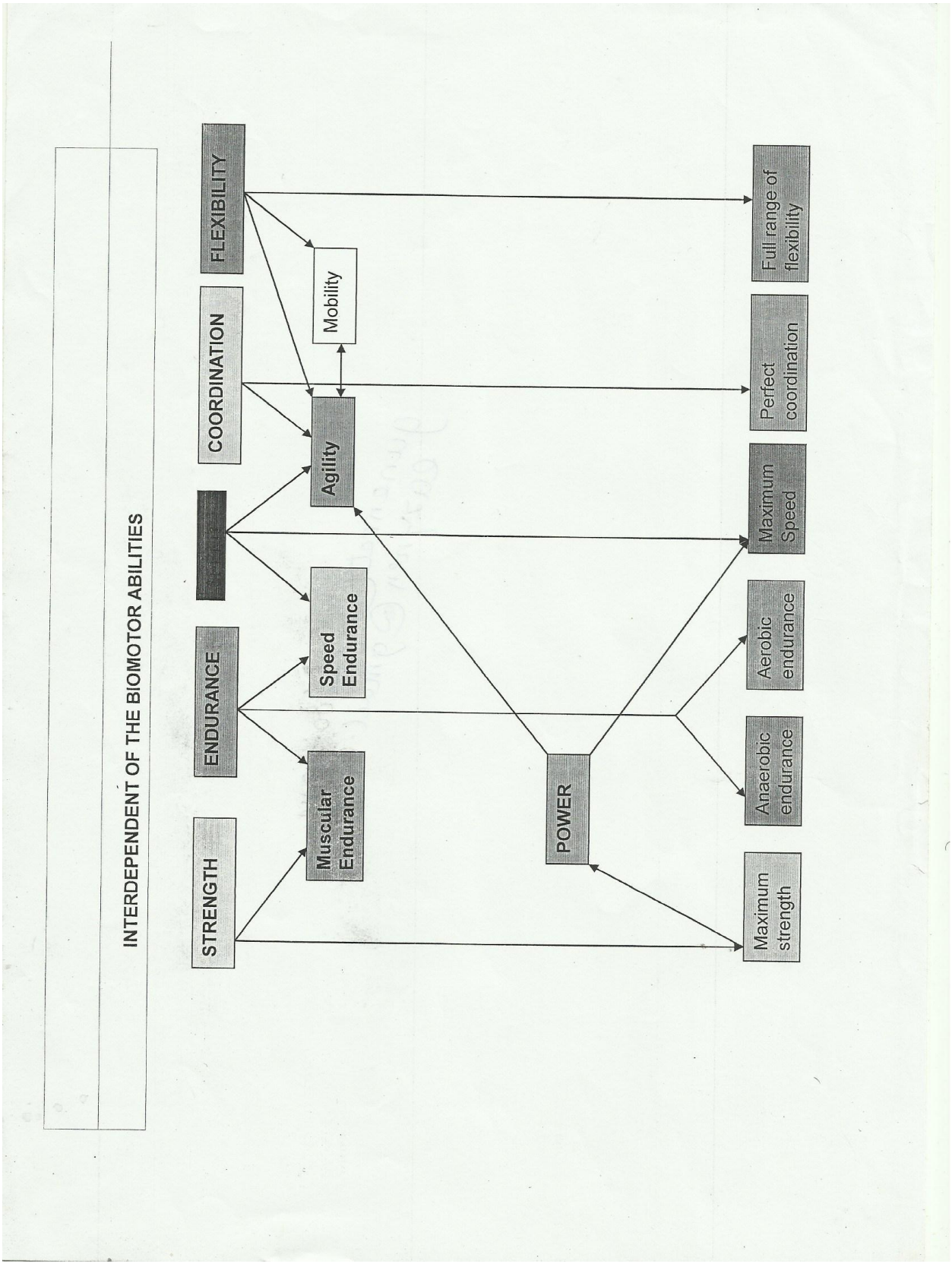
REQUEST FOR PERMISSION TO USE HUMAN SUBJECTS FOR RESEARCH

I am a postgraduate student from the above named Department. I am conducting a research on the "Effect of Resistance Training Programme on Selected Biomotor Abilities of Male Football Players in Federal College of Education, Kontagora, Nigeria". This research will require the use of human subjects. I am writing to request that an approval be granted me to conduct this research. I promise to observe all ethnical issues relating to research using human subjects.

Yours faithfully,

Shaibu Mohammed UMAR
(P14EDPE9013).

APPENDIX IV


INTERDEPENDENT OF THE BIOMOTOR ABILITIES
STRENGTH
ENDURANCE
COORDINATION
FLEXIBILITY
Muscular Endurance
Speed Endurance
Agility
Mobility
POWER
Maximum strength
Anaerobic endurance
Aerobic endurance
Maximum Speed
Perfect coordination
Full range of flexibility

APPENDIX V

DEPARTMENT OF PHYSICAL AND HEALTH EDUCATION
AHMADU BELLO UNIVERSITY, ZARIA - NIGERIA
(OFFICE OF THE HEAD OF DEPARTMENT)

VICE CHANCELLOR: **Professor Ibrahim Garba,** *B.Sc., M.Sc., (ABU); Ph.D. (London); D.I.C.*
HEAD OF DEPARTMENT: **Professor M. A. Suleiman,** *N.C.E. (OYSCE); B.Sc. (UNICAL); M.Sc, Ph.D, (ABU)*

Our Ref. No. P14EDPE9013 Date: ----------

Dear Sir/Madam,

INTRODUCTORY LETTER FOR COLLECTION OF DATA: SHAIBU MOHAMMED UMAR (P14EDPE9013)

The bearer is a postgraduate student of the above named Department and University. He is conducting a research on the **"Assessment of the Effects of Resistance Training on Selected Biomotor Abilities of Male Football Players in Federal College of Education Kontagora, Nigeria".**

In this regards, I wish to request for your kind permission and co-operation to allow him use some of the students and sport facilities of your Institution/Gym for data collection.

Your assistance to him will be highly appreciated.

Yours faithfully,

Prof,. E. A. Gunen
Chairman, Supervisory Committee