A COMPARISON OF HEALTH RELATED PHYSICAL FITNESS STATUS OF MALE AND FEMALE BASKETBALL AND HANDBALL PLAYERS OF BORNO STATE, NIGERIA.

BY

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MSC/EDUC/9942/2009-10

P15EDPE8048

DEPARTMENT OF HUMAN KINETICS AND HEALTH EDUCATION

FACULTY OF EDUCATION,

AHMADU BELLO UNIVERSITY, ZARIA, NIGERIA

NOVEMBER, 2018

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A THESIS SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES, AHMADU BELLO UNIVERSITY, ZARIA IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF SCIENCE (M.SC) DEGREE IN EXERCISE AND SPORT SCIENCE.

DEPARTMENT OF HUMAN KINETICS AND HEALTH EDUCATION

FACULTY OF EDUCATION,

AHMADU BELLO UNIVERSITY, ZARIA, NIGERIA.

NOVEMBER, 2018

DECLARATION

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

_____ **_____**

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CERTIFICATION

This dissertation titled "A Comparison of Health Related Physical Fitness Status of Male and Female Basketball and Handball Players in Borno State, Nigeria" has been read and approved as meeting the required standard for the award of Master of Science (M.Sc) degree in Exercise and Sports Science in Department of Human Kinetics and Health Education, Ahmadu Bello University, Zaria and for its contribution to knowledge and literary presentation.

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DEDICATION

This work is dedicated tomy late wife ZARA ALI IBRAHIM, who encouraged me to start the programme but couldnot wait to see the ending.She died at the point of delivery. May her gentle soul rest in perfect peace (Amin).

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Thanks be to God Almighty who has given the researcher the wisdom, long life and ability to pursue a programme of such magnitude, and for saving the life of the researcher throughout the vigorous period of study. The researcher heartfelt appreciation goes to his wonderful supervisors Prof. C.E Dikki, and Prof. M.A Chado, despite their tight schedules, read and made useful contribution to this work. Their constructive criticisms, comments and suggestions at different levels of the research are indeed immeasurable and highly appreciated.

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ABSTRACT

This dissertation is on the comparison of health related physical fitness status of male and female basketball and handball players in Borno state, Nigeria. To achieve this purpose, five (5) purposes of the study, five (5) research questions and five (5) hypotheses were used to guide the study. Quasi – experimental research design was used in this study. In the study 102 players are the total population; 80 players were eligible and sampled purposively for this study. The eight, (80) selected by sampling procedure were administered physical fitness test. The test items determined muscular strength, muscular endurance, cardio – respiratory endurance, flexibility, and body comparison. The muscular endurance was determined by the number of sit – ups, the cardio – respiratory endurance was determined by the performance of the subjects in 12munites distance run walk. Flexibility was determined by sit and reach test and muscular strength was determined using standing broad jump. Body composition was determined by sum of skin folds measurement by chest, abdomen, and thigh the descriptive statistics of mean and standard deviation and standard error, and the paired or two sample t – test are used to analyzed the data collected. The findings of this study revealed significant differences between test results of muscular endurance, muscular strength, flexibility, cardio – respiratory endurance and body composition. The study recommended that, physical fitness test should serve as recruitment criteria for players of basketball and handball in any sport competition; also, this study recommended that training programme should be designed to develop more speed and cardio – respiratory endurance for female players in all team sport.

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OPERATIONAL DEFINITION OF TERMS

Health Related Physical Fitness:-State of wellbeing that allows individuals to perform better in any exercise.

Health Related Physical Fitness Status:-One`s level of wellness to exercise.

Physical Fitness:-Ability to do any physical activities above expectation.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

The maintenance of physically active leisure oriented lifestyle has become increasingly significant in developed societies. In this electronic age, technological advancement often minimizes physical effort in most aspects of life. Sport and physical activity touch many aspects of peoples' lives, yet many are unaware of how powerfully sport affects them. Basketball and hand ball are intermittent sports whereby a large number of different activities and situations are developed. Basketball and handball are characterized by speed and repeated changes in the direction of activities and movement which require physical fitness to endure and become a more active member of the society (Williams, 2007).

Physical fitness is probably the most popular and frequently used term in physical education. The most important objective of physical educators is to develop physical fitness. According to Maud and Foster (1995), it was the desire to establish a scientific approach to the development of physical fitness that formed the basis of the first meeting of physical educators in 1885 when the profession of physical education originated. The physiological composition of human body is structured for diverse form of exercise such as running, hunting and waging of wars in order to survive, which required a physical fitness to make effective use of each physical ability (Sharkey, 2010). General fitness requires the ability of a person to live most effectively with his or her potentials, which depend upon the physical, mental, emotional, social and spiritual components of fitness that are highly interrelated.

Physical fitness is comprised of many different components. These components can be classified into two categories, one of which is health-related and the other is to skill performance related-fitness. According to Amusa (2012), physical fitness is concerned with the development and maintenance of the fitness components that can enhance health through prevention and remediation of disease and illness. Health related fitness among basketball players enhances their ability to function efficiently and maintain a healthy lifestyle. Thus, health- related fitness is important to all individuals throughout their lives especially to basketball players. Health-related physical fitness is based on the assumption that an adequate level of body development is required for health. There are five components of health-related fitness namely muscular strength, muscular endurance, cardio respiratory endurance, flexibility and body composition.

Physical fitness of a player depends on the nature of his game and also external conditions.There are a number of fitness elements that need to be developed. These include speed, endurance,agility and strength to correct and maintenance of body weight (Tukur, 2012). Basketball and Handball are almost similar games. Some of the standards the fit player attains to meet the demands of the gamesare strength, power, speed etc. fitness components (Purath, 2009).This research is therefore meant to compare the health related physical fitness status of male and female basketball and handball players in Borno State.

1.2 Statement of the Problem

Physical fitness has been the desire of professional team managers, coaches and sport scientists all over the world in the selection of players. Many male and female basketball and handball players have been disqualified in the process of selection of professional players due to lack of adequate health related and performance fitness status.

The world is becoming a technological world where everything is done with technology and the selection of players is done by experimentation of height, blood pressure, endurance and fitness.

Many trainers and coaches train sportsmen and women, basketball and handball players in order to improve their performance with inadequate observation or monitoring of player's level of physical fitness through practical physical fitness. It has been difficult for basketball and handball players in Borno State to follow the scientific principle of training, which will improve their performance. The basketball and handball players in Borno State have been finding it difficult to qualify and participate in the National league competition organized by the federation. This has been major a problem worth studying by the researcher to investigate the reasons for this.

Enduring to the end of the game is another major constrain of female basketball and handball players in Borno State which perhaps one can say has contributed greatly to their inability to progress by qualifying in any of the female league at the national level. Furthermore, many of the female basketball and handball players in the study area find it difficult to be selected to represent the country at international competitions.This prompted the researcher to compare the male and female basketball and handball players in the study area to see if they have similar attributes which contributed towards their inability to perform well to the point of qualifying in matches and selection. Indeed, many works have been done in regards to physical characteristics of basketball and handball male and female players. However, little has been done with comparison of health related physical fitness

status of male and female basketball and handball in the study area.Therefore this study is set to fill in the gap in knowledge.

Partly, insufficient participation in physical exercise and the increase in sedentary behaviour among students has reallyreduced the health status of the students. This research willcompare the physical fitness status of male and female basketball and handball players in Borno State.

1.3 Objectives of the Study

The objective of this study is to make a comparison of health-related physical fitness status of male and female basketball and handball players in Borno State. While the specific objectives are:

1. To compare the cardiovascular endurance of male and female basketball and handball players in Borno State.
2. To examinethe flexibility of male and female basketball and handball players in Borno State.
3. To analyse the muscular strength of male and female basketball and handball players in Borno State.
4. To explicate the muscular endurance of male and female basketball and handball players in Borno State.
5. To highlight the body composition of male and female basketball and handball players in Borno State.

1.4 Research Questions

1. What is the difference between the cardiovascular endurance of male and female basketball and handball players in Borno State?

2. What is the difference between the flexibility of male and female basketball and handball players in Borno State?

3. What is the difference between the muscular strength of male and female basketball and handball players in Borno State?

4. What is the difference between the muscular endurance of male and female basketball and handball players in Borno State?

5. What is the difference between the body composition of male and female basketball and handball players in Borno State.

1.5 Significance of the Study

This study is of great significance as it provides physical education to coaches on the norms to grade their players on the basis of their performances in the physical fitness tests. It will also help the players to know their own level of achievement in relation to the group, thus to motivate the player, to raise themselves to higher performance levels in comparison with their fellow players.

This study would provide norms to determine the fitness status of the players and help the coach to plan physical fitness programmes accordingly. No two individuals are alike. Individual differences make every physical education class a heterogeneous group. Therefore, no one programme of physical education can be ideal for all unless the strength and weakness of the individuals are known to the teachers.With the availability of norms, the coaches \cannot determine the fitness status of the players and know the exact needs of

each individual. Thus, a norm serves the purpose of a parameter to indicate the state of affairs with respect to physical fitness of the player.

The results of this study will serve as a guide for the other players to assess their physical fitness status and provide proper health related physical fitness programme.

This study will also provide an opportunity to physical education teachers andcoaches, to spot-out the latent talents of the students and to selectpotential students for different sports and games, and also will be more useful in planning educational curriculum.

1.6 Hypotheses

H_1 There is no significant difference between the cardiovascular endurance of male and female basketball and handball players in Borno State.

H_2 There is no significant difference between the flexibility of male and female basketball and handball players in Borno State.

H_3 There is no significant difference between the muscular strength of male and female basketball and handball players in Borno State.

H_4 There is no significant difference between the muscular endurance of male and female basketball and handball players in Borno State

H_5 There is no significant difference between the body composition of male and female basketball and handball players in Borno State.

1.7 Delimitation

This study is delimited to comparison of health related physical fitness status of male and female basketball and handball players in Borno State.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Introduction

This chapter examines the various views expressed by writers or authors in journals, books and articles as they relate to the topic of study. The review of related literature was done under four (4) sections which include: Concept of fitness and physical fitness, component of physical fitness, health-related physical fitness, components and methods of assessing health-related fitness of male and female players.

2.2 Concept of Fitness and Physical Fitness

Concept of physical fitness is as old as humankind. Throughout the history of man, physical fitness has been considered an essential element of everyday life. The ancient people were mainly dependent upon their individual strength, vigor and vitality for physical survival. This involved mastery of some basic skills like strength, speed, endurance, agility for running, jumping, climbing and other skills employed in hunting for their living. Over the past four decades, there has been an increase in the prevalence of overweight and physical fitness deterioration in adult across all genders, ages and racial/ethnic groups (Ichinohe, Mita and Saito, 2014). The negative effects of degraded physical fitness on both the individual and society are enormous and multi-dimensional. It can cause many risk factors to health including coronary heart disease, certain forms of cancer, diabetes, hypertension, stroke, gall bladder diseases, osteoarthritis, respiratory problems, gout and it is also associated with increase in all-cause mortality (Cataldo, 2014). In adults, relationship among physical activity, health related fitness, and health are fairly well-established (Boucherd and Shepherd, 2012). Low levels of

physical activity and cardio-respiratory fitness are both associated with higher risk of all cause and disease specific mortality (Thune,Njolstad, Lochen and Forde, 2014).

Physical fitness is the ability to perform daily activities willingly and actively. Physical fitness includes not only components of sports but those of health as well. Regular physical activity prevents or limits weight gain, and gain in Body Mass Index (BMI) (Kyle, 2001). The National College Health Risk Behavior Survey reported that 35% of American college students are overweight (Lowry,Galuska, Fulton, Wchsler, Kann and Collins, 2000). This is not surprising considering that more than two- thirds of American adult population are classified as overweight (Flegal,Carroll, Ogden and Johnson, 2002), making weight gains America's leading health problem (Mokdad, Bowman, Ford, Vinicor, Marks and Koplan, 2001). The expert committee of the World Health Organization (WHO) (2007) described physical fitness as "the ability to undertake muscular work satisfactorily." Physical fitness is the capacity to early out, reasonably well, various forms of physical activities, without being unduly tired and includes qualities important to the individual's health and well-being. Every person has a different level of physical fitness which may change with time, place of work and situation. There is also an interaction between the daily activities, and the fitness of an individual, the point where to put the level of optimum fitness. From the physiological point of view physical fitness may be said to be ability of the body to adopt and recover from strenuous exercise.

The human body evolved to be physically active. In other words, our bodies require physical activity to remain healthy. Throughout history, survival of the human species depended on hunting or gathering our food supplies, pursuits that demanded prolonged and often strenuous physical activity. The advent of mechanization and modern technology in the last few decades has resulted in the human race becoming less physically active than ever

before and we are paying for it with our health. Physical exercise is a more specific term and it implies planned, structured, repetitive and purposeful physical activity, often with the goal of improving or maintaining one's physical fitness. For example, gardening or walking upstairs in one's home may not be classified as "structured exercise", but it is certainly a physical activity.

Dimka (2002) understands fitness from two perspectives,that is aerobic and muscular fitness. He further explained that aerobic fitness refers to the ability of the human body to take in, transport and utilize oxygen. On the other hand, muscular fitness includes strength endurance and flexibility. Physical Activity (PA) among Handball and Basketball players is an important tool used in public health to treat and prevent both physical and some mental diseases such as depressive and anxiety disorders (Peluso and de Andrad 2005; Gerber and Pühse, 2009). Physical activity is also one option to increase workability (Nurminen, 2002). Recent findings in both cross-sectional and longitudinal studies as well as clinical trials suggest that exercise and physical activity interventions have beneficial effects on several physical and mental health outcomes, including a health-related quality of life.

Dimka (2002) also defined total fitness as an "individual's capacity to survive and live effectively in his environment". To him, it involves the whole person, the spiritual, mental, emotional, social and cultural as well as physical. Fitness is therefore "that state, which characterizes the degree to which the person is able to function" In other words, the ability to function depends on the physical, mental, social, emotional and spiritual components of fitness, all of which are related to each other and mutually interdependent. The term aerobic refers to energetic physical activity that requires high levels of oxygen consumption for a long period of time e.g. up to half an hour.

Physical activity is any body movement that works your muscles and requires more energy than resting and generally refers to movement that enhances health (US Surgeon General, 2008). Walking, running, dancing, swimming, yoga and gardening are a few examples of physical activity. Health- related physical activity consists of body composition, cardiovascular fitness, flexibility, muscular endurance and strength (Corbin, 2000). The relation between physical activity and fitness is very close, and physical fitness is mainly determined by physical activity patterns (Blair,Cheng and Holder, 2011). Genetic contributions to fitness are important; however, physical activity seems to be the principal determinant for cardiorespiratory fitness (Blair, Cheng and Holder, 2011). Increases in physical activity enhance physical fitness for most individuals, although the amount of adaptation in fitness to a standard exercise dose varies very much and is under genetic control (Haskell, 2007).

Dimka (2002) further explained that aerobic activities generally involve rhythmical actions that move the body over a distance or against gravity as in fast dancing, jogging, bi-cycling, swimming or certain calisthenics. He also noted that performing aerobic activity with i-indent intensity and duration on a regular basis increases the body's ability to extract oxygen from the blood and burn fatty acids and glucose efficiently, thus improving aerobic fitness. Exercise scientists view fitness from two perspectives:

i. Aerobic fitness (cardio-respiratory)

ii. Muscular fitness

Aerobic fitness is the phrase used to describe the Physical Working Capacity (PWC) of an individual who performs successive work bouts of between 3-6 minutes duration and of increasing intensity with adequate rest periods between successive bouts ('Devries, 2001). An individual’s aerobic fitness refers to his ability to take in oxygen, transport it to the parts that

needs it and its subsequent effective utilization by the muscles of the body at work (Chado, 1993)

Chado (1993) further emphasized that a person's aerobic fitness is largely dependent on the condition(s) of the heart. This is because when the heart beats slowly and ejects considerable volumes of blood into the blood stream, more blood is oxygenated. Hence, contracting muscles through peripheral circulation receive more oxygenated blood thereby providing the necessary Oil for all the working muscles engaged in that particular physical activity.

Muscular fitness, according to Chado (1993), refers to "the degree to which muscles adapt to physiological demands of a task in order to bring about improved movement. Among the variables to consider are muscle strength, local endurance and flexibility of joints. He further posited that very often, the percentage of body fat in terms of body composition, considering the individual's age and sex, forms part of the fitness level because it is unhealthy to have too much fat. Muscular fitness is affected to a large extent by the -amount of fat content of the body and/or sex and age of the person.There are several aspects of the total fitness which the Basketball and Handball coaches, team managers and sports scientists generally should know if they are to succeed, such as, the neuromuscular, sociological, psychological, Cardiovascular, aerobic and organic fitness. All these phases of the individual must be fit if a person is to be regarded as totally fit. To be precise, most discussion on physical fitness tends to focus on muscular fitness, which to many is physical fitness.

The term physical fitness has different meanings and explanations. However, it is an aspect of the total fitness. Physical fitness is multifaceted and involves both skill-related and health-related component. The skill-related component of physical fitness such as speed,

power, agility, balance, reaction time and coordination are primarily important in achieving success in athletics and are not crucial for the development of better health. The health-related components of physical fitness are cardiovascular endurance, muscular strength, muscular endurance, flexibility and body composition. Nwanko (2007) stressed that physical fitness is defined differently depending on whether it is defined by a physical educator, a physiologists, a cardiologists or a military recruitment officer, etc. For this study, physical fitness is defined by Nwanko (2007) as a reflection of one's ability to work with vigor and pleasure, without undue fatigue, with energy left for enjoying hobbies and recreational activities, and for meeting unforeseen emergencies. Physical fitness is to the human body what fine-tuning is to an engine. It enables us to perform up to our potential fitness. It can be described as a condition that helps us look and do our best. More specifically, it is the ability of the heart, lungs, blood vessel and muscles to perform at optimal efficiency and since what we do with our bodies also affect what we do with our minds, fitness influences to some degree qualities such as mental alertness and emotional stability. According to Kennedy, a one-time President of the United States of America, as quoted by Dimka (2002):

> *Physical fitness is not only one of the most important keys to healthy body; it is the basis of dynamic and creative intellectual activity. The relationship between the soundness of the body and the activities of the mind is subtle and complex such that intelligence and skill can only function at the peak of their capacity when the body is healthy and strong. That hardy spirits and tough minds usually inhabit sound bodies.*

Dimka (2004) maintained that physical fitness is "the development and maintenance of optimal individual muscular strength, muscularendurance, and cardiovascular endurance. The term includes such factors as flexibility, balance, agility, power and speed".

Hockey as quoted by Tukur (1995) defined physical fitness as "the ability to carry out daily task with vigour and alertness, without undue fatigue, and with ample energy to enjoy leisure time pursuits and to meet unforeseen emergencies" He further reported that physical fitness is the ability to last, to bear up and to persevere under difficult circumstances where an unfit person would give up. It is the opposite of being fatigued from ordinary efforts, to lacking the energy to enter zestfully into life's activities and becoming exhausted from physical exertion. Tukur (1995) further defined physical fitness as the quality of the whole body in terms of its state of adjustment to physical demands. A physically fit person is not overly fat, but has a strong skeleton, neuromuscular strength, strong connective tissues, and has good circulatory endurance. Physical fitness can be seen as a composed of a wide variety of characteristics included in the broad categories of cardio-respiratory fitness, body composition, muscular strength, endurance and flexibility.

A physically fit person tends to exhibit some appreciable and often acceptable behavioural patterns in other facets of his life such as sociological, emotional, psychological, cultural, spiritual, etc. Literature on the importance of exercise to the human machine has shown that a physically fit person is more socially outgoing, emotionally balanced, physiologically strong, psychologically stable, culturally flexible and spiritually strong. Nurminen (2002) noted that a high degree of physical fitness increases the individual's physical efficiency or ability to work effectively and the preparedness to meet the demands of daily living with vigor and also respond effectively in emergencies without undue fatigue or exhaustion. In other words, we should perform our daily or routine chosen tasks (domestic, professional and social responsibilities) with sufficient energy and enthusiasm and also be able to meet any emergencies without undue fatigue (muscle ache palpation of the heart,

depression, etc). Physical fitness fluctuates and may be maintained at optimum levels of exercising regularly.

Olusegun and Abiodun(1998), asserted that physical fitness is an individualmatter and is better defined with due considerations for the general health, occupation, vocational activities, interest, needs and capabilities of the individual. To him, physical fitness is the ability of the individual to persevere or endure physical exertion and stressful physical engagement beyond his routine daily occupational demands. Physical fitness could, operationally, be defined by the types of tests used to evaluate it. Physical fitness implies maximal functional capacity of all systems of the body, especially the cardiovascular and musculoskeletal systems. This concept implies that individuals should seriously concentrate on building their endurance, strength, flexibility and muscles endurance to their maximal levels. Physical fitness among basketball and handball players is very essential as it help to make them fit for the game which they tend to play. These kinds of games require running, jumping, endurance and flexibility for an individual player to be actively involved in them. Many team managers and coaches have neglected this particular concept of a player to be fit in any kind of game.

2.3 Components of Physical Fitness

Physical fitness can be divided into health-related and skill-related components of fitness. Health-related fitness includes those components of physical fitness that are most directly related to good health and well-being(Horvat,Eichstaed, Kalakian and Croce, 2002). Components of Physical Fitness are also known as health related fitness components. Importance and benefits of physical fitness are well-known. They are essential for complete fitness of body and mind. Physical fitness is an important part of life. Previously, fitness was

commonly defined as the capacity of the person to meet the physical demands of daily life and carry out the day's activities without undue fatigue. However, because of increased leisure time, changes in lifestyles rendered this definition insufficient. These days, physical fitness is considered a measure of the body's ability to function efficiently and effectively in work and leisure activities, to be healthy, to resist hypo kinetic diseases, and to meet emergency situations.

Olusegun. (1998) classified physical fitness elements into two general areas, namely, the health-related and performance -related physical fitness components. According to Gwani (2005), the components of performance-related physical fitness are agility, balance, speed, aerobic and anaerobic capacity, vasomotor coordination, rapidity of muscular contraction, coordination, skill and technique. These elements are necessary for skillful performance, hence should be classified as motor ability components and not physical, fitness components.

Chado (1993) and Insel, Roth, Pollins and Peterson,(1996) corroborated by asserting that the motor performance related fitness elements include speed, agility, coordination, balance, reaction time, playing strategies and power. The main components of physical fitness are cardiovascular endurance, flexibility, muscular strength and endurance, and skill development. The cardiovascular system is conditioned most effectively by active exercise such as running, swimming, or bicycling, and to a lesser degree, by weight resistance exercise and arm-cranking. Controlled passive exercise using machines, temperature changes, medication, or diets cannot replace active exercise. Flexibility, which also can be improved by weight training, is best achieved through stretching exercises that increase the body's range of motion. Muscular strength and endurance are developed through weight resistance exercise and, to a lesser degree, through sports activities.

Physically fit child feels more alert and eager to do things. A weak child is a weak brick in the wall of the nation. The wealth of a nation depends entirely upon the health of every citizen of the country. Hence, physical fitness of school children is major factor to be considered. Therefore, school physical education programmers should include multi furious activities appropriate to each age group. The complex nature of physical fitness can best be understood in terms of its components such as cardio-vascular endurance, strength, flexibility and muscular endurance. In addition to these components of physical fitness, there are many other factors which contribute to physical fitness including heredity, living standard, nutrition, hygienic conditions, environmental and climatic factors, etc.

2.4 Components of Health-Related Physical Fitness

Physical fitness is defined as a physical state of well-being that allows people to perform daily activities with vigor, reduce their risk of health problems related to lack of exercise, and establish a fitness base for participation in a variety of activities. In literature, any physical activity that benefits one's general health can be considered as health-related physical fitness. According to Haskell (2007), "health is the ability to access and apply resources from the six dimensions of health to the experiences of daily living, thus assuring growth and development and the sense of well-being that it affords". The six dimensions of health are physical, emotional, social, intellectual, spiritual and occupational dimensions. This definition, like the first ones, does not mention the absence of disease as an indication of being healthy, but confirms the fact that health is a composite situation. It also indicates that health is not static; it could change in the next moment, positively or negatively. Wellness is seen as the vehicle by which one's potential to live and work effectively and to make a significant contribution to society could be expanded (Fahey, Instel and Roth, 2003).

Health-related physical fitness is the portion of physical fitness directed towards the prevention of or rehabilitation from disease, the development of a high level of functional capacity for the necessary and discretionary tasks of life, and the maintenance or enhancement of physiological functions in biological systems that are involved in performance but are influenced by habitual activity (Plowman and Denise, 2011). Maintaining an appropriate level of health related fitness allows a person to Meet emergencies, Reduce the risk of disease and injury, work efficiently, participant and enjoy physical activity (sports, recreation, leisure);and look one's physical best.

The most important components of health-related physical fitness are: body composition, general cardiorespiratory endurance, muscular strength and endurance, and flexibility. In more detail, flexibility and balance are not the main goals for health-related fitness, but the lack of them may in fact be harmful in some cases. The concept that underlies health-related physical fitness is that better status in each of the components is associated with lower risk for development of disease and / or with functional capacity (Oja and Tuxworth, 1995; ACSM 2000; Horvat*et al.*, 2002).

Olusegun (1998) and Insel (1996) posited that cardio-respiratory endurance, muscular strength and endurance, flexibility, body composition, relaxation and emotional stability and risk factors reduction are the components that encompass health-related fitness which is the main focus of this study. Health-related fitness involves development and maintenance of muscular strength, local muscular endurance, joint flexibility, cardio-respiratory endurance and having an appropriate body composition between the percentage of body-fat deposit and the total body weight. These health-related physical fitness components are considered vital quantitative elements of physical fitness. This is so, due to the fact that they are directly linked

to the physiological functions of the body. These components improved health by reducing significantly the incidences of degenerative or cardiovascular diseases.

In a research carried out by Larson and Yocom as cited by Bucher (2001) that ten components were identified as benefits of physical fitness. These components are resistance to diseases, muscular strength and endurance, cardiovascular and respiratory endurance, 'muscular power, flexibility, speed, agility, coordination, balance and accuracy.

Malina (2001) asserted that health-related physical fitness is presumably an indicative of some aspects of an individual's health. In 6 - 9 year old children in second national children and youth fitness survey in the United States of America, it was discover that 28 indicators of physical activity, age and sex account for only 21 % of the variance in the run-walk and 18% of the variance in the fatness (Pate, Dauda and Ross, 2005). A similar analysis relating habitual activity to the health-related fitness of fourth grade children shows weak relationship. After controlling for gender, physical activity accounts for only 3% - 11% of the variance in health-related fitness items (Sallise*et al.,* 1993).

Among Taiwanese youths, 12-14 years of age, estimated daily energy expenditure and energy expenditure in moderate to vigorous physical activity (MVP A) is significantly related to the 1 mile run and sit and reach, but is not related to sit-ups and the sum of skinfolds. Partial correlations controlling for age, sex, socio-economic status and area of residence, though significant, are low (0.12 - 0.19) and account for less than 5% of the variance in health-related fitness items (Horvatr *et al.,* 1992). Similarly, there is a weak association between estimated daily energy expenditure in moderate to vigorous physical activity (MVPA) and health-related fitness of Quebec youths of 9-18 years of age. The variance shared by activity and fitness varieties ranges from 11% to 21% (Katzmarzykeffl, Malina, Msong, and Bocuhard,, 1998).

Since a large portion of the variability (80-90%) in health -related fitness is not accounted for by physical activity as measured in the studies the general pattern of results suggests that factors other than physical activity exert more influence on the health-related fitness of children and youths. Malina (2001) stressed that these factors are probably rooted in the biological and behavioural dimensions of changes that occur with normal growth, maturation and development from childhood through adolescence. According to Tukur (1995), health-related fitness is a state of being. It is transient. Unlike motor skill related fitness which has a high retention, health-related cannot be reserved for prolonged periods, but requires constant development and maintenance through regular programme of physical activity.

The health-related fitness components as outlined by AAHPERD (2005) and the American Academy of Pediatrics cited in Longchi (2011) are:

a. Cardiovascular or aerobic endurance

b. Flexibility at joints

c. Muscular strength

d. Local muscular endurance

e. Body composition

The importance of health-related fitness result is for an individual to look good and physically fit, having a high capacity for physical work and protects one against cardio-respiratory diseases and other ailments due to sedentary life style.

2.4.1 Cardiovascular/Respiratory Endurance

Cardiovascular endurance is considered as the most important aspect of health-related fitness due to its importance in decreasing risk of heart disease, and promotion of optimum

performance. Other names given to cardiovascular endurance are cardio respiratory fitness, cardio-respiratory endurance, cardiovascular fitness or aerobic fitness. The name cardio-respiratory fitness is given because it requires the delivery and utilization of oxygen, which is only possible if the circulatory and respiratory systems are capable to perform these functions. The term "aerobic fitness" has been in use, because aerobic capacity is considered to be the best indicator of cardio-vascular fitness, and aerobic physical activities are the only means to achieve it (Corbin, Welk, Lindsey, and Corbin, 2003). Cardio-vascular endurance, according to Wuest and Lombardo (1994), is often referred to as cardio respiratory endurance. It is the entire body's ability to exercise vigorously for extended periods of time without undue fatigue. Cardio-respiratory endurance, according to Inseland Roth. (2001), depends on the ability of the lungs to deliver oxygen from the environment to the bloodstream, the hearts capacity to pump blood, ability of the nervous system and blood vessels to regulate blood flow, the muscles capacity to generate power and capability of the body's chemical systems to use oxygen and process fuels for exercise. They have made it clear that improved cardio-respiratory fitness helps the heart to function efficiently, resting heart rate slows down, blood volumes increase, improved blood supply to tissues, blood pressure at rest decreases, bio-chemical function in muscle and liver are improved, increase in the ability of the body to use energy supplied by food and to do more exercise with less effort from the oxygen transport system.

Good cardiovascular fitness requires a fit heart muscle, fit vascular system, fit respiratory system, fit blood with adequate hemoglobin in the red blood cells and fit muscle tissue capable of using oxygen. These reduce risk of heart disease, other hypo kinetic conditions and early death. It is now known that appropriate physical activity can build cardiovascular fitness in all types of people and those with excess body fatness. Good

cardiovascular fitness enhances the ability to perform various tasks, improves the ability to function and is associated with a feeling of well-being (Newport, 2001).

Cardiovascular fitness could be developed through performance of active aerobic activities such as brisk walking, jogging, aerobic dancing, cycling, and tennis, playing football, swimming and many others. For optimal level of development, activities should be done daily, at least, not less than three times a week. However, it should be noted that vigorous physical activities have the potentials to increase the risk of orthopedic injury if done too frequently. In view of this, most experts recommend, at least, one day a week off. The recommended duration of physical activities capable of building cardiovascular fitness is 20-60 minutes of active aerobic activity. Activity could be either intermittent or continuous if the amount of exercise is the same, and last at least 10 minutes (Walt, 2003)

Cardiorespiratory endurance or aerobic endurance is the ability of the whole body to sustain long-lasting physical activity and involves relatively large muscle groups. Cardiorespiratory endurance is associated with the development of ability of cardiovascular and respiratory systems to maintain oxygen supply to the muscles engaged in prolonged physical activity, and with the ability of muscles to obtain the necessary energy via aerobic processes. These facts are the reasons why the terms cardiorespiratory endurance and aerobic endurance are often used interchangeably. It is the ability to exercise your entire body for a long time without stopping. It requires a strong heart, healthy lungs, and clear blood vessels to supply your large muscles with oxygen. Examples of activities that require good cardiorespiratory endurance are distance running, swimming, and cross-country skiing. Cardiorespiratory endurance is sometimes referred to by other names, including cardiovascular fitness, cardiovascular endurance, and cardiorespiratory fitness.

The primary functions of the cardiovascular and respiratory systems are to provide the body with oxygen (O_2) and nutrients, to rid the body of carbon dioxide (CO_2) and metabolic waste products, to maintain body temperature and acid-base balance, and to transport hormones from the endocrine glands to their target organs (Wilt, 2001). To be effective and efficient, the cardiovascular system should be able to respond to increased skeletal muscle activity. Low rates of work, such as walking at 4 kilometres per hour (2.5 miles per hour), place relatively small demands on the cardiovascular and respiratory systems. However, as the rate of muscular work increases, these two systems will eventually reach their maximum capacities and will no longer be able to meet the body's demands. The cardiovascular system, composed of the heart, blood vessels, and blood, responds predictably to the increased demands of exercise. With few exceptions, the cardiovascular response to exercise is directly proportional to the skeletal muscle oxygen demands for any given rate of work, and oxygen uptake (VO_2) increases linearly with increasing rates of work (Nurminen, 2002).

This health related physical fitness parameter is also referred to as circulatory or circulo-respiratory fitness. It is also referred to as the cardiovascular endurance. The circulo-respiratory capacity or endurance is conceived by Dimka (2002) as "the ability of the lungs and heart to take in and transport adequate amounts of oxygen to working muscles allowing activities that involve large muscle to be performed over long period of time". It is also referred to as the capacity of the circulatory system to supply oxygen to the cells to sustain the oxidative and enzymatic energy demands of the body and the removal of metabolic waste. Chado (1993) refers to cardiovascular and respiratory endurance as aerobic fitness, which implies the ability of oxygen uptake, transportation, and utilization by an individual during work, which exceeds three minutes continuously as it involves large muscle groups of the

body. He further stressed that this ability is related to the condition of the individual's heart when the heart beats slowly and powerfully and emptied large volumes of blood to be circulated. There is improved supply of oxygenated blood to the working muscle, hence the peripheral circulation receives and utilizes oxygen more efficiently (Chado, 1993).Cardio-respiratory endurance refers to how well the heart and lungs work to supply the body with oxygen during workout for a relatively long period of time. Cardio-respiratory endurance is the ability to perform dynamic exercise involving large muscle groups at moderate to high.

A person's total capacity for physical performance is determined by his capacity for aerobic (VO_2 max) and anaerobic performance. VO_2 max is shown to be linked with morbidity, mortality and several disease risk factors. More accurately, low aerobic capacity (peak VO_2) is known to be associated with high risk of coronary heart disease and increased blood pressure (Oja and Tuxworth, 1995). For many people who do not participate in sports, the lifespan is substantially reduced by cardiovascular and / or cardiorespiratory problems. Moreover, fitness is complicated by obesity in many retarded persons (Komi and Bosco, 2009).

2.4.1.1 Problems common to Cardiovascular Fitness Testing

Cardiovascular fitness Testing is affected by several problems depending on the purposes of the Test. These problems affect the physiological parameters and also the test results. The factors include nervousness, tension and other psychological imbalance (Nelson and Jenson, 2006). In addition, temperature, time of the day, changes in body position, altitude,

humidity, and state of health affect cardiovascular and other physiological parameter's measurement; hence reduce the reliability and objectivity coefficient (Devries, 2001).

Body composition refers to the relative proportions of fat to lean body mass and it is important to health-related characteristic. The body fatness is associated with increased risk for hyperlipidemia, hypertension, coronary heart disease and disabilities. The pattern of fat distribution is important and body composition gives more detailed data of individuals' tissues than weight alone (Oja andTuxworth, 1995; ACSM 2000). Studies have reported that adults with ID tend to have higher body mass index (BMI) and the percentage in the obese category was higher than for general population (Pitetti, Yarmer and Fernhall 2001; Yamaki, 2005).

2.4.2 Flexibility

Flexibility can be defined as the component which checks the ability of the joints in the body to move to their full range of motion. It is one of the major components of physical fitness. The fitness level is measured by the flexibility of your joints. If you have good flexibility in the joints, injuries related to joints could be prevented. Flexibility, mobility and suppleness all mean the range of limb movement around joints. In any movement there are two groups of muscles at work, protagonist muscles which cause the movement to take place and the antagonistic muscles which opposes the movement and determine the amount of flexibility.

Flexibility is the ability of joints to move through a full range of motion. Flexibility is specific to specific body parts and is a function of the type of joint(s) involved and the elasticity of the muscles and connective tissue (e.g. tendons, ligaments) surrounding the joint(s). Flexibility is beneficial to all activities that involve bending, lunging, twisting, reaching and stretching. Some activities that improve flexibility are: gentle stretching of muscles, sports such as basketball and handball, gymnastics and karate, yoga, Pilates, and any muscle strength or

endurance activities that work a muscle through a full range of motion.Brynteson, Bytenson and Huber (2001) posited that flexibility has traditionally been the most neglected of the health-related components of physical fitness. However, increased range of motion is thought to aid in the prevention of injuries associated with loss of mobility. As a health-related physical fitness component, flexibility is also used to connote, the range of movements and or motions in one or more joints. It is also referred to as the ability of an individual to move the body and its parts through a wide range of motion without undue strain to the articulating surfaces and muscle attachments (Maud, Cortez, 1995). A flexible body is therefore that which the joints can move easily, thereby allowing movements and performs a wide variety of physical activities.Haskell (2007) defined flexibility as the ability of a joint, or series of joints, to move freely through a full range of motion. Although flexibility is generally considered as one of the five components of health related fitness, its exact contribution to general health according to Maud (1995) is even less clearly defined than its importance to athletic performance.

Anyanwu (2002) mentioned the most important demonstrable benefits of flexibility to include improved cartilage's nutrition, it loses up the whole connective tissues, thereby enhancing physical mobility and they have a relaxing effect and improve bodily awareness. While, Maud (1995) confirmed that within the realm of sport there are many activities where high degree of flexibility in specific joints are desirable for enhanced performance in both quantitative and qualitative athletic activities. This implies that inflexibility could predispose sports men and women to muscle strains and tendon injuries. Hyper-flexibility or extensibility might lead to joint dislocations and ligamentous sprains. It optimizes the efficiency of movement and inflexibility results in a reduction of movement efficiency and may increase the chances of injury in some sports.

Flexibility is the ability of body segments to move through typical ranges of motion. Maintaining flexibility is lifelong need and it is important to loco motor system, balance and coordination. Flexibility gives physical support to the everyday living activities and decreases the incidence of accidents. Poor flexibility may cause musculo-skeletal problems, especially around the shoulder, lumbar and hip regions (Oja and Tuxworth, 1995; ACSM, 2000; Horvat*et al.,* 2002) Individuals with disabilities, who are often inactive, lose flexibility and that often complicates the ability to move. Although some individuals like persons with down Syndrome, may have more muscle flexibility than the others (Horvat*et al*., 2002).

Balance is not a goal for health-related fitness but it is important in many physical activities and it also has health implications. Balance is needed in everyday activities like in walking and climbing stairs, so it is important to have good balance to stay mobile and prevent falls (Oja and Tuxworth 1995:24). Balance is one of the abilities in which persons with down Syndrome are the most deficient. For example, many persons with DS can balance on one foot only a few seconds, and most of them cannot perform balance at all when eyes closed (Eichstaedt and Lavay, 1992:316). However, it is concluded that adults with DS, among the other individuals with ID, can improve their balance ability with systematic and well-designed training program (Carmeli, Merrick, Kessel and Bar-Chad, 2004; Tsimaras and Fotiadou, 2004).

2.4.2.1 Factors affecting Flexibility

There are many factors that affect flexibility of an individual as a sport person which can be long jump, race, volleyball, football but most especially basketball and handball:

i. Age: Flexibility progressively decreases with aging because of changes in the elasticity of the soft tissues and a decrease in the physical activity level. Gupta, Sandhu and Koley(2002)

reported significant improvements in shoulder and hip Range of movement (ROM) of older men (50-69years) following 10 weeks of flexibility training. Hence older persons can benefit from flexibility training and should be encouraged to perform stretching exercises at least three times a week to counteract, age-related decreases in range of motion (ROM).

ii. Gender: Alter (1996) reported that some evidences suggest that females generally are more flexible than their male counterparts at all ages. This, he attributed to gender difference in pelvic structure and to hormones that may affect the laxity of connective tissues. Nevertheless, the effect of gender on flexibility seems to be joint-and motion-specific. Females tend to have more hip flexion and spinal Lateral flexion compared to males of the same age; conversely, males have greater range of motion in hip extension and spinal flexion and extension in the thorax region (Norkiri*et al.*, 1995). . !

iii. Activity and inactivity: Lack of physical activity such as training is a major cause of inflexibility than gender, age and body type. Hartley (2002) reported that it is documented that inactive persons tend to be less flexible than active persons and that exercise increases flexibility. Disuse, due to lack of physical exercise or immobilization produces contraction and shortening of the connective tissue which, in effect, restricts joint mobility. Mobilizing the joints and muscle in a repetitive pattern or maintaining habitual body postures also may restrict range of motion (ROM) due to the tightening and shortening of the muscle tissue. For instance, joggers and people who sit behind a desk for long periods need to stretch the hamstrings and low back muscles to counteract the tautness developed in these muscle groups. The arrangement of muscles in an agonist and antagonist relationship would tend to suggest that an imbalance of strength or flexibility would predispose an athlete to injury (Maud, 1995).

iv. Warm-up: Heyward (1998) reported that warming the joints (113.F) produces a 20% increase in range of motion (ROM) whereas cooling the joint (65.F) results in a 10 to 20% decrease in flexibility. When flexibility tests are administered, it required that:

a. The client performs some type of warm-up activity to increase circulation and internal body temperature.

b. Multiple trials of each test items is administered. Excessiveamounts of stretching and flexibility training may lead to hypermobility, or an increased Range of motion of joints beyond normal, acceptable values. It leads to joints laxity (looseness or instability) and may increase the risk of musculoskeletal injuries. Chado (1991) also posited that inflexibility has been found to contribute to postural problems, because the muscles become weak due to physical in-activity.

v. Body type: People with well-developed muscles or excessive amount of subcutaneous fat may score poorly on range of motion (ROM) test, because adjacent body parts contact each other quickly than for those with smaller limb and trunk girths. This is not true in all cases. For example, some body builders and obese people who always stretch their muscles have adequate level of flexibility. Heyward, (1998) and Maud (1995) posited that flexibility is affected by joint congruence, tendons, Ligaments, fascia, joint capsules and adipose tissue in addition to muscle.

2.5 General Guidelines for Flexibility Testing

In order to assess a client's flexibility, he should select a number of test items, due to the highly specific nature of flexibility (Heyward 1998). Heyward (1998) further stated that, direct tests that measure the range of joint rotation in degrees are usually more useful than indirect

tests that measure static flexibility in linear units. He then advanced that when administering these tests he should consider the following guidelines. - Have the Client perform a short warm -up prior to the test and avoid fast, jerky movements and stretching beyond the pain -free range of joint motion. Administer three trials of each test item. - Compare the Clients best score to norms in order to obtain a flexibility rating for each test item and use the test results to identity joints and muscles group in need of improvement. Direct Methods of Measuring Static Flexibility To assess static flexibility directly, measure the amount of joint rotation in degrees using a universal goniometer, flexometer, or inclinometer. Research shows high agreement between Range of Motion 40 (ROM) measured by radiographs and universal goniometers for the hip and knee joints. Mayer et al (1984) reported no difference between radiography and the double- inclinometer technique for assessing spinal range of motion in patients with low back pain. Measurements of upper-extremity joints are generally more reliable than range of motion measurements of lower extremity joints (Maud and Foster, 1995). The inter-tester reliability of inclinometer measurements is variable and joint specific. Studies reported reliability coefficients ranging from 0.48 for Lumber extension to 0.96 for subtalar joint position (Haskell, 2007). The knowledge of anatomy and standardized testing procedures, as well as training and practice to develop your measurement techniques are very important, in obtaining accurate and reliable range of Motion (ROM) measurement. In indirect Methods of Measuring Static Flexibility Maud et al (1995) and Heyward (1998) explained that static flexibility, can be assessed indirectly using Linear measurements of the Range of motion. For this purpose, you use a tape measure, Yardstick, and sit-and -reach box to measure flexibility in inches or centimeters rather than degrees of joint motion. A major weakness of some flexibility field test is that, the length or width of the body segments may affect the performance.

In addition, Maud et al (1995) stated that recent studies by Katiyar and Rastogi (2013) have found that although the sit -and reach test appeared to be a valid measure of flexibility in hamstring area, it was not necessarily a valid measure of Low-back flexibility. They reported that for both young and adult females, the sit-and reach test correlated moderately well with passive hamstring flexion, r=,64 and r=,70 in that order, but poorly with low-back flexibility, r=.28 and, r =.12. On the other hand, they reported that for adult males, the sit –andreach test correlation was, r = .89 for hamstring r = .59 for low-back flexibility. They further advanced that a more valid description of the sitand-reach test would be that it assesses the flexibility of the posterior muscles, that is, the hamstring and the lower middle and upper para-spinal and calf muscles. This means that, the tightness of any of these muscles can limit the subject's ability to reach forward. To eliminate problems associated with varied arm and leg lengths, Hoeger (1991) developed a modified sit -and-reach test that standardized the finger-to-box distance to give room for proportional differences between arms and legs. This was demonstrated by Hoeger et al (1992) and hence recommended that when a sitand-reach test protocol is deemed appropriate, the modified procedure of Hoeger (1991) be utilized.

2.6 Reach-test

Brynteson (2001) reported that, the sit and reach test measures the flexibility of the lower back and hamstrings. The subject sits on the floor with buttocks, shoulders, and head in contact with the wall. The legs are extended with knees straight and the soles of the feet against a box of 12cm high. The hands are placed one on top of the other, with neither set of fingers extending beyond the other. A yardstick is placed on top of the box with the zero ends toward the subject. The subject reached forward as far as possible without allowing either head or shoulders to

loose contact with the wall, and the yardstick is positioned and held so that the zero end touches the extended fingers. The yardstick must now be held firmly in place until after completion of the test. The subject then leans forward gradually, allowing the head and shoulders to move away from the wall and the fingers to slide along the top of the yardstick. Three slow, forward movement trials are made, on the third forward motion, the subject leans as far forward as possible, holding this position for a minimum of 2 seconds. Reading is taken from the distance covered by the fingers along the yardstick. Two separate trials are made, and the mean of the two is recorded as the sit-and-reach score of each subject. Skin, connective tissue and condition within joints restrict the range of motion so also excessive body fat (Sharkey, 1990). Flexibility is limited by structural components which differ so much 43 among joints. (Heyward, 1998). He further stated that these structural components include the bone structure at each joint that controls the movement of the joint and in some cases impede movement while the muscles tissues and ligaments hold the skeletal frame together. Injuries occur when the ligaments are stretched beyond their anatomical elasticity. Optimal flexibility rest on the duration and intensity of the exercises for full range of motion to occur. The relevance of flexibility to sports performance and physical exercise are many. For example, a person's ability to move depends largely on his general and specific flexibility. It is therefore undoubted that a high level of flexibility helps an individual to perform physical activities including football efficiently. Flexibility is very important in diving, hurdling, swimming, jumping, gymnastics and other sports, (Nelson et al., 1972). They further stressed that football, American football and basketball need average flexibility, which is an indication that, it is not a general component rather, it is specific to each joint and the sports engaged in. Cabin et al (1985) asserted that a certain amount of threshold level of flexibility is necessary for most

sports, though it varies from sports to sports. They further expatiated that many daily activities need threshold amount of flexibility. Nevertheless, some people may need less flexibility to perform recreational and daily activities than others. However, all people need maximal amount of flexibility to prevent muscle pain, soreness and injury. Sharkey (2010) and Singhl, Kumar and Ranga (2014) have conducted a study and identified two types of flexibility: a. Static flexibility which implies range of motion when a joint is moved slowly. In other words, range of motion about a joint. b. Dynamic flexibility refers to the resistance to movement produced by a joint. Flexibility as an important component of health related fitness parameter plays vital role in the health status and performance level of sportsmen. The benefits of having good flexibility according to Sparks et al (1997) are many and increase the quality of life for many people especially the elderly. It reduces the incidence of low-back pain, muscle and joint injuries because lack of flexibility affects the degree of extension and flexion of joints.Chado (1991) also added that lack of flexibility has been found to contribute to postural problems, because muscles become weak due to physical inactivity. There is a saying that goes thus, "use it or lose it". If an individual wants to reduce injury, inhibit lower back pain, prevent post exercise pain, and relieve emotional tension that person should work on attaining adequate flexibility.

Furthermore, Haskell (2007) also reported that static flexibility is a measure of the total Range of Motion (ROM) at the joint, while dynamic flexibility is a measure of the resistance to movement. Both types of flexibility are important in performance of sports skills as well as activities of daily living, such as bending to pick up the newspaper or getting out of the back of a two-door car. Range of Motion (ROM) is highly specific to joint and depends on morphological factors such as the joint geometry, joint capsule, ligament, tendons, and muscle

spanning of the joint. The joint structure determines the planes of motion and may limit the Range of Motion (ROM) at a given joint. Triaxial joints (e.g. ball and socket joints of the hip and shoulder) afford a greater range of movement in more directions than either the uniaxial or biaxial joints. There are no universally adopted flexibility test batteries because it is evaluated in different ways by individuals or groups. However,Longuchi (2011) reported that flexibility tests can be grouped into two as follows:

1. Relative flexibility tests. These are designed to be relative to the length or width of a specific body part. That is, it measures the movement, length and width of an influencing body part.

2. Absolute flexibility tests. They measure only the movement in relation to an absolute performance goal. For example, on the splits you determine the distance between the floor (which is the goal) and the performer's sit. There are many scientific devices for evaluating flexibility among which are goniometers for measuring angles, flexiometers to ascertain degree of flexion, anthrometers or anthropometers for measuring joints. Recent sophisticated devices include electrogoniometers and radiogoniometers (Corbin et al., 1985). These devices are costly and complex to operate for self-testing at home and school. Nevertheless, they remain the best instruments and or method for the evaluation of joint flexibility. However, the sit-and-reach test is widely employed by sports scientists as field test to evaluate flexibility. Chado (1991) explained that this test is popular with AAPHERD, used for measuring the extent of the students' joint flexibility particularly around the trunk and the areas of the posterior thigh. Corbin et al (1985) corroborated the statement above because they stressed that, this test (Sitand-reach) provide good assessment for flexibility and requires only a ruler or measuring stick and a box or chair. They further expatiated that other field tests include the arm and shoulder reach, the prone trunk lift, and various tests for assessing the length of different

muscle groups of the lower limbs. To conduct the sitand-reach test, the measurement is performed on the test apparatus, consisting of a specially designed box with a measuring scale on the top level of feet (Hoeger 1991).

The measuring stick is fixed with a tape to a box with the stick's end overlapping. After a warm up, the subject reaches as far as possible recording the distance reached with the stick. The knees are kept straight and the two hands overlapped. The position of the maximum reach is recorded after taking the average of the three trials or record the farthest of the trials. The sit-and-reach is the test battery used to evaluate the flexibility (extensibility) of the low back and posterior thighs. To assume the starting position, clients remove their shoes and sit down at the test apparatus with their knees fully extended and the feet shoulder wide apart. The feet should be flat against the end board. The arms are extended forward with the hands placed on top of each other to perform the test. The test reaches directly forward, palms down, along the measuring scale four times and holds the position of maximum reach on the fourth trial for one second. The score is the most distant point reached on the fourth trial measured to the nearest centimeter. The test administrator should remain close to the scale and note the most distant line touched by the fingertips of both hands. The tester should place one hand on the subject's knee to ensure that they remain extended (AAHPER & D, 1986). The flexibility tests are used in physical fitness to determine potentials in certain sports. It is also employed to determine achievement, skill grade and the cause of poor posture.

2.8 Muscular Strength

Muscular strengthis the maximum amount of force (weight or heavy resistance) a muscle or muscle group can generate in a single effort to the point that no more repetitions can be done without rest. Muscular strength is quite the opposite of cardiovascular fitness in regards to the

fact that cardiovascular fitness is measured over a certain period of time. While on the other hand, muscular strength is measured in one repetition. In our daily lives, we need modest levels of strength to be able to perform everyday physical tasks like lifting, moving, carrying, etc. A common test to measure upper body strength is some type of weightlifting exercise, such as the bench press. Anaerobic weightlifting exercises like the bench press, leg press, shoulder press, or bicep curls are examples of the best ways to improve muscular strength. Strength is the amount of force a muscle or group exert in one maximum effort.

Strength in the muscle is necessary for the normal physical activities and enjoyment of a happier life. Horvat et al (2002) has condemned the idea that strength is necessary only for highly trained athletes and other individuals who have jobs that require muscular work. To them, strength is undoubtedly a basic component of fitness and wellness, and is crucial for optimal performance in daily activities such as sitting, walking, running, lifting, carrying objects and doing household work or even enjoying recreational activities. Strength is seen as an equally important aspect of health-related fitness and refers to the maximum tension or force muscles develop in a single contraction against a given resistance. Wue and Lombardo (1994) also state that muscle strength is the ability of a muscle or muscle group to exert force in a single effort against resistance. It is also made clear, that there is some crossover effect between muscular strength and muscular endurance. Development of muscular strength also produces some increase in muscular endurance. However, muscular endurance does not enhance strength. Muscle strength is best developed with exercises done against resistance. This is also referred to as Progressive Resistance Training (PRT) or Progressive Resistance Exercise (PRE). This name is given because the frequency, intensity, and length of time of muscle overload are progressively increased as muscle strength increases.

Muscular strength as a basic component is the ability of the muscle or muscle group to apply force and refers the maximal one-effort force or strength endurance, where muscles apply force repeatedly for certain period of time. The muscle strength and endurance appear to have little relationship to the management of specific disease. However, good muscular performance is fundamental for producing efficient movement for individuals with and without disabilities (Oja and Tuxworth, 1995:19; ACSM 2000:81-84; Horvat*et al.*, 2002:132; Pitetti and Yarmer, 2002; Keskinen, 2004:125) Moreover, muscular fitness improves or maintains the fat free mass and resting metabolic rate, which is related to weight gain and bone mass, which is equally related to osteoporosis and glucose tolerance, which is related to type 2 diabetes. Based on a related study, Pitetti and Yarmer (2002) reported that for all age groups, males and females without ID were significantly stronger than their same-gender peers with ID for all isometric strength measurements. For individuals with ID, particularly decreasing leg and back strength is a serious health and social concern. Muscle strength, especially lower body muscle strength, for persons with intellectual disability is fundamental for overall health, for improving vocational productivity and for gaining independence in activities of daily living(Pitetti and Yarmer 2002). Pitetti, Fernandez, Pizarro and Stubbs (2007) observed that there is a relationship between upper body strength and aerobic capacity. The significant positive relationship has also demonstrated between maximal aerobic capacity and isokinetic leg strength and it is noted to be substantial especially for individuals with DS (Pitetti and Boneh, 1995). Poor muscle strength has also been linked to a higher incidence of osteoporosis and greater risk of falling among individuals with ID (Pitetti and Yarmer, 2002).

Hockey (1977) considers strength as the maximal one-effort that can be exerted against given resistance, while Robbins, Powers and Burgess. (1997) defined it as the muscular force

exerted against a movable and immovable objects and can best be measured using one-maximum effort on a given movement or position. Muscular strength is just one component of physical fitness. Along with cardiovascular fitness, muscular endurance, flexibility and body composition, muscular strength can provide several health benefits. Muscular strength refers to the amount of force a muscle can produce and is usually measured by the maximum amount of force a muscle can produce in a single effort (maximal effort). The amount of muscle strength which can be achieved depends on gender, age, and inherited physical attributes. While strong muscles are essential for any athletic endeavour, strong muscles can benefit everyone in some way.

Systematic and well-designed training can elicit increases in muscle strength and endurance male and female basket-ballers and hand-ballers. In addition, to be able to improve and normalize the muscle strength level, especially in lower extremities, people need progressive resistance exercise programs (Horvat, Groce and Roswall, 1993; Croce, Pitetti, Horvat and Miller, 1996; Tsimaras and Fotiadou, 2004).

Muscular endurance is the ability of a muscle or group of muscles to perform repeated movements (or to hold a particular position) with less than maximum force for an extended period of time or until muscular fatigue. Or, to put it simplistically, it is how long your muscles can do something before getting too exhausted to finish. One must be careful not to confuse muscular endurance with muscular strength. While they can work together, they are definitely not the same. For many athletes, there may be a need to distinguish between muscular strength and muscular endurance. But for everyday people who want to easily perform their daily routines, trying to stay healthy and fit, and just want to enjoy physical activities like hiking,

biking, or just playing in the park with their children, muscular endurance plays a major role in fitness.

Common testing for muscular endurance can be dynamic (the ability to repeat contractions) or static (the ability to sustain a contraction). Dynamic tests would be to see how many push-ups or sit-ups, for example, a person can complete in a designated amount of time (e.g. 30 seconds, a minute, or maybe longer). Or without being timed, the person could do as many repetitions of the exercise as they could until they could not do not anymore. An example of a static test would be the flexed-arm hang whereby the performer hangs on a bar until the designated stopping time or until they become too weak to continue hanging. Muscular endurance can be improved by both aerobic and anaerobic exercises. Some examples would be biking, step machines and elliptical machines.

2.7.1 Strong Muscles that have direct and indirect benefits on health include:

1 Ease of movement

2 Good posture

3 Easier performance of work, everyday activities and exercise

4 Easier performance of recreational activities

5 Stronger tendons and ligaments, and bones

6 Decreased risk of injury

7 Decreased risk of falls

2.7.2 Health benefits of Muscular Strength

Muscles support the skeleton and enable movement. Strong muscles in the legs, buttocks, back, abdomen, chest, and shoulder provide a person with the strength to stand up straight and maintain good posture. Strong muscles enable functional movements associated with everyday living. Many recreational activities such as skiing and kayaking require strength in particular muscle groups such as legs or upper body. When muscles are strong, the associated tendons which attach muscles to bone, and ligaments, which attach bone to bone are usually also strong. Exercises which strengthen muscles are associated with strengthening bones. Strong muscle, tendons, ligaments and bones decrease the risk of injury as the body is able to respond to falls or extra loads which the body experiences. Back pain can be prevented or reduced by strengthening back muscles and arthritis can be alleviated by strengthening the muscles around the joints that are affected while strength training may be therapeutic for people with chronic pain (Rani, Singh and Kalsi, 2013).

Good muscle strength can also increase work capacity so that an individual does not tire easily and can improve athletic performance. During an emergency, strong muscles enable an individual to work beyond his normal capacity. Daily tasks, such as lifting heavy items and placing them on shelves can be made easier if an individual has good muscular strength. Parents and grandparents need strong muscles to lift infants and young children. For example, lifting a heavy box or piece of equipment and placing it on a self at shoulder height.

Jackson *et al.* (1999) discovered the following benefits of strength

- Having adequate strength can help minimize the risk of injury by making participation less stressful on the body.
- Strength increase people resting metabolic rate, and helps you look and feel good. It boost your psychological and physical preparation, hence improves physical performance.
- By building muscular strength, players do not lose bone mineral density, muscle mass or at least postpone or minimize these losses.
- Strength can improve physical performance in sports and leisure time activities. Players need sufficient strength to be professional basket-ballers and hand-ballers.

2.7.3 Muscular Endurance

Muscular endurance is the ability to perform repeated contractions against a sub-maximal resistance (Anderson *et al.*, 1995). The ability of the muscle to exert a sub-maximal force against resistance repeatedly or to sustain muscular contraction continuously over time is characterized by activities of long duration but low intensity (Robbins *et al.*, 1997). Corbin *et al.* (2003) define muscular endurance as the maximum number of repetitions or muscle contractions one can perform against a given resistance. Muscular endurance is one of the main

fitness components, important for success in many sports. Muscle endurance plays a very important role in sports such as rowing. In many other sports, including field team sports, good muscle endurance is also an important part of the overall fitness profile. Muscle endurance is different from cardiovascular endurance because it involves the muscle fatiguing rather than a limitation in the amount of oxygen being supplied or utilized by the muscles

Muscular endurance is the ability of a muscle to contract repeatedly over an extended period of time. It describes how long you can sustain a given type of muscular exertion. One way that fitness professionals measure muscle endurance is by determining the maximum weight a person can lift 20 times consecutively. You can build better muscular strength and endurance through resistance training. Resistance Training is also referred to as weight training or strength training and can be done with measured weights, body weight, or other resistive equipment (i.e., exercise bands or exercise balls). Resistance exercises stress the body's musculoskeletal system, which enlarges muscle fibers and improves neurotic control of muscle function, resulting in greater muscular strength and endurance.

2.7.4 Muscle Strength and Muscle Endurance Tests

The strength can be tested by means of strength tests where a maximum strength effort is performed once (maximum strength) like hand grip test or during a maximum number of repeats within a defined period (muscle strength endurance) like number of sit ups in 1 minute (ACSM, 2000; Massuca, Branco, Miarka and Fragoso, 2015). Reliable strength measures can be obtained from sport men and women. Here too, we must try to get the sport men and women understand that they must try to exert the greatest possible strength to move the heaviest possible weight once, or that they must repeat the strength exercise as many times as possible in certain time. Lavay*et al.*, (1995) concluded that strength tests like hand grip strength, sit-

ups, isometric push-ups and bench press test were reliable for use with male and female adolescents with mild to moderate sport profession. The validity and reliability of strength and muscular endurance measures are affected by client's factors, equipment, technical staff and environmental factors. They must be controlled to ensure the accuracy and precisions of muscular fitness score (Heyward, 1998).

Timed Static Test of Muscular Endurance

The performer maintains one continuous muscle contraction rather than a series of repetitive bouts, and the test is scored in terms of the amount of time the weight was held. The flexed - arm hang test for girls 62 is a good example (Blattner and Noble, 2006). Muscular endurance test differs from strength test because the score is based on the number of repetitions executed (or the duration of time a set tension is maintained) and not the maximum amount of weight lifted or force exerted as is the case for measuring strength. Blattner and Noble (2006) mentioned that footballers need the following types of endurance: - General endurance - Specific endurance - Strength endurance - Speed endurance He further stated that general endurance is usually aerobic in nature and specific endurance can be aerobic or anaerobic. For instance, at the beginning of all training seasons e.g. during the preparatory seasons the Footballers should be made to do 2 -3 kilometers of jogging or running at 50 - 60 percent of the maximal speed. Strength endurance is a must for all footballers. Running about on the football pitch demands strength in the legs and for a footballer to run about on the field for over 120 minutes, he needs strength and endurance. Exercises such as series of squat jumps, with or without barbell on the shoulder, skipping and jumping over series of hurdles or platforms, running uphill and running on sand will help to develop strength endurance in footballers. Practice matches lasting between 120 and 150 minutes are recommended also for

the development of strength endurance in Footballers. Speed endurance training is also a must for Footballers. A good footballer should be able to run 100m race easily in at least 11.0 seconds. Some strikers and defenders can run faster than that and they do spring so many times in a match when chasing a ball or when moving with the ball towards the goal area of the opponents. Cherappurath (2015), further specified that most of the work-outs suitable for the development of speed endurance in sprinters can be used for developing speed endurance in Footballers. Exercises like pair running, series of short sprints, series of 200m races at about 80 percent of their maximal speed, running with the ball repeatedly from one end of the field to the other (shuttle relay sprint races with the ball) are some of the activities that can be used by Football coaches to develop speed endurance in Footballers. The bent-knee sit up is one of the most commonly used measures of local muscular endurance of the abdominal muscle, which are very important muscles in maintaining good posture. The test requires counting the number of times the individual comes to a sit-up position from the spine position with fingers clasped behind the head and knee flexed or hands crossed on the chest with palms placed on the shoulder. The validity and reliability of strength and muscular endurance measures are affected by client's factors, equipment, technical staff and environmental factors. They must be controlled to ensure the accuracy and precision of muscular fitness score (Heyward 1998).

2.8 Body Composition

Body composition refers to the relative proportions of fat to lean body mass and it is important to health-related characteristic. The body fatness is associated with increased risk for hyperlipidemia, hypertension, coronary heart disease and disabilities. The pattern of fat distribution is important and body composition gives more detailed data of individuals' tissues than weight alone (Oja and Tuxworth, 1995; ACSM, 2000). Studies have shown that male and

female who do not participate in sport are tend to have higher Body Mass Index (BMI) and the percentage in the obese category was higher than for general population (Pitetti, Yarmer and Fernhall, 2001; Yamaki, 2005). Individuals with Down Syndrome have a different body shape and body proportion than individuals in general population or other individuals. Moreover, women that are fat are more likely to be overweight or obese than other individuals who participate in sports activities. Collacott, (2005). Conducted studies have evaluated the effects of exercise on body composition with population. Those studies found no significant effects of exercise on body composition. To have more effective results, it is recommends combined programmes of exercise and nutrition diet. However, more research in the areas of body composition and sport in male and female are needed (Fox, Burkhart and Rotatori, 2003; Pitetti, Rimmer and Fernhall, 1993; Pommering*et al*., 1994; Chanias, Reid and Hoover, 1998).

In physical fitness, body composition is used to describe the percentages of fat, bone, water and muscle in human bodies. This means that muscular tissue takes up less space in our body than fat tissue, our body composition, as well as our weight, determines leanness. Two people of same sex and body weight may look completely different from each other because they have a different body composition. It also refers to the proportion of fat and fat-free mass in the body. A healthy body composition is one that includes a lower proportion of body fat and a higher proportion of fat-free mass. Body composition is one measurement that is used to assess your health and fitness level.

Howley*et al*. (1997) advanced that, appropriately one third of adults are obese. They further defined obesity as a condition in which a person is over fat (i.e. has an excess of adipose, or fat tissue) and is typically defined as a body fat percentage of greater than 32% for females and greater than 25% for males. Body composition is the percentage of fat in your

body compared to your lean body mass (muscles, bones, tendons, ligaments, organs, etc.). Body composition is a better indicator of your overall fitness condition than body weight. So you should understand that your total body weight or what you see on your bathroom scale does not tell you how much fat or lean body mass (muscle) you have. Body composition is useful in helping to determine health risks. Therefore, knowing your body composition and how it relates to your overall fitness level is essential. An optimal ratio of fat mass to lean mass is a clear indicator of good fitness.

Body composition is a consequence of the extent that you perform the other components of physical fitness. In other words, when you improve the other four components, it will have a positive impact on body composition resulting in less body fat. Alternatively, when you have a high body fat content ratio, you are considered overweight or possibly obese. And, it negatively affects the other fitness components as well as your daily performance, your appearance, and your overall health. There are several methods that can be used to calculate body composition. The best method is underwater weighing. But due to the expenses, this is not practical for the everyday person. Incidentally, if you can go to a university or some other place that is set up to do it, it would be well worth your time to check it out. Therefore, the most common method of determining your body composition is skinfold reading - using skinfold caliper and taking measurements from certain areas of your body. A regular program involving aerobic exercise and strength training can help you decrease your body fat and increase your muscle mass, and thereby, significantly improving your body composition and general overall health and fitness. Being fit is not just about being able to bench press a lot of weight, but you also need to know how well you can handle running a mile, for example, and a few other things. The key is that by understanding the 5 components of physical fitness, you

will be able to assess your fitness level and determine what specific health and fitness goals you like to achieve (Emiola, 2004).

2.8.1 Measurement of Body Composition

McArdle et al (1991) stated that there are several methods advanced by scientists to evaluate and quantify the body composition, where the major structural components of the body e.g. muscle, bone and fat are estimated Willet et al (1999) stated that the measurement of body fat, which is composed mainly of adipose in the form of triglyceride, represents a challenge to researchers and clinicians. He further stressed that the main stores of fat are subcutaneous and intra-abdominal, and considerable amounts of fat can also reside within muscles, particularly in elderly persons. The body composition could be best determined through the dissection and chemical analysis of the animal carcass and human cadaver. Johnson et al (1979). However, other methods include radiography in which bone, muscle, fat and skin are estimated through xray analysis, the potassium-40 method, which employs the measurement of gamma radiation, from the body and requires a chamber and elaborate equipment, the helium dilution method, in which volume differences between volume in a special chamber and subject volume are analyzed (Tukur, 1995). Traditionally, the gold standard for estimating body fat has been hydro densitometry (under water weighing). However, it is limited by its methodological requirements. This is based on the principle that fat tissue is less dense than muscle and bone (Willet et al., 1999). They further explained that dual-energy x-ray absorptiometry is now replacing densitometry as a standard because of its high precision and its simplicity for the subject. Skinner et al (1990) also stated that the body composition could be determined through body density which according to them is a function

of the densities of the various body components and other proportions each represents relative to the entire body mass. They further explained that the major reason for using the body density to estimate body fat is because the young and old population tends to be underestimated. Another error may be the assumptions that the density of fat is fairly constant with age, gender and location while muscle and bone densities vary markedly. They noted further that bone elasticity increases up to the age of 20 and decline after age of 50. All of these methods are used primarily for research purposes and are not available for routine clinical care, but they can be used to validate other methods of measuring body fat (McArdle, Katch and Katch. 1991) mentioned that there are two general procedures used to evaluate body composition:

1. Direct. This refers to the chemical analysis of the animal carcass and human cadaver and

2. Indirect which is the hydrostatic weight, skin fold and circumference measurement otherwise known as hydrostatic weighing and skin fold and girth measurement.

It requires significant amounts of technical expertise and is difficult or impossible to administer on some special populations e.g. obese, elderly, children, etc. (Vescovi, 2001 and Maud, 1995).

2.8.2 Body Composition Estimation

Maud et al (1995) reported that the hydrostatic technique has been found to be highly reliable with pearson-product correlation coefficients >.95. The percent body fat can be estimated from bioelectrical impedance (McArdle et al., 1991 and Claessens et al 1990). One of the most valid or gold standard of estimating body fat has been

hydrodensitometry(underwater weighing). This is based on the principle that fat tissue is less 75 dense than muscle and bone. That is, fat floats whereas lean body tissue sinks, and fat weight is determined by immersing the subject in water to see how well they float. It is an indirect method based on the Achimede' s principle of floatation, which states that the loss of weight of the body in water is equal to the weight of the water displaced by the body. This method is expensive, time wasting and requires expertise and subjects full cooperation, (Mc Ardle et al (1991), Willet et al (1999) and Maud et al (1995). They further discussed that the dual-energy x-ray absorptiometry is replacing densitometry as a standard method due to its high precision and simplicity for the subject. In clinical practice and epidemiologic studies, the body fat is often estimated by using a formula that combines weight and height. The underlying assumption is that most of the differences in weight for persons of the same height is due to fatness. The ratio between body fat and lean body tissue is a better gauge of fatness than the body weight measured by use of a scale or height/weight chard method. For instance, a height/weight chard may label a 6-foot, 210 pound Football player as overweight, when in reality he has only 10% body fat as measured with skinfold calipers (Donatelle et al., 1994). The formula used most times in epidemiologic studies is the body-mass index, also referred to as the quetelet index, which is the weight in kilograms divided by the square of the height in meters. In the 19th century, this index observed empirically that in adults, this index is minimally correlated with height and hence provides an appropriate measure of weight adjusted for height. Among middle aged adults, body mass index is strongly correlated with fat mass measured densitometrically and adjusted for height (Heyward, 1998). It has an approximate correlation of r = 0.90 for both men and women (Willett et al., 1999).

The Body Mass Index (BMI) and skin fold are routinely used in fatness surveys as indicators of fatness (Rolland et al., 1989 and Guo et al., 1994). The underwater weighing and measurement of lung residual volume enable one to readily assess the body fat percent or body composition with considerable degree of accuracy, but obviously not for ease of measurement. (Maud 1995). He further stated that the body fat and composition may be reasonably estimated from measurements of subcutaneous fat as reflected by skin fold thickness. He also pointed that such measurements which are relatively uncomplicated, have been adopted by physicians, trainers, coaches and physical educators as a means of assessing the body composition of different persons, sports men and women inclusive. The skin fold measurements are taken with an instrument called a skin fold caliper meant to measure folds of skin only without muscle tissues (Heyward, 1998). Measurement of body fat with the skin fold caliper has methodological problems such as the caliper pressure, inter-observer error, difficulty of obtaining accurate measures on obese people and the expertise required to obtain accurate measurements (Skinner et al., 1990). Heyward (1998) and Claessens et al (1990) added that the skinfolds are measured on biceps, sub-scapular, suprailiac, medial calf, calpopliteal front thigh; chest, midaxillary and abdomen. Accumulation of intra-abdominal fat is of most concern for longterm health consequences (Van Loan 1996). He also advanced that the waist-to-Hip Rate (WHR) is used to estimate abdominal adipose tissue distribution and is a risk factor for cardiovascular diseases and diabetes. The waist circumferences by itself has also been proposed as a measure of abdominal fat. C = waist circumference 0.1091N0 + (kg)/h+(m) A higher value of circumference indicates more percentage of body fat. The Procedure for Measuring Skinfolds In a number of regions of the body, the subcutaneous adipose (fat) is lifted with the fingers to form a skinfold. The skinfold fat measures consist of a double Layer

of subcutaneous fat and skin, the thickness of which is measured with a skin fold fat caliper AAPHERD (1986) With regarding to Health relate physical fitness test items Brozek et al (1963) advanced five skinfolds sites (SFS) for measuring skinfolds thus: biceps, triceps, subscapular, abdominal and suprailiac. The skinfold sites are better assessed in the morning, so as to eliminate error that could result from vascular tissue vasodilatation (MacArdle et al., 1991). The recommended testing procedure by AAPHERD Health related physical fitness test items (1986) and Heyward (1998) are:

1. Locate the site of measurement and mark with wash-felt tip pen.

2. Grasp the skinfolds between the thumb and forefinger and ensure the fold is large as possible and it contains all the subcutaneous fat at the site.

3. Place the contact surfaces of the caliper 1cm (1/2 inch) above or below the finger.

4. Slowly release the grip on the calipers enabling them to exert their full tension on the skinfold.

5. Read skinfold to the nearest 0.5 millimeter after needle stops (1 – 5 seconds after releasing the grip on caliper). In a similar way, Watson (1983) recommended the following procedure for skinfold measurement.

6. Take the reading 1 - 5 seconds after the application of the Measurements are taken on the right side of the body in standing position.

Behnke et al (1974) recommended the following equations for estimating body composition:

1. Lean Body Weight (LBW) in kg, calculated from four skeletal diameters -bi-acrominal, bitrochanter, wrist and ankle.

2. Body density (Db) as estimated from Sinning (1974) equation for college athletes; Db = 1.1080 - 0.00168XI - 0.00127X2 where Xl is the subcapular site fold (SF) and X2 is abdominal SF. This equation has reliability coefficient of 0.975

3. The percentage of the body fat in the body can be determined from a simple equation that incorporates density. The simplified equation is obtained by substituting 0.90 gccand 1.10gcc-1 for densities of fat and lean tissue respectively (McArdle et al., 1991).

4. Percent body (% fat) is also calculated from the equation of Brozek et al (1963) with a reliability coefficient of 0.99 % fat = (4.510/DB - 4.142) x 100. 5. Fat weight is also estimated from Behnke et al (1974) equation. Using the Durnin and Rahaman procedure as advanced by Tukur (1995), in the skin folds thickness conversion into estimated fat percent. There are two steps:

1. Skinfolds thickness - estimate of body density, 80

2. Body density - estimate of percent fat He further explained that the conversion of the skin-folds thickness to estimate body density is found out after adding all the measurements of all the skin fold sites and substituted in one of the following equations.

1. Men: body density = 1.161 - 0.0632 Log10 (total skin).

2. Women: body density = 1.158 - 0.0732 Log10 (total skinfolds)

3. Boys: body density = 1.1533 - 0.0643 Log10 (total skinfolds)

4. Girls: body density = 1.1369 - 0.598 Log10 (total skinfolds) Body density for white athletes or men(18-61 yrs) = 1.1120 - 0.0043499 (∑7skf) + 0.00000055(∑7skf)2 - 0.00028826 (age) Jackson et al (1978). For the body density to be converted to estimate body fat, the following equation is used and is the same for all subjects. Percentage fat - (4.95) - 4.5 x 100 Body density or percent body fat formula as derived by Berkeley Scientist Dr. William Seri (1989) = 495 - 450 Density Body Mass Index (BMI) = Current weight Body height (m2).

2.9 Physical Fitness among Male and Female Basket Ball and Hand Ball Players

Basketball has become one of the most popular court sports in many countries. PaivaNeto and Cesar (2005) performed a literature review on the physical abilities required to play basketball and defined it as a high-Intensity sport with significant physical contact, high speed and constant jumps and shifts (both to attack and to defend). As a result, the main features of general physical fitness involved in basketball are anaerobic endurance and speed of movement. Other authors have added agility as a key factor in this sport (Ziv and Lidor, 2009). This intermittent feature requires the use of all three energy systems (aerobic, lactic anaerobic and alactic anaerobic) to meet the players' metabolic demands. Moreover, these sports have complex demands that require a combination of individual skills, teamwork, technique, tactics and strategies, which contribute to the physical conditions of the players as well as the dynamic nature of team court sport, in general (Stone and Kilding, 2009). Handball is a sport with great anaerobic demand. During the game, tasks such as pushing and blocking require high power and strength levels in the limbs and trunk regions (Izquierdo*et al*., 2002; Gorostiaga, Granados, Ibanez and Izquierdo, 2005). Gorostiaga*et al*. (2005) reported that

stronger players with higher body mass have an advantage in handball because the requirements of the game, such as throwing the ball with power and speed are met through jumping and physical contact with the opponent.

2.10 Performance Related Physical Fitness Component of Female Handball Players

Physiological characteristics that have been reported as essential for football players are aerobic fitness, agility, muscle strength, speed, and explosive jumping power (Nofiu,2015). While aerobic fitness contributes up to 90% of energy utilization during football matches (Mokdad, et al. 2001), typically high intensity bouts of sprinting are necessary to score goals. These efforts may be complemented by jumping used by footballers when controlling the ball in the air and to score or defend goals by way of heading. Sprinting accounts for approximately only five percent of the match duration (Bloomfield, et al. 2007) with each sprint covering up to 30 meters (Di Salvo, Baron, Tschan, Montero, Bachl, &Pigozzi, 2007) and most efforts not completed in a straight line. Thus, acceleration, speed, and agility are determined by the athletes muscle strength and power (Wisloff, et al. 2004), and can be effectively trained through a well-developed and structured program (Metaxas, Koutlianos, Kouidi, &Deligiannis, 2005). These key components have been shown to differentiate elite and non-elite players independent of football specific skills such as ball control, dribbling, and tackling (Ostojic2004). However, it remains unknown how elite Indian footballers compare with previously reported physiological results of professional footballers. Speed, agility, and quickness all involve learned motor skills. Although the magnitude of proficiency will vary with each individual, learning the efficient and effective execution of these skills can improve overall athletic ability. The concept of agility is difficult to precisely define operationally, even though there is general agreement among coaches, athletes and researchers as to what is meant

by the term agility (Wilmore, 1977). Agility typically refers to the ability to move and change position or directions, rapidly without loosing balance or sacrificing space. Generally, agility can be defined by the ability to explosively start, decelerate, change direction, and accelerate again quickly while maintaining body control and minimizing a reduction in speed (Paivaneto and Csar, 2005'9). Universally, agility can often be described as an athlete's collective coordinative abilities (Tittel1991; Plisk(2008). These are the basic elements of technical skills used to perform motor tasks spanning the power spectrum from dynamic gross activities to fine motor control tasks and include adaptive ability, balance, combinatory ability, differentiation, orientation, reactiveness, and rhythm (Plisk, 2008).

Coordinative abilities are often recognized to be most easily developed in preadolescence, which is considered to be an important time period for skill development (Sallies, Mckenzie and Lalcaratz, 1993). This period often changes focus during adolescence when the shift from general to special preparation should begin. Most athletic activities that utilize agility occur in less than 10 seconds and involve the ability to coordinate a few or several sport specific tasks simultaneously (like catching a football and then making a series of evasive moves and cuts to avoid being tackled in order to advance the ball further down the field (Cissik& Barnes(2004). With the exception of skills specific to the sport, agility can be the primary determining factor to predict success in a sport (Halberg2001). Sports inherently require changes of direction in which lateral movements are used in the several planes of movement simultaneously. Sports regularly are played in short bursts of 30 feet (10 yards) or less before a change of direction, acceleration and/or deceleration is required. Because movements can be initiated from various body alignments, athletes need to be able to react with strength, explosiveness and quickness from these different positions. Wilmore, (1977),

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

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

2.11 Components of Speed

Speed, agility, and quickness are some of the most significant, and visible, components of athletic success. An improvement in the ability to react quickly, apply significant force rapidly in the appropriate direction, and to redirect that force if needed is the ultimate goal of a program to improve speed, agility, and quickness. A carefully designed program that addresses these factors of athleticism significantly improves overall performance and reduces the risk of injury. Speed, mostly in the form of acceleration, is an important factor in almost all games and sports.It becomes a determinant in scoring, passing and defending or preventing a goal.Inother

words, speed makes the difference where one is able to gain an advantage over an opponent. According to Wilmore, (1977), speed can be accomplished for the individual body segments, such as for the arm or leg, by using an elaborate system or micro switches and electronic timer.Total body speed can be measured by timing the athlete over a set distance from 50-100 meters.

2.12 Muscular Power

Muscular power, often called explosive strength, is a combination of strength and speed. This is the ability to realize maximum force in the fastest possible time. Also, it is known as the ability to exert a maximum contraction at one explosive act. Stability, strength, and power training help shift the force-velocity curve up and to the right. While stability training develops appropriate balance, strength training improves the body's ability to create force, and power training aids in decreasing the amount of time needed to create that force. These all have significant contributions in regards to improving speed. When performing stability, strength, and power drills specific for speed development, it is important to include exercises for contributing areas, such as the feet, anterior and posterior muscles of the shins, the core, and hip flexors/extensors as part of a whole-body program. In addition, movements that emphasize powerful plantar and dorsiflexion of the ankle, as well as extension and flexion of knee and hip are also important components. Ballistic movement, as found in speed, agility, and quickness training, is created by a forced and rapid lengthening of a muscle immediately followed by a shortening of the muscle, creating an elastic "rubber-band-like" effect of energy release. This action is often reflexive, and referred to as the "stretch reflex." Training the muscle and tendon's ability to load eccentrically and rapidly release energy concentrically improves the magnitude and effectiveness of the stretch-shortening cycle. This is achieved

through power training and plyometric. Muscular power according to Jensen and Nelson, (1972), is the ability to apply force rapidly. Power is typically demonstrated in perfecting the body... (as in jumping) or an object (as in throwing). The muscles must apply great force at a rapid rate in order to give the body of object the momentum necessary to carry it in the desired distance. Explosive strength is very important to vigorous performances because it determines how hard a person can hit, how far he can throw, how high he can jump and to some extent, how far he can run. Running is a series of body projections, therefore leg power is essential to fast running. Power is the resultant of force multiplied by displacement divided by time (Wisløff et al., 2004). The ability to achieve more force over the same distance and time period would increase power. Therefore, increasing strength should translate to increased power in professional athletes (Noffal et al., 2012). Nelson & Jensen, (1972), explosive strength can be increased by increasing the strength without sacrificing speed or by increasing the speed movement without sacrificing strength, or by increasing both the speed and strength.

According to Fisher and Jensen, (1979), increasing strength affords the greatest potential for improving power because strength can usually be increased by a significant amount while speed can be improved with a very limited amount. Neuromuscular Adaptation – Agility training may be the most effective way to address the neuromuscular system and sport-specific skills necessary for sport performance, since agility training must closely resembles the sport itself (Cissik, et al. 2004). Training at sport-specific metabolic training speeds enables athletes to train at a level that most closely resembles the intensity, duration, and recovery time found in sport during the off-season. The use of agility training in an annual training cycle provides a critical link for athletes to apply their strength and conditioning program gains to the competitive athletic arena. Explosive strength can be assessed very accurately within the

laboratory using expensive force transducers and recorders. (Wilmore 1977). Several field tests have been in use but lack objective validation. The sitting shot put and medicine ball throw have been used to estimate upper body power while standing broad jump and vertical jump have been used to estimate lower-body power. The margaria-kalamen leg power test. (Mathew and Fox 1981), present a more objective measure of lower body power. The subject begins by standing six meters in front of a series of steps. On the command go, he runs as quickly as possible up the stairs, stepping on every third step. A micro switch embedded in a rubber mat is placed on the third step while a second micro switch is placed on the ninth step, which stops the timer when hit. The elapsed time represents the time required to move the body weight, the vertical distance between the third and the ninth steps. Power is calculated by the following formula power (Kg X meter/sec) = Body weight (kg) x vertical distance (meters), Elapsed time (seconds). Studies have reported a fairly higher reliability and validity of the sergeant jump test as a measure of explosive power (McArdle et at, 1981).

2.13 Volume of Oxygen Uptake

VO2max stands for maximal oxygen uptake and refers to the amount of oxygen your body is capable of utilizing in one minute. It is a measure of your capacity for aerobic work and can be a predictor of your potential as an endurance athlete. Although there are many factors that affect your VO2max, it is a commonly accepted measure of cardiorespiratory fitness. Cardiorespiratory endurance is the most vital means of determining a person's maximal oxygen uptake (Vo2max)(Massuca, Branco, Miarka and Fragoso, 1981). Maximal oxygen uptake, according to Verducci (1980), indicates how well various physiological functions can be adjusted to increasing metabolic demand of work. There are many physiological factors that combine to determine VO2 max but which of these are most important? Two theories have

been proposed: a. Utilization Theory: This theory maintains that aerobic capacity is limited by lack of sufficient oxidative enzymes within the cell's mitochondria (Wilmore &Costill, 2005). It is the body's ability to utilize the available oxygen that determines aerobic capacity. Proponents of this theory point to numerous studies that show oxidative enzymes and the number and size of mitochondria that increase with training. This is coupled with increased differences between arterial and venous blood oxygen concentrations (a-vO2 difference) accounting for improved oxygen utilization and hence improved VO2max. b. Presentation Theory: The theory suggests that aerobic capacity is limited not predominantly by utilization, but by the ability of the cardiovascular system to deliver oxygen to active tissues. Proponents of this theory maintain that an increase in blood volume, maximal cardiac output (due to increased stroke volume) and better perfusion of blood into the muscles account for the changes in VO2max with training. So what plays the greater role in determining an athlete's VO2 max - their bodies' ability to utilize oxygen or supply oxygen to the active tissues? Saltin and Rowell (1980), concluded that it is oxygen supply that is the major limiter to endurance performance. Studies have shown only a weak relationship between an increase in oxidative enzymes and an increase in VO2 max (Costill, Thomas, Roberg, Pascoe, Lambert, Barr & Fink, (1991). One of these studies measured the effects of a 6-month swim training program on aerobic function. While oxidative enzymes continued to increase until the end, there was no change in VO2 max in the final 6 weeks of the program (Costill, et al. 1991).

Over the years, various tests were developed to measure Vo2 max, but most of these tests require laboratory settings. Such tests include treadmill running/walking, cycle, ergo-meter pedaling and stepping tests. Again, most of these tests cannot be used on large populations at the same time because of cost of the equipment and time limitation. To

overcome these limitations, varied field tests were developed as alternative tests. These tests are not only reliable when compared to the laboratory tests, but found to be more convenient when large samples are involved. Some of these field tests include 6 minutes, 9 minutes and 12 minutes run and the 72 mile run tests. Cooper (1968), designed a 12-minute run/walk test, which was considered suitable when compared with laboratory test. Pollock, et al., (1990), stated the widely used tests for measuring Vo2 max and the 12 minute and the 1 mile run tests. The contributions of metabolic, physique and mechanical variables to athletic performance are functions of distance and intensity. Maximal oxygen uptake (Vo2 max), running economy, and lactate threshold are metabolic variables that increase in performance as distance increases (Brandon, 2000). Long distance runners (runners that compete in 5000 meters or longer), typically have higher Vo2.max values, use oxygen more efficiently and have lower lactate accumulation than significantly middle distance runners (runners that compete in 8000 meters or 3000 meters) (Berg and Bell, 1992).

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

is an endurance sport that incorporates periods of intense exercise interspersed with lower levels of activity over a 9Ominute period (Reilly, 2000).

Therefore, a large amount of aerobic ability may be required and assessed by measuring maximal aerobic power (Vo2 max). This is the maximum rate at which energy can be released from the oxidative process exclusively (Bouchard, 1990). For this reason, Vo2 max is an essential measurement in the study of a footballer, since the physiological as well as physical characteristics are important considerations in players performance (Bell, 1980). Recent study showed that Vo2 max in basketball players' increased as the playing level increased. The differences between the guards and the forwards were not significantly different for any of the team tested, both senior and junior categories (Gabbet, 2001). They Counted the pulse beat for ten seconds and multiplied the result by 6. This gives the per-minute total.

2.15 Empirical Review

Cherappurath (2015) examined thecomparison of performance related variables between college level handball and basketball players. The purpose of the study was to compare the speed and agility between handball and basketball players of Pondicherry University. For this purpose, thirty (30) male students from Department of Physical Education and Sports, Pondicherry University were selected. The age of the subjects ranged from 18 to 24 years. The selected subjects were tested on speed by 50 yard dash and agility by shuttle run which was selected as criterion variable. The collected data was analyzed using independent t test to find out the significant difference between handball and basketball players. The result of the study showed that handball players have greater speed than basketball players. However, no significant difference was elicited between handball and basketball players for the variable of agility. It was concluded that, there is a

significant difference in speed between handball and basketball players and it shows that handball players are better in the speed ability than basketball players. Handball players scored higher scores in speed, but on the other hand, there wasno difference in agility. Speed and agility are vital to the performance of fundamental motor skills like throwing, kicking, jumping, striking, hopping and skipping.

Singh1, Kumar and Ranga (2014) investigated the Comparison of Vertical Jump Performance of Male Handball & Basketball Players. It was conducted on 30 male players (fifteen male basketball players; age: 16.40 ± 0.83 years & fifteen male Handball players; age: 15.80 ± 0.68 years) comprising of players training under the guidance of Punjab State coaches in Patiala (India). The experimental protocol developed by *Bosco et al., (2003)* and *Mcguigan et al., (2006)* were used to measure the vertical jump performance of male handball and basketball players. Thirty male players (fifteen male basketball players; age: 16.40±0.83 years & fifteen male Handball players; age: 15.80±0.68 years, were briefed for the purpose of the study and the experimental protocol designed by Bosco et al., (2003) &Mcguigan et al., (2006).The subjects comprised of players getting training under the guidance of Punjab State coaches in Patiala (India). All the risks involved were also explained to each player and voluntary consent was taken from them. Each volunteer was first subjected to physical examination that included measurements of corporal data like date of birth, age, training age, height, body mass and sports discipline. The participants performed an adaptation process previous to the vertical jump test so that error could be minimized. Mean and standard deviation for all the attributes age, height, body mass and biomechanical transients related to vertical jump tests were calculated. Test of significance of the differences was applied and the level of significance was kept as $p< 0.05$. Test of significance of the differences was applied

and data was judged at 0.01 and 0.05 level of significance. Results of this study show that the male basketball players performed better in vertical jump test parameters like the squat jump flight time, squat jump height, countermovement jump height, countermovement flight time, Eccentric Utilization Ratio (EUR), Elasticity Index (EI), Peak Power (0-15sec), Peak Power (45-60sec) and Mean Power (0-60sec), as compared to male handball players,which may be due to the difference in playing techniques and effect of training.

According to Ramsbottom, (2001) the physiological characteristic of professional rugby league players are well developed with estimates of maximal aerobic power (Vo2 max) reported to be in the range 48.6 - 62.6 mI/Kg/mm. Mean measurements of l0m and 40m speed of 1.71 seconds and 5.32 seconds respectively have also been reported. Conversely, Baker (2003) argued that the physiological characteristics, of amateur rugby league players are poorly developed, with a recent study showing that muscular power, speed, and estimated Vo2 max were 20 - 42% activity. However, recent time and motion studies of rugby league matches played under the l0m defensive rule have shown that forwards were required to run 49 - 50% further than previously required under the 5m defensive rule. These findings suggest that forwards have adapted to the further running distances required for the modern game, or conditioning. Coaches have, modified training programs to develop a greater sprinting ability in forwards. This finding of higher estimated Vo2 max in under-16 backs than forwards is consistent with some, but not all studies of senior rugby league players.

Billat, et al., (2004) compared the training characteristics and the physical profiles of top class male and female Kenyan long-distance runners, the subjects were 20 elite Kenyan runners. 13.men (10-km performance time of 28mm, 36 seconds ± 18s) and 7 women (32 mm, 32 seconds ± 65s). The male runners were into high speed training runners (HST: N = 6) and

low speed training runners (LST: N = 7) depending on whether they train at speeds equal or higher than those associated with the maximal oxygen uptake (Vo2 max). All but one woman were high-speed training runners (female HST: N = 6).Subjects performed an incremental test on a 400 meter track to determine Vo2 max, and the velocity at the lactate threshold (VLT) results within each gender among the HST group. 10-Km performance time was inversely correlated with Vo2 max (rho = -0.86. P = 0.05 and rho = -0.95. p = 0.03, for men and women, respectively). HST male runners had a higher Vo2 max, a lower (but not significant) fraction of Vo2 max (F Vo2 max) at the lactate threshold, and a higher Energy Cost of Running (ECR). Among men, the weekly training distance at Vo2 max explained 59% of the variance, and Vo2 max explained 52% of the variance of 10-km performance time. Kenyan women had a high Vo2 max and Vo2 max at VLT that was lower than their male HST counterparts. ECR was not significantly different between genders. The velocity at the Vo2 max is the main factor predicting the variance of the 10-km 39 performance both in men and women, and high - intensity training contributes to this higher Vo2 max among men.

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

of war participants compared with 51.1(1.4) mt/Kg/mm for the rugby forwards (P< 0.05, erythrocytes volume, rASup2A.= 0.37, P0.0001, hemoglobin concentration, rASup2A = 0.21, P0.01).

Green, (2001)concluded that, the data indicated that international level tug of war participants had excellent strength and above average endurance relative to body size, but relatively low explosive leg power and back flexibility. The data provided reference standards for the sport and may be useful for monitoring and evaluating current and future participants. The physiological characteristics of tri athletes have been substantially reviewed (Toole and Douglas 1995, Sleivert and Rowlands 1996). As with other endurance athletes it has been reported that tri athletes possess a high Vo2 max and an elevated ventilator! (Threshold, Sleivert and Rowlands 1996). Other research has shown that the metabolic responses to submaximal exercise are indicative of short distance performance in national level competitors (Schabort, 2000). However, in these studies the athletes assessed have been either of mixed ability level or the event they were training for has not been established. Moreover, none of the previous studies examining the physiological characteristics of triathlon were conducted after the generalization of the drafting rule during the cycling stage of elite short distance triathlon that resulted in different physiological demands; the athletes are required to exert “Stochastic” burst of very high power output interspersed with more sub-maximal exercise (Bentley, 2002). In contrast, the demands of long distance triathlon events involve prolonged steady state exercise of >4h. The training volume and intensity completed by long distances and short distance tri athletes differ dramatically, since the training volume has been previously shown to influence the oxygen cost of sub-maximal exercise.The metabolic adaptations to sub-maximal

or incremental exercise task may differ in tri athletes race demands in elite short distance or long distance triathlon events.

Miller, (2000) compared the physiological responses in cycling and running of elite short distance (ShD) and long distance (LD) tri athletes. Fifteen elite male tri athletes participating in the world championships were divided into two groups (SD) and (LD) and performed a laboratory trial that comprised sub-maximal ergbmetry cycling and then an additional submaximal run, best short distance triathlon performances were also analyzed for each athlete. Short distance demonstrated a significantly faster swim time than long distance whereas Vo2 max (ml kg' mm'),cycling economy (w!1 mm'), peak power output (w peak, w) and ventilator threshold (% Vo2 max) were all similar between short distance and long distance. Moreover, there were no differences between the two groups in the change (%) in running economy from the first to the second running bout. Swimming time was correlated to w peak ($r = -0.76$, $P< 0.05$) and economy.fr = -0.89, $P< 0.01$) in the short distance athletes. Also, cycling time in the triathlon was correlated to w peak ($r = -0.83$, $P< 0.05$) in long distance. In conclusion, short distance tri athlete had a faster swimming time but did not exhibit different maximal or sub-maximal physiological characteristics measured in cycling and running than long distance tri athletes.

Gabbett, Sheppard, Pritchard-Peschek, Leveritt and Aldred (2008) compote the physiological and anthropometric characteristics of specific playing positions and positional playing groups in junior rugby league players. Two hundred and forty junior rugby league players underwent measurements of standard anthropometry (body mass, height, sum of four skinfolds), muscular power (vertical jump), speed (10, 20 and 40 m sprint), agility (L run), and estimated maximal aerobic power (multi-stage fitness test) during the competitive phase of the

season, after players had obtained a degree of match fitness. Props were significantly (p0.0S) between forwards and backs. When compared with professional rugby league players, the training status of amateur rugby league players was 30-53% lower, with players devoting less than three hours a week to team training sessions and about 30 minutes a week to individual training sessions. The training time devoted to the development of muscular power (about 13 minutes a week), speed (about eight minutes a week), and aerobic fitness (about 34 minutes a week) did not differ significantly ($p>0.05$) between forwards and backs. At the time of the field testing, players had participated, on average, in one 60 minute match every eight days. The physiological and anthropometric characteristics of amateur rugby league players are poorly developed. These findings suggest that position specific training does not occur in amateur rugby league. The poor fitness of non- 46 elite players may be due to a low playing intensity, infrequent matches of short duration, and/or an inappropriate training stimulus. Investigations of professional rugby league players have reported mean 10m and 40m sprint times of 1.71 seconds and 5.32 seconds respectively.'' Estimates of Maximal aerobic power (Vo2max) have been in the range 48.6-67.5 ml kg mm. Despite having contrasting match play activities, the physiological profile of professional rugby league forwards and backs is remarkably similar,suggesting that fitness training or professional rugby league is uniform for all positions. Indeed, most studies have reported sot ii muscular and aerobic power between professional rugby league forwards and backs. However, backs are reported to be lighter, leaner and have faster 10m, 20m and 40m sprint times than forwards. It has been shown that first class rugby union players have superior muscular strength, endurance, and power to second class players. Significant differences have also been reported between elite and non-elite Gaelic football players for in muscular power, speed, and arid aerobic power. These results suggest that fitness

requirements differ according to the level of competition. However, these findings may also be attributed at least in part, to the poorly developed training habits of non-elite football players. While investigators have developed physiological and anthropometric profiles of professional rugby league players, similar studies have not been performed in amateur rugby league players. Therefore, the purpose of this study is to investigate the physiological and anthropometric characteristics of amateur rugby league players.

Katiyar and Rastogi (2013) investigates the differences in selected anthropometric, strength-power parameters and functional characteristics of fencing performance between elite and sub-elite fencers. Thirty-three fencers (18 females and 15 males) from the Greek National Team, (age 47 19 ± 3.5yr, body height 175.6 ± 7.6cm, body mass 66.1 ± 9.1 kg, systematic training 8.4 ± 2.9yr) were classified as elite and sub-elite, according to their international experience. Subjects underwent a detailed anthropometric assessment and performed selected leg power and fencing-specific tests. Significant differences were observed between the two groups in sitting, height, triceps, sub-scapular and quadriceps dominant skinfold thickness, absolute and body mass-dependent expressions of leg functional power characteristics of fencing performance: “time of lunge” and time of the “shuttle test”, Anthropometric traits, such as height, body mass, percent fat and limb length were not different among elite and sub-elite fencers. Although technical and tactical factors are good indicators of fencing success, the observed differences in functional fencing performance tests among different levels of fencers are useful for the design of effective talent development and training conditioning programs for competitive fencers. Klafts and Amheim (2007) focused on anthropometric and physiological characteristics of soccer players with a view to establishing their roles within .t\talent detection, identification and development programmes. Top-class soccer players have to adapt

to the physical demands of the game, which are multifactorial. Players may not need to have an extraordinary capacity within any of the areas of physical performance but must possess a reasonably high level within all areas. This explains why there are marked individual differences in anthropometric and physiological characteristics among top players. Various measurements have been used to evaluate specific aspects of the physical performance of both youth and adult soccer players. The positional role of a player is related to his or her physiological capacity Thus midfield players and full-backs have the highest maximal oxygen intakes (>60 mlkg1min1) and perform best in intermittent exercise tests. On the other hand, midfield players tend to have the 48 lowest muscle strength. Although these distinctions are evident in adult and elite youth players, their existence must be interpreted circumspectly in talent identification and development programmes.

A range of relevant anthropometric and physiological factors can be considered which are subject to strong genetic influences le g. stature and maximal oxygen intake) or are largely environmentally determined and susceptible to training effects. Consequently, fitness profiling can generate a useful database against which talented groups may be compared No single method allows for a representative assessment of a player's physical capabilities for soccer. We conclude that anthropometric and physiological criteria do have a role as part of a holistic monitoring of talented young players. Walt (2003) evaluates whether players in different positional roles have a different physical and physiologic profile. For the purpose of this study, physiologic measurements were taken of 270 soccer players during the precompetitive period of 2005/06 and the precompetitive period of 2006/07. According to the positional roles, players were categorized as defenders (n = 80), midfielders (n = 80), attackers (n = 80), and goalkeepers (n = 30) Analysis of variance (ANOVA) was used to determine differences

between team positions. Goalkeepers are the tallest and the heaviest players in the team. They are also the slowest players in the team when sprinting ability over 10 and 20 meters is required. Attackers were the quickest players in the team when looking at sprint values over 5, 10, and 20 meters. There were statistically significant differences between attackers and defenders when measuring vertical jump height by squat jump. Goalkeepers were able to perform better on explosive power tests (squat jump and countermovement jump) than players in the field. Midfielders had statistically significant superior values of relative oxygen consumption, maximal heart rate, maximal running speed, and blood lactate than defenders and attackers. Defenders had more body fat than attackers and midfielders ($p < 0.05$). Coaches are able to use this information to determine which type of profile is needed for a specific position. It is obvious that players in different positions have different physical and physiologic profiles. Experienced coaches can use this information in the process of designing a training program to maximize the fitness development of soccer players with one purpose only: to achieve success in soccer. Vicente-Rodriguez, (2003) determines anthropometric and physical fitness characteristics of Brazilian male children and adolescents at the beginning of soccer training. In this study, 282 male soccer players ranging in age from 10 to 13 years were evaluated. The athletes participated in a formal soccer training program 3 times per week, with each training lasting 3 hours. Anthropometric and physical fitness parameters were obtained. The boys were divided into age classes and prevalence data were analyzed using Pearson's chi-square test. Parametric data were compared by one-way ANOVA or the Kruskal-Wallis test, when necessary.

Summary

From the literature reviewed, it is crystal clear that the most fundamental attribute of all living organisms is physical survival. This point to the fact that physical survival is central to an individual's existence which implies that physical survival is predicated on good health achieved through physical activities. Sports evolved from the prevailing circumstances of the Stone Age man. The primitive or ancient men had to survive through hunting and looking for means of livelihood as well as defending themselves against their enemies, diseases, threat from natural forces around them, hence physical fitness was a must for the survival of the primitive man. Even though there is increased enthusiasm and concern by the general public for physical fitness and the various researches on it, there are still divergent views among physical education professionals and those in allied professions as to the general consensus on the meaning and constituents of physical fitness. Some argued that it concerns the performance related fitness only e.g. agility, coordination, while another school of thought says it encompasses both the health related physical fitness components (cardiovascular endurance, muscular endurance, muscular strength flexibility and body composition) and the performance related physical fitness elements. Nevertheless, conceptual definitions are matters of individual`s perspectives. However, for the purpose of this research, physical fitness was discussed under two components; the health related and skill or performance related physical fitness. The health related components, which is the focus of this research include, cardiovascular endurance, muscular endurance, strength, flexibility and body composition. The performance or skill related components were just mentioned e.g. agility, balance, coordination, speed and reaction time. The former components enhance physical fitness and good health while the later enhance motor skill learning and performance.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter discusses the procedures adopted for the research. The purpose of this is to compare health-related physical fitness status of male and female basketball and handball players in Borno State. The chapter describes the procedures for conducting this research under the following sub-headings:

3.2 Research design

3.3 Population

3.4 Sample and sampling procedures

3.5 Test Instruments

3.6 Testing Procedures

3.7 Test Description

3.8 Research Assistants

3.9 Test Conditions

3.10 Statistical techniques

3.2 Research Design

The research design adopted in the conduct of this study was the quasi-experimental design.According to Nofiu (2014), a quasi-experimental design is to experiment design but does not have a control group and it is a design used outside the laboratory settings. In this design, skinfold measurements, sit-ups, 12 minutes distance run walk, sit and reach, standing and broad jump were taken respectively.

3.3 Population

The population for this study comprised of the 102 male and female players of the three teams that participated in basketball and handball game in the study area. The rationale behind the selection is because of their active participation.

3.4 Sample and Sampling Procedures

The sample size for the study was made up of eighty (80) players in basketball and handball. 40 Players during the league season of Borno State. Purposive sampling procedure was used to select players, that is, 20 male and 20 females in Basketball team, 20 males and 20 females in Handball team.

3.5 Test Instruments

The instruments that wereused by the researcher in measuring the physical fitness status of the basketball and handball players for this study were:

i. Bathroom weighing scale (Hana model): was used to measure subjects weight to the nearest kilogrammes

ii. Stop watches: The electronic types (WRS bar model) was used to time subjects in 12 minutes run, walk and sit ups.

iii. Ruler: 60cmwas used to measure distance covered in sit and reach.

iv. Sit and reach box: was used to measure flexibility.

v. Whistle: Fox 40was used to start and stop subjects in12 minutes distance run, walk and sit-ups.

vi. Mats (Rubber types): was used for sit-ups.

vii. Skinfold calipers (Lange Skinfold Calipers No. Part. No. 3008239 Beta Technology Incorporated Cambridge, Maryland) was used for Skinfold measurement which was measured in millimeter.

viii. A standard 400 track at the Government College, Maiduguri was used for 12 minutes distance run walk.

ix. Metric measuring tape: This was used for subjects height and distance covered in standing broad jump.

x. Long jump pitch was used to measure distance in broad jump.

3.6 Test Procedures

Before the test was administered,the players wereinformed and formswere given to them and the sheets, which they completed and returned. The subjects were certified to be medically fit to undertake the tests by the medical officer of each team. Detailed explanations and demonstrations of every test ten preceded actual performance of the tests. Before the test started, subjects were allowed to inspect the instruments to be utilized during each test for familiarization and to avoid fright. The tests were administered on the players of the four Clubs independently. Numbers were given to each club (Borno Warriors, Borno Queens, Topline Spiders and Topline Sparrows). They were alphabetically arranged to give everyone fair treatment. Out items - 12-minutes distance run/walk-test, sit-up test, sit and reach test, standing broad jump and skin fold measurement, and the researcher grouped the players of each club into five and administered the five tests on each group for five days, after morning warm-up exercises. Each of the five test items were administered as described below:

3.7 Test Descriptions

The purpose of this study was to compare health-related physical fitness status of Male and female basketball and handball players in Borno State.

3.7.1 Cooper's twelve minute distance run/walk test

To administer the 12-minute distance run/walk test a standard 400- metre track of the Government College, Maiduguri was used. Markers was placed on the track to divide the course into quarters, so that the exact distance covered in 12 minutes can be determined quickly and correctly. The subjects were instructed to run as fast as possible. Walking/jogging was allowed, as long as much distance will be covered in 12 minutes each. The distance covered by each subject at the end of 12 minutes was calculated by multiplying the number of Laps by 400m and the product was converted to kilometres to know the distance covered in kilometres (Km) recorded against the subject code numbers. The researcher used some students of PHE as Research Assistants. A student was assigned to each subject to count the number of Laps covered. The research assistants was given thorough orientation before the tests.

The researcher used the American College sport medicine formular for converting the 12 minutes distance run walk covered to $V0_2$ max b) multiplying it by 0.2 and add 3.5. The distance covered in the 12 minutes distance run walk test was converted in metres first per minutes. Example: a subject covered 7 laps in 12 minutes run, the $V0_2$ ma: will be calculated as follows:

$$\text{(12m distance) } v\,n_2\,m\,n\,v = \frac{7\ 1aps \times 400}{} \times 0.2+3.5$$

$$V0_2 \text{ max } \frac{2800 \text{ metres}}{} \times 0.2 + 3.5$$

$V0_2$ max = 50.17ml/kg (ACSM 1997)

3.7.2 Sit - up Test

The subjects were told to assume the starting position by lying on their backs with knees flexed, feet on the floor with heels between 3' 45cm from the buttocks, with the fingers interlocked behind the neck. The subject's feet was held firmly by a research assistant who counted the number of sit-ups. The exercise will be repeated as many times as possible in one minute. The total number of repetitions in one minute was recorded as each subject's score. Instructions were given to the subjects in respect of the position of the fingers, which must remain interlocked behind the neck throughout the test. The research assistants gave the signal "ready" "go" and the sit-up performance stopped on the command "stop". The numbers of correctly executed sit-ups performed in 60 seconds were recorded as the scores of the subjects for muscular endurance.

3.7.3 Sit and Reach Test

Hoeger (2005), modified sit- and - reach test, which takes into account the distance between the end of the fingers and the sit-and - reach box and uses the finger-to-box distance as the relative zero point was used. A 30cm high box or a sit -and reach box was used. The subjects sit on the floor with buttocks, shoulders and heads in contact with the wall, extends (but do not lock) their knees, and place the soles of the feet against the box. A 60cm ruler placed on top of the box with the zero end toward the subject. Keeping the head and shoulders in contact with the wall, each subject reached forward with one hand on top of the other and the 60cm ruler is positioned so that it touched their fingertips to serve as the Zero point for each subject. The 60cm ruler was firmly held in place then each subject reached, forward slowly, sliding his fingers along the top of the 60cm ruler (Heyward, 1998).

The score in (cm) is the most distant point on the 60cm ruler, contacted by the fingertips. Three slow, forward movement trials were made, and on the third forward motion the subject's leans as far forward as possible holding this position for a minimum of two (2) seconds. The furthest distance reached of the three trials was recorded as each subject sit- and - reach score. This ensured that each subject followed instructions before taking the records.

3.8 Research Assistants

Some students of the Department of Human Kinetics and Health Education, Kashim Ibrahim College of Education, Maiduguri were employed to assist the researcher throughout the conduct of the tests as recorders. They received training on the timing of subjects and other test procedures to enable them assess the subjects.

3.9 Test Conditions

1. The testers made sure the tests took place on the same course and field to ensure similar test conditions for all the subjects.
2. The procedures and reasons for each test item were explained to the subjects before the commencement of the tests.
3. The time for the commencement of the tests lasted between 7:30 and 8:30 am each day.
4. The subjects were at test venue at .least 30 minutes, before the commencement of tests.
5. All the subjects wore sports outfit appropriate for the test conditions.

3.10 Statistical Techniques

Descriptive statistics of mean, standard deviation, standard error of means was used to analyze the data. Therefore, the statistical techniques used for this study was the inferential statistics ofIndependent samplet-test used to determine whether there is any significant difference between the male and female basketball and handball players. Data collected was analysed using statistical package for social science (SPSS) version 22.0.

CHAPTER FOUR

RESULT AND DISCUSSION

4.1 Introduction

The purpose of this study was to make a comparison of health related physical fitness status of male and female basketball and handball players in Borno state, Nigeria. To achieve the stated objective, the data collected were statistically analyzed. The results of the tests are presented and discussed according to hypotheses in this chapter.

4.2 Results

Information regarding the mean scores of the male and female basketball and handball players in their physical characteristics are shown in table 4.2.1.

Table 4.2.1(a): Mean Score of Male and Female Basketball and Handball Players in their Anthropometric Characteristics.

Variables	**Age (yrs)**		**Height (metres)**		**Weight (kg)**		**Total leg length (cm)**		**Total arm length (cm)**	
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Male	21.2	2.2	1.6	0.1	61.3	8.0	100.0	18.3	82.4	4.8
Female	20.4	1.9	1.5	0.3	60.5	4.9	100.3	4.7	82.8	11.2

Table 4.2.1.1a shows the mean score of age, height and weight, length and arm length of both male and female basketball and handball players. The mean ages were 21.2

± 2.2 and 20.4 ± 1.9 years for male and female players respectively. The mean of the height for respectivecategory of players were 1.6 ± 0.9m and 1.5 ± 0.8m. while the mean for their weight (kg) were 61.3 ± 8kg and 60.5 ± 4.9kg. the mean for the total leg length 100± 18.3 and 104.3 ± 4.7cm respectively while that of total length, 82.4 ± 4.8 and 82.8 ± 11.2 respectively. However, the male players were taller (1.6m ± 0.6) than the female players.

Table 4.2.1b Mean Scores of Male and female Basketball and Handball Players in their physical fitness Status.

Variables	**Cardio respiratory endurance**		**Muscular endurance (pushup)**		**Muscular strength (situp)**		**Flexibility sit reach**		**Body composition (body fat)**	
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Male	2.0	0.4	22.1	4.8	20.5	5.2	23.3	5.3	1.6	0.3
Female	2.3	0.4	21.4	2.1	20.9	2.2	28.0	2.8	1.8	0.2

A careful look at table 4.2.1b shows the mean scores of cardio respiratory endurance; Muscular strength (arm) muscular strength (Leg), flexibility, standing board jump (lower limb power) of the male and female players.

The mean score of cardio – respiratory endurance were 2.0 ± 0.4 and 2.3 ± 0.4 for male and female basketball players respectively. The mean score of muscular strength (arm) for players were 22.1 ± 4.8 and 21. While the mean for muscular strength (leg) were 20.5 ± 5.2 and 20.9 ± 2.2. The mean for flexibility were 23.3 ± 5.3 and 28.0 respectively. While that of the lower limb power, 1.6 ± 0.3 and 1.8 ± 0.2. It was revealed that, female

players had higher mean scores in cardio respiratory endurance and other variables than the male players.

4.3 Hypotheses Testing

Sub Hypothesis 1: There is no significant difference between the cardio vascular endurance of male and female basketball and handball players in Borno state. This hypothesis was tested using two sample t – test for differences of male and female basketball and handball players. The results of which are shown in table 4.3.1.

Sub Hypothesis 1a: There is no significant difference between the cardio vascular endurance of male basketball and male handball players in Borno state. This hypothesis was tested using two sample t – test for differences of male basketball and handball players. The results of which are shown in table 4.3.1.

Table 4.3.1: Two sample t – test for differences on cardio – respiratory endurance Test (12 minutes) of male and female basketball and handball players in Borno State.

Variables		N	Mean	SD	SE	DF	t -	P - value
Male Players	Basketball	20	2.0	0.6	0.3	38	2.71	0.00
	Handball	20	2.2	1.4	0.2			

t = (38) = 1.980, p≤0.05

Table 4.3.1 above shows that the male basketball and handball players differ significantly in their cardio – respiratory endurance test. The observed t – value (2.4) in the table shows the higher critical value 0.05; at the same degree of freedom and observed

level of 0.00 ($p \leq 0.05$).The hypothesis that stated that there is no significant difference between the cardio vascular endurance of male basketball and male handball players in Borno state is rejected.

Sub Hypothesis 1b: There is no significant difference between the cardio vascular endurance of female basketball and female handball players in Borno state. This hypothesis was tested using two sample t – test for differences of female basketball and handball players. The results of which are shown in table 4.3.1.

Table 4.3.2: Two sample t – test for differences on cardio – respiratory endurance Test (12 minutes) of male and female basketball and handball players in Borno State.

Variables		N	Mean	SD	SE	DF	t -	P - value
Female Players	Basketball	20	3.3	1.6	0.2	38	3.01	0.001
	Handball	20	3.1	1.5	2.1			

t (38) = 1.980, $p \leq 0.05$

Table 4.3.2 above shows that the female basketball and handball players differ significantly in their cardio – respiratory endurance test. The observed t – value (3.01) in the table shows the higher critical value 0.05; at the same degree of freedom and observed level of 0.001 ($p \leq 0.05$). The hypothesis that stated that there is no significant difference between the cardio vascular endurance of female basketball and female handball players in Borno state is rejected.

Sub – Hypothesis 2: There is no significant difference between the flexibility (sit and reach test) of male and female basketball and handball players in Borno State.

Sub – Hypothesis 2a: There is no significant difference between the flexibility (sit and reach test) of male basketball and handball players in Borno State.

Table 4.3.3: two sample t – test for differences in flexibility (sit reach) test of male basketball and handball players.

Variables		N	Mean	SD	SE	t	Df	P - value
Male players	Basketball	20	25.3	5.6	1.0	4.31	38	0.001
	Handball	20	29.1	3.4	0.6			

$t(38) = 1.980$, $P<0.05$

Table 4.3.3 above shows paired t – test analysis of the flexibility (sit reach test) of male basketball and handball players. The observed t – value 4.31 table is higher than the critical of 0.05 at the same degree of freedom. The level significance for the test is 0.001 ($P<0.05$), therefore, the null hypothesis which stated that, there is no significant difference between the flexibility of male basketball and handball players in Borno State measurement by sit reach was rejected.

Sub – Hypothesis 2b: There is no significant difference between the flexibility (sit and reach test) of female basketball and handball players in Borno State.

Table 4.3.4: two sample t – test for differences in flexibility (sit reach) test of female basketball and handball players.

Variables		N	Mean	SD	SE	t	Df	P – value
Female players	Basketball	20	25.3	5.6	1.0	3.81	38	0.001
	Handball	20	29.1	3.4	0.6			

t (38) = 1.980, P<0.05

Table 4.3.4 above shows paired t – test analysis of the flexibility (sit reach test) of female basketball and handball players. The observed t – value 3.81 is higher than the critical of 0.05 at the same degree of freedom. The level significance for the test is 0.001 (P<0.05), therefore, the null hypothesis which state that, there is no significant difference between the flexibility of female basketball and handball players in Borno State measurement by sit reach was rejected.

Sub – Hypothesis 3: There is no significant difference between the muscular strength of male and female basketball and handball players in Borno State, Nigeria.This hypothesis was tested using two sample t – test for difference of male and female basketball and handball players.

Sub – Hypothesis 3a: There is no significant difference between the muscular strength of male basketball and handball players in Borno State, Nigeria.

Table 4.3.5: Two Sample t – test for difference in muscular strength (sit up) of male basketball and handball players

Variables		N	Mean	SD	SE	t	Df	P - value
Male Players	Basketball	20	24.1	5.5	1.0	3.08	38	0.004
	Handball	20	22.0	3.2	0.6			

t (38) = 1.980; $p<0.05$

Table 4.3.5 above shows two sample t- test analysis of the muscular strength (sit up) of male basketball and handball players. The observed t – value 3.08 is higher than the critical value 0.05 at the same degree of freedom. The p value is 0.004, therefore, the null hypothesis which state that, there is no significant difference between the muscular strength of male basketball and handball players was rejected; because the t – value 3.08 is greater than the critical value 0.05 at the same degree of freedom.

Sub – Hypothesis 3a: There is no significant difference between the muscular strength of male basketball and handball players in Borno State, Nigeria.

Table 4.3.6: Two Sample t – test for difference in muscular strength (sit up) of male basketball and handball players

Variables		**N**	**Mean**	**SD**	**SE**	**t**	**Df**	**P - value**
Male Players	Basketball	20	24.1	5.5	1.0	3.08	38	0.004
	Handball	20	22.0	3.2	0.6			

$t(38) = 1.980; p<0.05$

Table 4.3.3: above shows two sample t- test analysis of the muscular strength (sit up) of male basketball and handball players. The observed t – value 3.08 is higher than the critical value 0.05 at the same degree of freedom. The p value is 0.004, therefore, the null hypothesis which state that, there is no significant difference between the muscular strength of male basketball and handball players was rejected; because the t – value 3.08 is greater than the critical value 0.05 at the same degree of freedom.

Sub – Hypothesis 3b: There is no significant difference between the muscular strength of female basketball and handball players in Borno State, Nigeria.

Table 4.3.6: Two Sample t – test for difference in muscular strength (sit up) of female basketball and handball players

Variables		N	Mean	SD	SE	t	Df	P - value
Female Players	Basketball	20	24.1	5.5	1.0	3.08	38	0.004
	Handball	20	22.0	3.2	0.6			

t (38) = 1.980; $p<0.05$

Table 4.3.6: above shows two sample t- test analysis of the muscular strength (sit up) of female basketball and handball players. The observed t – value 3.08 is higher than the critical value 0.05 at the same degree of freedom. The p value is 0.004, therefore, the null hypothesis which state that, there is no significant difference between the muscular strength of female basketball and handball players was rejected; because the t – value 3.08 is greater than the critical value 0.05 at the same degree of freedom.

Sub – Hypothesis 4: there is no significant difference between the muscular endurance of male and female basketball and handball players in Borno State.

Sub – Hypothesis 4a: there is no significant difference between the muscular endurance of male basketball and handball players in Borno State.

Table 4.3.7: Two sample t – test for difference in muscular endurance of male basketball and handball players in Borno State.

Variables		**N**	**Mean**	**SD**	**SE**	**Df**	**t-**	**P - value**
Male player	Basketball	20	3.2	1.7	0.3	38	4.21	0.00
	Handball	20	2.1	1.2	0.6			

$t = (78)\ 1.980,\ p<0.05$

Table 4.3.7 above shows two sample t –test analysis of the muscular endurance of male and female basketball and handball players. The observed t – value 4.21 compared with critical value of 0.05 at the same degree of freedom.The level of significance for the test is 0.00 ($P<0.05$). Therefore, the null hypothesis that, there is no significant difference between the muscular endurance of male basketball and handball players in Borno State in their muscular endurance was rejected.

Sub – Hypothesis 4b: there is no significant difference between the muscular endurance of female basketball and handball players in Borno State.

Table 4.3.8: Two sample t – test for difference in muscular endurance of female basketball and handball players in Borno State.

Variables		N	Mean	SD	SE	Df	t-	P - value
Male player	Basketball	20	2.7	1.4	0.2	38	3.72	0.00
	Handball	20	2.1	0.8	0.5			

t = (78) 1.980, p<0.05

Table 4.3.8 above shows two sample t –test analysis of the muscular endurance of female basketball and handball players. The observed t – value 3.72compared with critical value at the same degree of freedom (38). The level of significance for the test is 0.00 (P<0.05). Therefore, the null hypothesis that, there is no significant difference between the muscular endurance of male basketball and handball players in Borno State in their muscular endurance was rejected.

Sub – Hypothesis 5: There is no significant difference between the body composition of male and female basketball and handball players in Borno State. Two sample t – test was used to analysed this hypothesis.

Sub – Hypothesis 5a: There is no significant difference between the body composition of male basketball and handball players in Borno State.

Table 4.3.9: Two Sample t – test for difference in body composition of male basketball and handball players in Borno State.

Variables		Mean	SD	SE	Df	T	P - value
Male Players	Basketball	21.88	3.51	0.74	38	5.340	0.002
	Handball	20.2	2.16	0.52			

t (38) = 1.980, P<0.05

Table 4.3.9 above shows paired t – test analysis of the body composition of male basketball and handball players. The observation on t – value for the test is 5.340, compared with critical value at the same degree of freedom (38). Therefore, the null hypothesis that, there is no significant difference between the body composition of male basketball and handball players in Borno State in their body composition was rejected.

Sub – Hypothesis 5b: There is no significant difference between the body composition of female basketball and handball players in Borno State.

Table 4.3.10: Two Sample t – test for difference in body composition of female basketball and handball players in Borno State.

Variables		Mean	SD	SE	Df	T	P - value
Male Players	Basketball	25.88	3.52	0.97	38	4.14	0.002
	Handball	21.02	2.06	0.82			

t (38) = 1.980, P<0.05

Table 4.3.10 above shows paired t – test analysis of the body composition of male basketball and handball players. The observation on t – value for the test is 4.14, compared with critical value at the same degree of freedom (38). Therefore, the null hypothesis that there is no significant difference between the body composition of female basketball and handball players in Borno State in their body composition was rejected.

4.4 Summary of Major Findings

1. There is significant difference between the cardio respiratory endurance of male and female basketball and handball players in Borno State (p, value 0.001).
2. There is significant difference between the flexibility (sit reach) test of male and female basketball and handball players in Borno State, (p, value of 0.001).
3. Male and female basketball and handball players are significantly in their muscular strength (p value 0.001)
4. Male and female basketball and handball players are significantly different in their muscular endurance with (p value of 0.002).
5. There is significant difference between the body composition of male and female basketball players in Borno State with (p, value of 0.004).

4.5 Discussion

The purpose of this findings was to compare health related physical fitness status of male and female basketball and handball players in Borno State. To achieve the stated objectives, the health related physical fitness test items as contained in AAHPECD health (1986), Bryntenson (2001) and Robwood (2006) were used.

The findings of this study revealed significant difference between cardio respiratory endurance, muscular strength, muscular endurance, flexibility and body composition of the male and female basketball and handball players in Borno State. In basketball, like any other team sport, the demands made by different position of players differ and therefore the physical and psychological characteristics of the players significantly differ. The findings of the study are reported in this regard relating to basketball and handball.

Anthropometric Characteristic

Anthropometric parameters of male and female basketball and handball players are the height, the weight, total arm length, and total leg length. The results of the study indicated significant difference between male and female basketball and handball players in their weight, leg length and total arm length. These findings corroborate the findings and observations of Khosa (2003), Bale (2006), Boopa (2009), Venkateswarlu (1998), according to which height and arm length play very significant roles not only in basketball and handball sports, but also to throws and jumps in track and field athletes.

The study showed slight differences in the height and weight of basketball and handball players. The height of male is (1.6m), and the height of female is (1.5m). The absence of significance may be attributed to the selection of the players. This study is similar to Gabben (2011), and observation of Bompa (2001), according to which height and weight are determinant factors in sport like handball and basketball.

Physical Fitness

Male and female basketball and handball players in their physical fitness status are looked into in this study. The physical fitness components investigated in the study were cardio-respiratory endurance, muscular strength, muscular endurance, flexibility and body composition.The finding of the study shows a significant difference between male and female basketball and handball players in cardio – respiratory endurance and muscular strength/endurance. These findings are in agreement with those of Gabbelt (2010), on rugby players, Kenpen(2006) on soccer players, Acikada (2010) on soccer players, Bompa (1999) on handball and soccer players and Varketeswarlu(1992) on speed and endurance

sport, according to which there are significant difference between male and female basketball and handball players in their cardio – respiratory endurance and muscular strength / endurance. This was attributed to training schedule of the athletes. This indicated that male basketball and handballers are more endured in their cardio – respiratory than female.

However, this study shows a significant difference between male and female basketball players in their flexibility and body composition of the lower limbs. These findings are in agreement with the observations of Venkatewarln(2005), according to which females are greater in body composition.

Due to their Body Mass Index (BMI), this finding justified that the physical characteristics, physiological basis,and demand for sports like basketball and any team sport are greater for particular physical fitness characteristics like speed, flexibility and strength which are essential for playing forward position than defense.

Maud (1995) confirmed that, within the realm of sports, there are many activities where high of flexibility in specific joints are desirable for enhanced performance in both quantitative and qualitative athletic activities. Because flexibility predispose sport men and woman to muscle strains, tendon and ligament strains, Corbin (2009) asserted that a certain amount of threshold level of flexibility is necessary for most sports, though it varies from sport to sport.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary

This chapter presents the summary, conclusion and recommendations of the findings on the comparison of health related physical fitness status of male and female basketball and handball players in Borno State, Nigeria. The data collected for this study was analysed using statistical package for social science (spss) version 20.2 of paired sample t – test in analyzing the hypotheses formulated.

To achieve this purpose, subjects comprising 40 males and 40 females of basketball and handball players in Borno State werechosen. The players were tested on Anthropometric parameters of age, height and weight. Also, the physical fitness muscular strength, muscular endurance, flexibility and body composition of the basketball and handball players were measured. The data collected were analyzed using descriptive Statistics of mean standard deviation, standard error and independent sample t test analysis.

The overall results showed that, there are significant differences between male and female basketball and handball players in their cardio – respiratory endurance, muscular strength, muscular endurance flexibility and body composition.

5.2 Conclusion

1. There is difference between the cardio – respiratory endurance of male and female basketball and handball players in Borno State.
2. There is difference between the flexibility of male and female basketball and handball players in Borno State.
3. Male and female basketball and handball players are different in their muscular strength.
4. Male and female basketball and handball players are different in their muscular endurance.
5. There is significant difference between the body composition of male and female basketball and handball players in Borno State.

5.3 Recommendations

On the basis of the findings of this study, the following recommendations were made.

1. Basketball and handball players with height and weight but greater flexibility and muscular strength should be selected for offensive position.
2. Training programme should be designed to develop more speed and cardio respiratory endurance for female players in all team sport.
3. More flexibility and muscular endurance/strength exercise should be encouraged among basketball and handball players.
4. Taller and heavier basketball and handball players should be selected for defensive positions.

5. Physical fitness tests should be served as recruitment criteria for players of basketball and handball in all competition preparation.

5.4 Suggestion for Further Studies

1. Studies should be conducted to find out the relationship between playing experience and physical fitness of male and female basketball and handball players
2. Studies on physical and physiological characteristics of male and female basketball and handball players participating in different competition in Nigerians should be conducted.

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